Some Problems and Development Possibilities of the Livestock Sector in Saudi Arabia : A Case Study in Livestock Development in Arid Areas.

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SOME PROBLEMS AND DEVELOPMENT POSSIBILITIES OF THE LIVESTOCK SECTOR IN SAUDI ARABIA: A CASE STUDY IN LIVESTOCK DEVELOPMENT IN ARID AREAS

by

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ABSTRACT

The present study is the first effort to survey the structure of the livestock sector in Saudi Arabia. It is hoped that it will provide a contribution to the knowledge of the livestock geography of the country, by shedding light on the main problems facing livestock development. Particular attention has been given to the limitations and potential of livestock development and the spatial pattern of the present state of the livestock sector.

In the general introduction the present state of livestock and its declining importance in the Saudi economy is emphasised and it is suggested that the recent disequilibrium in the livestock sector is a main reason for this decline.

Part One, in three chapters, examines the extent of the limitations and constraints facing livestock development, mainly environmental - climate and water resources -, institutional - MAW, and social - al-Badiah.

The types of livestock, their potentials, economic significance, and spatial characteristics are the main themes of Part Two, which is composed of two chapters: one dealing with animal types and the other with their spatial organization.

Part Three, in three chapters, deals with the livestock structure through the evaluation of livestock systems, their present condition and the main problems associated with them.

Part Four deals with the role that livestock can play in the national development and the strategies for livestock development.

The Thesis ends with some concluding remarks, summarising the most significant general findings of this study.

NOMENCLATURE

The date for most of the material presented in this study is in the Hijra Fiscal Year. To assist the reader in making conversions, a table showing Hijra years compared with Gregorian years is shown below.

Hijra and Gregorian Years

Hijra Year	Gregorian Dates: Hijra Year Starts	Gregorian Dates: Finishes	Gregorian Dates: Hijra Fiscal Year Starts
1374	30 Aug 1954	19 Aug 1955	
1375	20 Aug 1955	7 Aug 1956	
1376	8 Aug 1956	27 Jul 1957	
1377	28 Jul 1957	17 Jul 1958	
1378	18 Jul 1958	6 Jul 1959	
1379	7 Jul 1959	24 Jun 1960	31 Dec 1959
1380	25 Jun 1960	13 Jun 1961	19 Dec 1960
1381	14 Jun 1961	2 Jun 1962	9 Dec 1961
1382	3 Jun 1962	23 May 1963	28 Nov 1962
1383	24 May 1963	11 May 1964	17 Nov 1963
1384	12 May 1964	30 Apr 1965	5 Nov 1964
1385	1 May 1965	20 Apr 1966	25 Oct 1965
1386	21 Apr 1966	10 Apr 1967	15 Oct 1966
1387	11 Apr 1967	29 Mar 1968	4 Oct 1967
1388	30 Mar 1968	18 Mar 1969	23 Sep 1968
1389	19 Mar 1969	8 Mar 1970	12 Sep 1969
1390	9 Mar 1970	25 Feb 1971	1 Sep 1970
1391	26 Feb 1971	15 Feb 1972	21 Aug 1971
1392	16 Feb 1972	4 Feb 1973	10 Aug 1972
1393	5 Feb 1973	25 Jan 1974	30 Jul 1973
1394	26 Jan 1974	14 Jan 1975	19 Jul 1974
1395	15 Jan 1975	3 Jan 1976	8 Jul 1975
1396	4 Jan 1976	23 Dec 1976	27 Jun 1976
1397	24 Dec 1976	13 Dec 1977	17 Jun 1977
1398	14 Dec 1977	2 Dec 1978	7 Jun 1978
1399	3 Dec 1978	22 Nov 1979	27 May 1979
1400	23 Nov 1979	11 Nov 1980	26 May 1980

Definitions and Abbreviations used

- SR · Saudi Riyal
- A.H. After Hijra Moslem lunar year
- MAW Ministry of Agriculture and Water
- CPO Central Planning Organization
- Aramco Arabian American Oil Company
- CDS Central Dept., of Statistics/Ministry of Finance
- LDC's Less Developed Countries
- AU Animal Unit; one sheep and one goat equals one AU, and cattle and camels as five animal units each
- AUY Animal unit per year

Measurements and Units

4.5 Saudi Riyals = $1.00) up to
10.8 Saudi Riyals = £1.00*) 1970+

1 Saudi Riyal = 20 quirsh = 100 halalah

Hectare = 2.471 acres

Hectare = 10 donums

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*In 1975 SR 7.18 = £1 as at 13 Oct. (National Westminster Bank, An Economic Report Pub.Oct 1975

+ Saudi Arabian Monetary Agency, Saudi Arabia (SAMA) based on the per values given in the IMF, International Financial Statistics, Feb., 1971, and need not correspond with the free market rates prevailing.

ACKNOWLEDGEMENT

A great number of people have contributed a great deal at various stages and in many different ways to making this study possible. In Saudi Arabia my gratitude is to the government of His Majesty for making it possible for me and for hundreds of other Saudis to get the best education, at the best institutions, all over the world. I am grateful to The Ministry of Agriculture for the permission to come to Durham for graduate work. I would like to express my gratitude to many friends who were very helpful during my field work; in particular to H.E.Sheikh Abdulrahman al-Sudairy, Governor of al-Jawf Province, for his hospitality, guidance, encouragement and for providing the necessary means to make my stay with Ruala and other tribes in the north possible. My thanks are also due to the Prince of Wadi Dwasir district Mr.Badre al-Asker who made it possible for me to get acquainted with the Wadi Dwasir tribes and their ranges. Last but not least many thanks to the hundreds of Bedwins and farmers for their hospitality and help.

Here at the University of Durham, in the Department of Geography, headed by Professor W.B.Fisher and the Centre for Middle Eastern and Islamic Studies headed by Professor H.Bowen-Jones, I found an academic atmosphere aimed at the encouragement of serious training and with special interest in the development of knowledge about the Middle East.

I am indebted most of all to my supervisor, Dr.B.Floyd, not only for his guidance without which this study would never have seen the light, but most important of all for his patience, inspiration, encouragement and sustained interest in the subject and the author throughout this study. My thanks should also be extended to the staff of the Middle East Centre and the Science Library, particularly Mrs.Chisholm for her ceaseless effort to help everyone to make the best of the Science Library services. My thanks to Mrs.J.Munro for her tireless efforts in typing this thesis and to Mr.G.Brown and Mr.J.Donnini in the Drawing Office and Mr.D.Huspeth in the photographic laboratory for putting the final touches to the figures.

Finally I am most indebted to my wife, Norah, for her patience, encouragement and for seeing that everything under her control was geared to the completion of this study. I should not forget finally to thank my sons Badre (6 years) and Ziyad (3 years) who made it clear in their own way that if I have any serious thoughts of study I should find somewhere else other than my home. That is exactly what has happened, the whole study was done within the academic atmosphere of the Sky Lab of the Geography Department.

CONTENTS

page

PART THREE : LIVESTOCK PRODUCTION SYSTEMS page

PART FOUR : LIVESTOCK DEVELOPMENT

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

INTRODUCTION

The aim and significance of the study

This livestock study deals only with the main four ruminant animals: camels, cattle, sheep and goats. Other animals (horses, donkeys, poultry, game animals and fish) have not been included because (a) ruminants are different from these other animals in feed requirements, resources used and in approaches for development, and (b) ruminants are the most common type of livestock throughout the country while the others vary much more from locality to locality.

The general objectives of this study are to undertake a geographic analysis of the livestock sector in Saudi Arabia and to accomplish the following specific aims:

(1) To fill a gap in the literature. An examination of the bibliography reveals that little of significance has been published by geographers or even economists on the livestock sector, not only in Saudi Arabia but also in most under-developed countries in the arid parts of the world. Moreover economists and geographers, as well as planners, have neglected the role that the livestock sector can play in national development. It is important that a study is attempted to identify and throw some light on the nature of the livestock sector in Saudi Arabia, and hopefully to provide a basis for future studies of this sector.

(2) To explore and identify in their locational context the main structural problems that have prevented the livestock sector from achieving the desired rate of development. Emphasis will be given to the location, regional distribution and classification of livestock production systems.

(3) To organize the available data, as well as add new data, either previously unpublished or obtained through the author's field work.

(4) To outline the role of livestock in national development and some possible strategies for developing the livestock sector.

Historical Background

Throughout the known history of Arabia, from earliest times to as recently as the 1940's, a pastoral economy dominated the Arabian scene and provided the main economic activity. Unfortunately the literature dealing with Arabia before the late 19th century tends to give little detailed information about the economic aspects of this era. However the importance of pastoralism as a way of life may be deduced from early writings.

It was in the late 19th century that Western explorers started to provide a great deal of information about the economic situation in Arabia, and it is their accounts that show how important pastoralism was to the economy of Arabia.[1] The prominence of pastoralism in Arabia is revealed by an early and comprehensive report prepared for the British Foreign Office in 1920.[2] The study stated:

> Sheep and camel rearing, and to some extent the breeding of horses, are the staple occupations of the country...Hides and skins, especially the latter, are today the most important source of wealth in the country.[3]

The importance of Arabia as a centre for livestock export, particularly camels, was stressed in this report:

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1. The most important contributions were provided, among others, by the following:
   Burkhardt, J.S., Travels in Arabia, (London; Colburn, 1829)
   Palgrave, W.G., Narrative of a Year's Journey through Central and Eastern Arabia, (1862-63), 2 vols. (London; 1865)
   Daughty, C.M., Travels in Arabia Deserts, (London; 1908)
   Great Britain, Geographical Section of the Naval Intelligence Division, Naval Staff, Admiralty, A Handbook of Arabia, 1. (London; H.M.S.O., 1920)
   Musil, A., Manners and Customs of the Ruala Beduins, (New York; American Geographical Society, 1928)
   ________ Arabian Deserts, (New York; Am.Geog.Soc., 1927)
   Raswan, C.R., "Tribal Areas and Migration lines of the North Arabian Beduins", The Geographical Review, Vol.20, 1930, pp.494-502
   Dickson, H.R.P., The Arab of the Deserts, (New York; Randon House, 1946)
2. Great Britain, Foreign Office, Historical Section, Arabia, (London; H.M.S.O., 1920)
3. Ibid., p.68

> Arabia is the chief camel-breeding country of the world, but as no Arab in Arabia can accumulate capital sufficient for large deals, the centre of the camel trade is at Damascus and some trade is also carried out at Baghdad. The camel merchants, both at Damascus and Baghdad, employ as buyers the Ukeil, a class of recognised caravan guides...when the tribes need money they make their purchases and camels through the agency of the sheikhs...the camels bought are kept through the winter in the oases of Kasim [Qassim] and in spring are driven across the desert to Damascus and hence into Egypt... the camels of Jebel Shammar [Hail area]...are exported in considerable numbers to Mesopotamia. The camels of Oman and the Aden interior are exported from Oman and el-Katr [Qatar] to Persia...It is estimated that the chief camel-rearing tribes possess 720,000 head; of these only the surplus are sold, amounting to nearly 45,000 per annum.[4]

The report indicated that livestock products for export were collected at the following main Arabian Centres: camels at Buraydah and Unayzah (Qassim), skins at Rijal (Asir), horses at Hail and ghee at Hail, Buraydah and Unayzah.[5] Most Arabian exports at that period - apart from those to Iraq, Syria and other inland areas - went from the five principal Arabian ports: Aden, Hodida, Jeddah, Muscat and Bahrain. About a sixth of the total imports to Aden in 1913 came from Arabian sources. In 1913 the total import value of hides and skins to Aden was £641,878 of which almost 13.3% was from Arabian sources,[6] and most of it was exported to the U.S.A., U.K., France, Germany, Italy and Austria. Even as late as 1939 the chief imports into Aden from Saudi Arabia were hides and skins, which totalled 77,635 U.S. dollars.[7]

In the late 1930's the importance of livestock in the economy started to dwindle and oil started to take a prominent place. Oil in commercial quantities was discovered at Dammam in 1938 after three years of drilling operations. After the war, in response to the high world demand for oil, Saudi Arabia's production expanded rapidly, eventually placing the country in the top rank of the world's major oil-producing countries. Along with the increase in oil production, livestock declined

4. Ibid., pp.72-73
5. Ibid., p.90
6. Calculated from Ibid., p.95
7. Neilson, M.A., "Arabia" in To promote Foreign Trade, Dec.4,1943, p.6

in importance not only as an export item; it also failed to supply the country's needs for livestock products.

The present state of Livestock in the economy

Very few details are available on the livestock sector, its size and magnitude in a monetary terms. The most recent estimate was produced by a special study carried out by the Central Department of Statistics (CDS)[8] which yielded estimates of gross output for the agricultural sector as a whole - including livestock - for 1967/68. Estimates of gross output for later years for livestock were derived by index numbers (1387/88 $\approx$ 1967/68 = 100) of physical output and producer prices, as shown in Table 1.

Table 1

Index numbers of physical output in livestock (1387/88=100)

Year	Index No. %
1386/87	95
1387/88	100
1388/89	103
1389/90	106
1390/91	110.8
1391/92	114.1

Source: CDS, National Account of Saudi Arabia 1392,A.H.

These index numbers were constructed using rough and ready methods and were based on information on rainfall, developments in irrigation and mechanization. They were supplemented by interviews and discussions with informed people, while indices of producer prices were based on wholesale price index numbers prepared by the CDS. On the basis of these and similar indices, production figures were calculated for the agricultural sector, and the gross output of livestock was estimated in 1387/88 (1967/68) to be second to field crops (Table 2), amounting to around SR

8. Saudi Arabia, Ministry of Finance, CDS, National Accounts of Saudi Arabia, 1392,A.H., (Riyadh; CDS,1973),unpublished

335 millions or 31.4% of the gross output in agriculture. This shows that livestock production not only lost its national lead but also lost its historical position as the main agricultural activity. Since 1387/88 (1967/68) the position of livestock in the agricultural sector has not improved; production in 1971/72 was still second to field crops and constituted 31.5% of the agricultural sector (Table 2).

Table 2

Gross Output in Agriculture 1387/88 and 1391/92

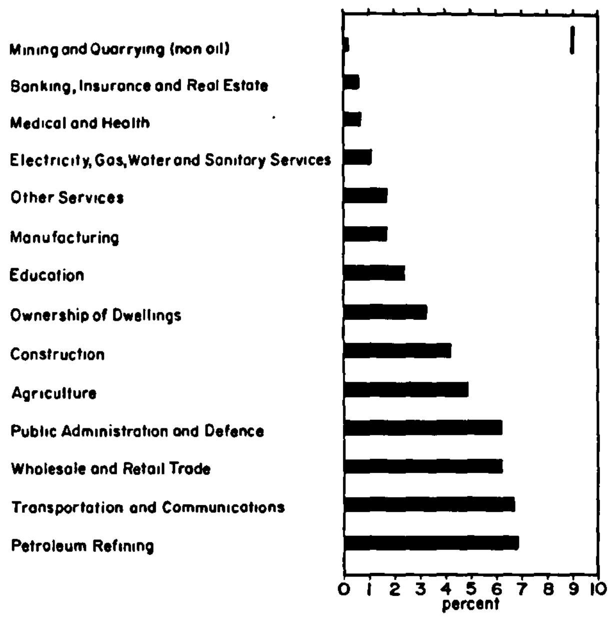
in millions SR

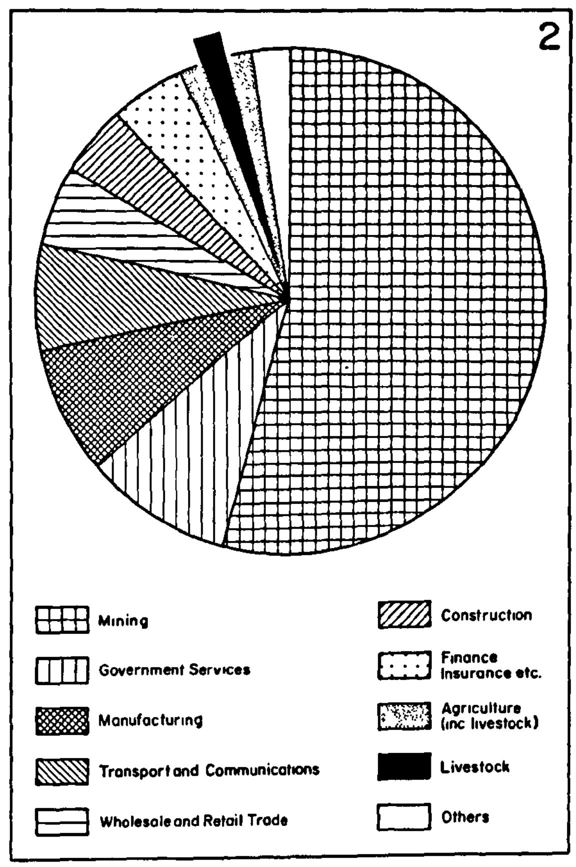
Agricultural Sector	1387/88 Gross Output	%	Index numbers	1391/92 Gross Output	%
Field crops	354.2	33.2	115.9	410.5	33.9
Fish	46.9	4.4	115.3	54.1	4.5
Vegetables	99.5	9.3	116.8	116.2	9.6
Fruits	179.7	16.8	106.0	190.5	15.7
Livestock	335.0	31.4	114.1	382.2	31.5
Forestry	51.5	4.8	112.6	58.0	4.8
Agricultural Sector	1,066.8	100	113.6	1,211.5	100

Source: 1387/88 compiled from CDS op.cit., p.14
1391/92 was derived on the basis of index numbers in CDS op.cit., p.14

The modest share of livestock in the agricultural gross output (about 31.5%) illustrates how livestock's part in the economy has shrunk. The agricultural sector as a whole contributed a very small share in the economy (around 4.6% of the GNP) and, as shown in Figure 1, it ranks fifth after petroleum, transportation, trade and government in the GDP for 1392/93 (1972/73). The exact share of livestock in the GDP is not known, but can be derived for 1971/72 from the gross output of livestock in the agricultural sector of 31.5% (Table 2) and the relative share of the agricultural sector in the GDP of 4.6% to produce the very modest value of around 1.4% as a rough estimate of the relative share of livestock in the GDP.* Figure 2 compares the relative share of livestock

* Calculated as follows $\frac{31.5 \times 4.6}{100} = 1.449$





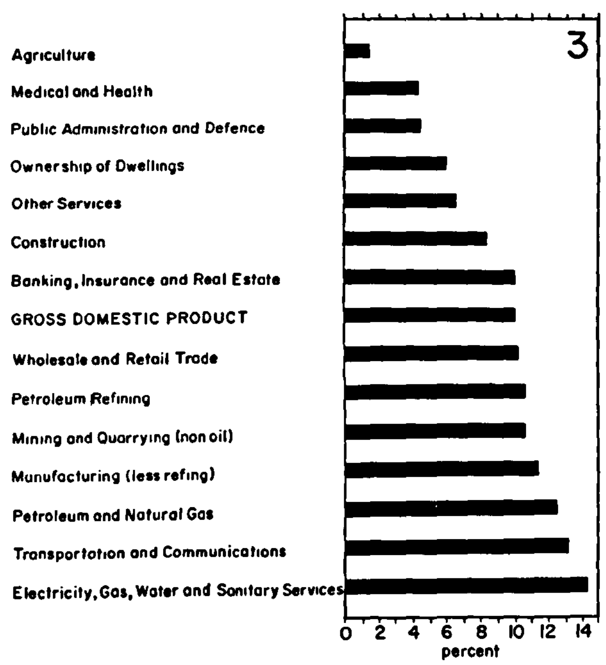


Fig 1 RELATIVE SHARES OF SECTORS IN GROSS DOMESTIC PRODUCTS (CURRENT PRICES) 1392–93

Fig 2 RELATIVE SHARE OF THE LIVESTOCK SECTOR AS COMPARED TO OTHER SECTORS 1392–93

Fig 3 AVERAGE ANNUAL GROWTH RATES (CONSTANT PRICES) 1382-83 to 1390-91

(Compiled from C.P.O. Report of the Central Planning Organization 1394)

in the GDP with other sectors of the economy and reveals its shrinking contribution.

Table 3

Agricultural production in the Gross Domestic Product in producer values at constant prices for 1386/87 to 1391/92 (SR million)

Years	GDP	%	Agriculture	%
1386/87	13,564.2	91.8	884.6	95.7
1387/88	14,772.8	100	924.8	100
1388/89	15,904.3	107.7	956.5	103.4
1389/90	17,398.6	117.8	984.1	106.4
1390/91	19,906.8	134.8	1,017.8	110.1
1391/92	22,963.3	155.4	1,050.1	113.5

Source: CDS op.cit.

Because of the paucity of information on livestock production, the diminishing position of livestock can only be illustrated by the situation of the similarly shrinking agricultural sector (which includes livestock). Since 1387/88 (1967/68) the growth of the agricultural sector has been slow, only increasing by 13.5% in the period up to 1391/92 (1971/72), while the GDP in the same period has increased by as much as 55.4% (Table 3). The relative share of the agricultural sector in the total GDP has declined from 6.5% in 1386/87 to 4.6% in 1391/92 (Table 4).

Table 4

Relative share of agricultural activity in the total Gross Domestic Product, in producer values at constant prices, 1386/87 to 1391/92

Years	%
1386/87	6.5
1387/88	6.3
1388/89	6.0
1389/90	5.7
1390/91	5.1
1391/92	4.6

Source: CDS op.cit

Due to the staggering increase in the oil industry and the slow increase in agricultural production, the average annual growth rate of agriculture compared to most of the other sectors is small for the period 1382/83 to 1390/91, averaging around 1.5% (Fig.3).

The causes of the decline

The two main causes behind the recent decline of livestock in the economy are: (1) economic factors and (2) production factors.

(1) Economic Factors

The increase in oil production and prices has provided the country with a remarkable increase in income. The per capita national product increased from an average of SR 455-900[9] in 1957 to around SR 5,288.7 in 1970/71. Since 1962/63 the GDP per capita rate of increase has averaged 9.3% (Table 5). This large fiscal growth induced a major increase in incomes, which in return increased the purchasing power and enhanced the demand for livestock products. This high purchasing power could not be satisfied by the domestic livestock sector, hence the increase in demand and consumption induced an increase in livestock imports.

Table 5

The rate of change of per capita GDP at factor cost 1382/83 - 1391/92

Year	GDP SR million	Population	Per capita SR	% change
1382/83	8,603.7	3,302	2,605.6	100
1383/84	9,205.2	3,384	2,720.2	4.3
1384/85	10,257.5	2,469	2,956.9	8.7
1385/86	11,775.6	3,556	3,311.5	12
1386/87	13,078.6	3,645	3,588.1	8.4
1387/88	14,458.1	3,736	3,869.9	7.8
1388/89	15,660.7	3,829	4,090.0	5.6
1389/90	17,371.1	3,925	4,425.8	8.2
1390/91	21,276.3	4,023	5,288.7	19.5
Ave.				9.3

Source: Compiled from CPO, Report of The Central Planning Organization 1394,A.H. (1974) and CDS, National Account of Saudi Arabia 1386/87 - 1391/92 (1967-1972)
Population for 1382/83 (1962/63) based on a semi-official estimate of CDS, Census of Population and Establishment 1963.
Rate of increase in population of 2.5% per annum was estimated by al-Turki, M., Accelerating Agricultural Production in Saudi Arabia,(Colorado State University, Ph.D., 1971),p.10

9. Fryer, D.W., World Economic Development, (London; McGraw-Hill Book Co., 1965), p.5, The part exchange rate for US Dollars - SR 4.50 was from SAMA, Annual Report, (Jeddah; 1968),p.109

Imports

Table 6

Value of imports of live animals and animal products as related to total imports (SR 000) and (%) for 1968-1972

	1968	1969	1970	1971	1972
Live animals and animal products	263,336	232,813	229,825	249,917	310,440
Total imports	2,578,287	3,361,520	3,196,842	3,667,487	4,708,320
Per cent of live animal and animal products to total imports	10.2	6.9	7.2	6.8	6.6

Source: Compiled from CDS Foreign Trade Statistics, (Riyadh; CDS, 1970, 1971, 1972). Also CDS Statistical Yearbook, (Riyadh; CDS, 1972, 1973)

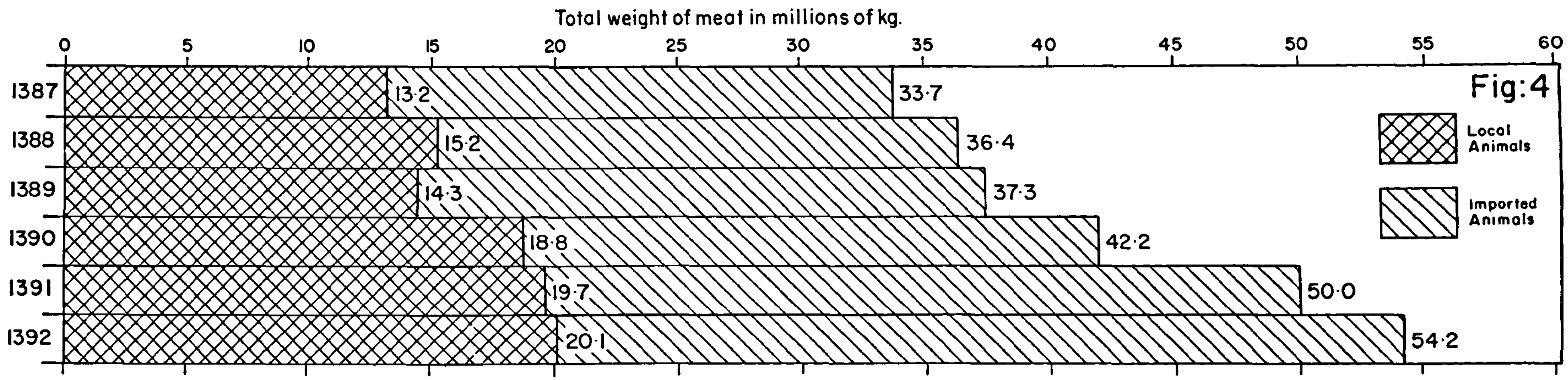
Table 6 shows that the value of imported live animals and animal products has increased from SR 263.3 millions in 1968 to SR 310.4 millions in 1972 (6.6% of the total imports).

Table 7 shows that since 1967 (1387) imported animals have provided around 60.7% of the meat in government municipal slaughter houses, and in 1972 around 63% of the meat provided by these houses was from imported animals (Fig.4). As shown in Figure 5, since 1388 the average annual increase in total meat slaughtered has averaged 10.1% with meat from local sources averaging 9.3% and that from imported animals increasing by an average of 11.2%. Figure 5 shows that the annual changes in the quantity of meat produced from imported and local animals are reciprocal, so that when local sources of animals are short as a result of droughts and poor summer conditions the share of imports increases, and vice versa.

Meat Consumption

The per capita meat consumption has been increasing in the last few years, and at present is more than the 9.5 kg.[10] that UN and F.A.O. publications indicate for 1970. A more indicative per capita estimate can

10. F.A.O., Agricultural Commodity Projection, Vol.1, (Rome; 1970), p.132



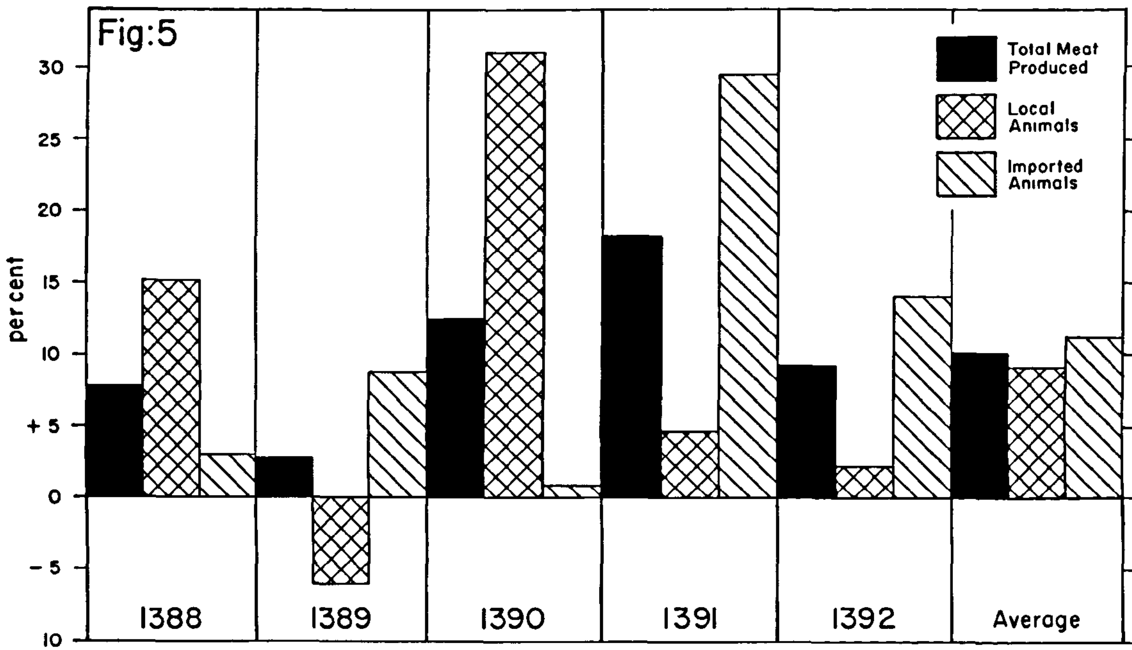


Fig:4 Total weight of meat in kg. slaughtered in the main urban and rural centres in the Kingdom in 1387–1392 from both imported and local Animals

(1387–1392 approx. ≈ 1967–1972)

Fig:5 Annual changes in the total meat production of the main slaughter houses in the Kingdom from both imported and local animals in 1388–1392 A.H. in % of kg when 1387 = 100%

Source: Table 7

Table 7

The estimated meat weight and rate of change of animals slaughtered in the main urban and rural centres (1387-1392 ≈ 1967-1972) in (kg) and (%) (00000)

Year	Total	Local	Imported	Imported % total	% of change in total meat slaughtered	% of change in local meat slaughtered	% of change in imported meat slaughtered
1387	33.7	13.3	20.5	60.7	100	100	100
1388	36.4	15.3	21.1	58	7.8	15.2	3.0
1389	37.3	14.4	23.0	61.5	2.7	-6	8.9
1390	42.0	18.8	23.2	55.2	12.5	31	0.9
1391	49.7	19.7	30.0	60.4	18.2	4.4	29.4
1392	54.2	20.1	34.2	63	9.2	2.1	13.9
Ave.					10.1	9.3	11.22

Source: Compiled from Ministry of Interior Municipalities semi-annual reports, No.1-9 (Riyadh; 1387-1391 ≈ 1967-1971) and CDS, Statistical Books, 1967-1973 be constructed from the total meat consumed nationally in 1972, around 90.2 kg. million (Table 8), and the estimated population of around 4.1 millions in the same year (Table 5). This produces an estimated 21.9 kg. per person per year which is more than double the UN estimates. This substantial difference is a result of the lack of available official statistics to UN agencies from the country.

Table 8

Meat weight estimated by kind of animals slaughtered in Saudi Arabia 1392,A.H. in kg.

Animal kind	Slaughter in municipal houses (a)	Margins to count for outside slaughtering % (b)	Estimated total slaughtered in the country
Goats	8,496,193	100	16,992,386
Sheep	17,527,539	100	35,055,078
Cattle	9,148,467	25	11,435,584
Camels	19,062,679	40	26,687,750
Total	54,234,878		90,170,798

Source: Compiled from: (a) Ministry of Interior, op.cit.
(b) These margins are developed by the CDS to correct for animals slaughtered outside government slaughter houses, from source cited in Table 1.

(2) Production Factors

The problems and difficulties confronting production within the livestock sector throughout the last 30 years have been mounting, causing an imbalance in the overall structure of the livestock sector and it is the main aim of this study to analyse some of the main causes of this state of disequilibrium.

Sources of Data

Most of this study is based on the author's experience in the Ministry of Agriculture and Water (MAW), and on official documents and first-hand information collected during a field study in different parts of Saudi Arabia in 1974. The sources of the data obtained are organized according to the following classification:

I - Experience: The author graduated in 1967 (Fresno State College, California, U.S.A.) with a degree of B.Sc., in Agricultural Business, (Animal Husbandry option). He worked in the MAW from 1967 to December 1972. He was employed first as a livestock specialist, stationed in the MAW headquarters in Riyadh. As a livestock specialist the author had the opportunity of travelling to many parts of the Kingdom and of observing a great deal of the livestock sector. At the end of 1968 he became Director of the Hofuf Research Station in al-Hasa Oasis. His experience in this station brought him face-to-face with the basic issues that confront livestock development, mainly animal types, management and related aspects. At the beginning of 1970 he became responsible for the supervision and operation of the Wadi Jizan irrigation project, on the south-western coast of Tihama. This assignment differed from the previous ones in that it was wider in scope, covering a whole province, and was an agricultural project where livestock constituted only a segment. The experience in this project was helpful in gaining an insight into the vital issues related to regional development, the competition of crops and animals for land use, national and regional planning and the utilization of international expertise. The numerous reports, memoranda and official correspondence written throughout this period helped a great deal in writing this study.

II - Field work: The period from the middle of August 1974 to the middle of January 1975 was spent in an extensive field work programme. Over 50 days of this period were spent with the tribe of al-Ruala in the northern parts of the country and with the al-Dwasir, Yam and Gahttan tribes in the south, mainly to observe and to evaluate their pastoral activities. The author stayed with these tribes, moved with them and participated in their daily activities. One month was devoted to the study of dairy activities around Riyadh and al-Kharj. The rest of the field work was done in Riyadh with short visits to Hofuf, Jizan, Qassim, Jeddah and Mecca for the collection of documents, information and to undertake interviews.

III - Interviews: The author was fortunate to interview around 75 officials of varying rank, including ministers, regional governors, deputies, directors and others. Around 30 tribal *sheikhs* and numerous Bedwins and farmers were interviewed at length in different parts of the country. The number of people interviewed is too large to be specified in this study but their contribution is certainly significant.

IV - Questionnaires: Two sets of questionnaires were prepared. One concerned al-Badiah and their pastoral activities. The second was for the evaluation of the main dairy activities in the area around Riyadh. This second questionnaire was completed in December 1974. The first questionnaire for al-Badiah was abandoned in the middle of the author's work in the northern desert, because formal and direct questions in this case produced unreliable results. The day after the author's interviews rumours spread that an MAW man had come to finalize animal subsidies and so all the answers received later were very alike with the intention of over-stating animal estimates, under-estimating government help and emphasising dramatically their needs. The author had never told anyone that he came from the MAW and at that time he did not know of any forthcoming subsidies, a matter he came to learn about only in early January 1975. The author realised later that the best way to find out about the Bedwins is through unofficial and casual approaches, such as asking indirect questions and making observations at gatherings around the fire.

V - Studies and Documents: The author had access to valuable and largely confidential documents from the following sources:

(1) MAW Resource Survey Studies, now completed for six of eight areas encompassing most of the land mass of the country, have resulted in the

accumulation of large quantities of valuable data on ranges, climate, water resources, crops, livestock and other subjects. They are considered the main informative source about ranges in the Kingdom.

(2) Central Planning Organization (CPO) Reports are regional studies for the northern, western and south-western areas aimed at evaluating the potentials for regional development.

(3) MAW Circulars and Official Correspondence are largely confidential, and the author, on the basis of his experience in the MAW, has been able to utilize them to the benefit of this study without exposing the confidential aspects. This source was very helpful in providing an insight into the institutional, social and developmental aspects of the livestock sector.

VI - Supporting Material: This includes international publications, mainly UN reports and scientific research related to livestock development in under-developed regions in the world, and arid areas in particular.

Organization of the Study

The study is divided into four parts. Part One is concerned with the main limitations and constraints facing livestock development. Physical and environmental constraints and the extent of their effects on the development of livestock are elaborated in Chapter One. Chapter Two deals with the main problems facing the Ministry of Agriculture and Water, as an example of administrative limitations. This is followed by an examination in Chapter Three of the al-Badiah society and the changes that are affecting its organization and the consequences for pastoral development.

Part Two focuses on the types of livestock, their main characteristics and their distribution. Chapter Four is devoted to livestock types, characteristics and economic potentials. Chapter Five examines the animal population, trends and the pattern of their structure, composition and distribution with an emphasis on trends related to regional concentration and specialization.

Part Three is an examination and evaluation of livestock production systems. Chapter Six traces the basis for classification and the relationship between the spatial pattern of land uses and the evaluation of livestock systems, while Chapter Seven and Eight elaborate in detail the main problems facing the two main livestock systems; pastoralism and livestock farming. al-Ruala tribe is described in Chapter Seven as a case study. The Riyadh dairies are surveyed in Chapter Eight.

Part Four is composed of two chapters and is devoted to the evaluation of the role of livestock in national development. Chapter Nine argues the case for livestock development. The main strategies for livestock development based on the findings of earlier chapters are elaborated in Chapter Ten.

A summary of the major findings of the study is presented in the conclusion.

PART ONE

LIMITATIONS and CONSTRAINTS

INTRODUCTION

In an under-developed and largely arid country like Saudi Arabia, the development of the livestock sector is hampered by numerous ecological, social and institutional obstacles. There are environmental constraints that restrict the expansion of livestock production. There are animal husbandry problems created by the rudimentary nature of animal management in the country. There is a wide range of problems related to animal health, feed, processing, marketing, infra-structure, education, finance etc. All these problems are fundamental and have to be solved if livestock development has any hope of being achieved. Moreover, the traditional nature of the livestock sector in the country and the lack of any major efforts to modernize it have resulted in this sector being one of the most under-developed sectors in the country.

This part focuses on three main limitations that are not only fundamental but are structural also,i.e., directly related to the structure or the framework of the livestock sector. These limitations are environmental, administrative and social. Unless the extent of these limitations is understood, other problems cannot be solved.

Chapter One deals with environmental limitations, their extent and importance. Because the country is largely arid, environmental limitations are crucial and need a great deal of understanding. Climate and water resources have been emphasised, particularly their effect on the livestock development in the country.

Chapter Two is concerned with administrative limitations, mainly those within the Ministry of Agriculture and Water,(MAW). It is not common for a geographical study to venture into administrative aspects, but this does not mean that there is no relation between the two. Geographers are concerned with the relationships between man and his environment and their spatial consequences. Furthermore, geographers have contributed a great deal towards an understanding of the under-developed world by their evaluation of space, its use, and organization. Yet development is also concerned with the spatial reorganization of society and that in turn necessitates an indepth study of the administrative organization that makes the decisions and administers the implementation of policies. Government officials make it very clear that in many cases the problem, its extent, solution and the approach to the solution are not always the main issue; for these officials the main difficulty is finding a suitable administrative body and system to deal with the problem. The development of the livestock sector in Saudi Arabia has been hindered by the lack of a suitable organization to plan for it and implement it. Thus Chapter Two examines the main problems facing the MAW as an institution. Particular attention is given to problems related to the use of man-power, organization and regional activities.

The third chapter deals with al-Badiah, the main pastoral community that specialises in livestock production. This ancient community has recently been undergoing major changes that have affected the livestock sector in a profound manner. This chapter identifies al-Badiah, evaluates the major trends affecting them and their effect on the livestock sector.

CHAPTER ONE

PHYSICAL AND ENVIRONMENTAL CONSTRAINTS

1.1 Physical Aspects

1.1.1 Location

The Kingdom of Saudi Arabia, with an area of some 2,100,000 sq.km., covers almost three-quarters of the Arabian Peninsula and extends east to the Arabian Gulf. It borders Kuwait in the north-east and Qatar in the east, thence the United Arab Emirates and Oman. The People's Democratic Republic of Yemen occupies most of the southern coastline of the peninsula. The Red Sea and the Yemen Arab Republic are located to the west and south-west of Saudi Arabia. The northern parts of the country border the deserts of Jordan and Iraq. Saudi Arabia extends from 16°N to 31°N and occupies a position between tropical and temperate latitudes (Fig.1-1).

1.1.2 The Terrain

The landscape is an arid desert panorama, with a small semi-arid zone in the south-west region, and a considerable tract of an extremely arid nature in the Empty Quarter (Fig.1-2). The country can be divided into six main physiographical zones (Fig.1-3):

(1) The Coastal Plains

The coastal areas, located in the east along the Arabian Gulf and in the west along the Red Sea, are distinguished by low relief and are generally extremely irregular and sandy. One of their dominant features is the salt flats, sabkah, an impure mixture of salt and sand forming a crust a few inches deep and found in moist depressions. Vegetation in these depressions is limited and unsuitable for most animals. Along the eastern coast is a fairly wide belt of shifting sands, which widens to the south and merges with the sandy area of al-Jafurah, which runs into the Empty Quarter. No part of this coastal region is more than a few

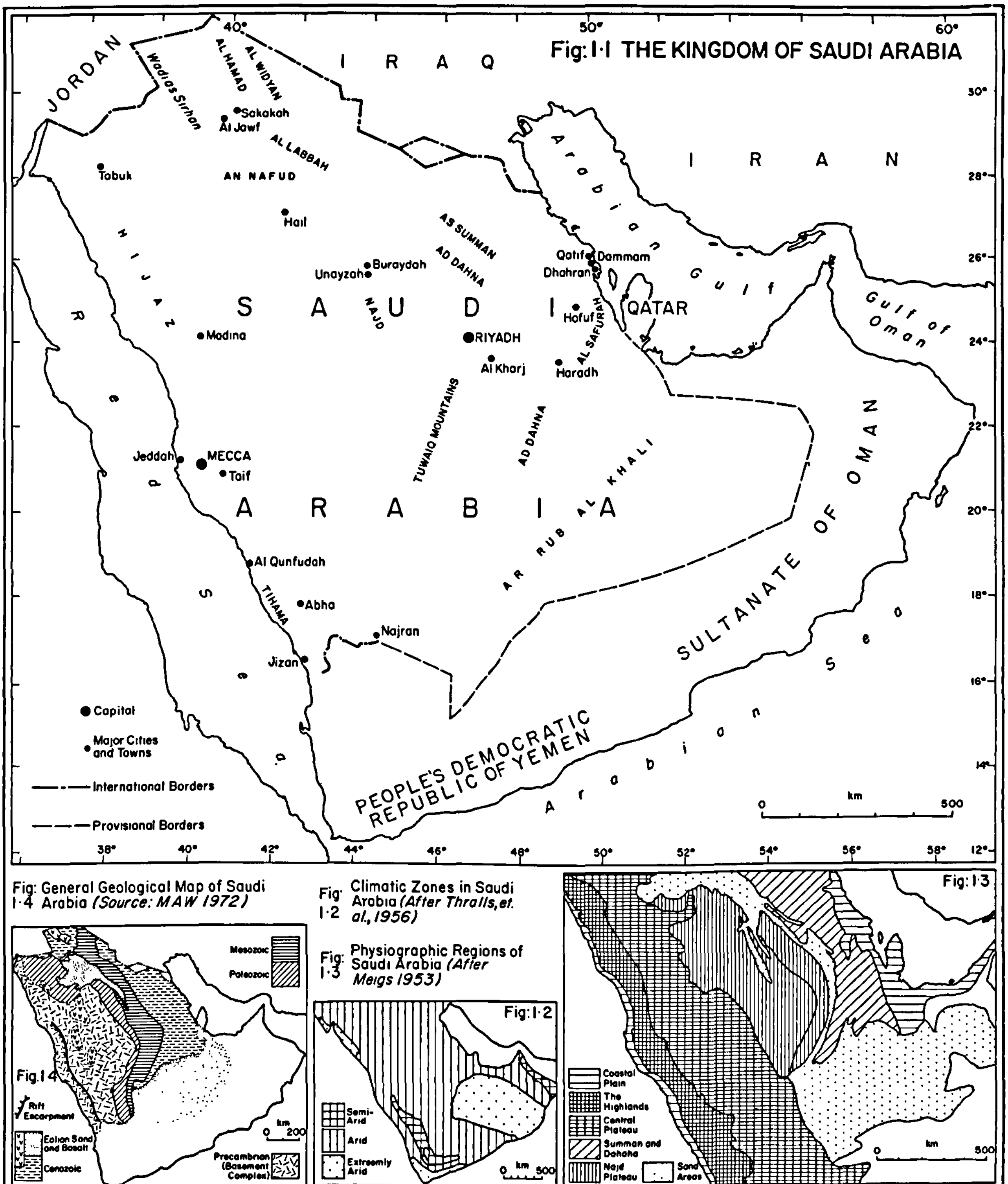


Fig: 1·1 THE KINGDOM OF SAUDI ARABIA

Fig: 1·4 General Geological Map of Saudi Arabia *(Source: MAW 1972)*

Fig: 1·2 Climatic Zones in Saudi Arabia *(After Thralls, et. al., 1956)*

Fig: 1·3 Physiographic Regions of Saudi Arabia *(After Meigs 1953)* hundred feet above sea level. The elevation of the region, as a whole, increases gradually from the coast towards the interior of the peninsula. The western coastal plains lie at sea level and are situated all along the eastern shore of the Red Sea, confined within a narrow space by mountains dropping sharply towards the sea. The Tehema area, at the southern tip of the western coastal plain, varies in width from 15-40 km. and is characterised by numerous short wadis which lie at the extreme end of south Tehama and drain into the Red Sea and offer a combination of climate, soil and water suitable for a relatively sizable crop and livestock production.

(2) The Highlands

A wall of steep highlands stretches all along the Red Sea with a partial gap in the vicinity of Mecca. The western highlands extend for nearly 1,600 kms. from the Gulf of Aqaba in the north-west of Arabia to Aden in the south-western corner of the Arabian Peninsula. The northern tip of these highlands has a plateau of 300-460 m. in altitude. It becomes higher and more rugged to the south, at Madina, and reaches a height of 2,440 m. to the south of Mecca. The altitude is much higher in the south-west, where there are several peaks that reach an altitude of more than 2,450 m. The highest peak is over 2,750 m. and is located south of Asir. The mountains slope gradually to the east into the central plateau and this, consequently, lends itself more to settlement. Their slope to the west is abrupt, and heavily eroded into steep, narrow wadis, some of which carry large amounts of water accompanied by vast quantities of silt.

(3) The Central Plateau

Located east of the highlands, this region is an extension of the Basement complex, and, with more recent volcanic flows, harrah forms a moderate to high plateau with elevations ranging from 800-1,800 m. It extends eastwards to the interior desert plateau, which offers a variety of land forms.

(4) Summan and Dahaha Plateau

The Summan Plateau is a hard rock plain from 80-250 km. wide and is fairly flat, but to the east, old stream channels and other forms of erosion have cut the plateau into an irregular terrain. The elevation averages about 250 m. at its western margin adjoining the Dahaha sands. Some vegetation springs up after rain in sandy depressions which form major grazing areas in winter and spring.

The Dahaha is a long, narrow belt of sand which extends approximately 1,290 km. in a large arc from the great Nafud in the north to the Rub' al-Khali in the south. The sands of the Dahaha are medium to fine grain and the vegetation formed on it provides good grazing in winter and spring.

(5) Najd Plateau and the Escarpment Region

The Escarpment Region, west of the Dahaha, is around 322 km. wide and is dominated by several steep, west-facing escarpments with gentle eastern slopes. The Tuwaiq Escarpment, which is 800 km. long, and the Aramah Escarpment are the most prominent topographical features of the region. The average elevation for the region is 305-1,066 m. and thus allows more grazing than other surrounding areas.

(6) Great Sand Areas

The great Nafud, in the north, is an expanse of sand covering approximately 22,000 sq.kms. and consisting of rolling sand dunes supporting sparse vegetation. The Rub'al-Khali(Empty Quarter) is approximately 1,200 km. long and has a maximum width of nearly 640 km. altogether it covers an area of about 647,500 sq.kms., making it the largest continuous body of sandin the world.

1.1.3 Geological Setting

Geologically, the country consists of two principal parts; the eastern sedimentary basin (1,640,900 km^2 or around 73% of the country), and the western Precambrian (Arabian) shield (610,000 km^2 or around 27% of the country) (Fig.1-4).

The sedimentary basin is a source of immense economic advantage to the country. It is composed of a variety of rocks which, under certain conditions, become an ideal environment for the storage of oil and water. This basin surrounds and dips away from the Arabian Shield in the west, and thickens towards the south into the Empty Quarter, towards the east into the Arabian Gulf and towards the north into the great Nafud Desert. It has a thickness of a few metres near the Precambrian basement complex, which gradually increases towards the east. The thickness reaches 3,000 m. in Riyadh (160 km. distant from the Arabian Shield). In Dhahran, on the west side of the Arabian Gulf, the thickness reaches 6,232 m. It also thickens southwards into the Rub' al-Khali basin and to the north to the great Nafud, to reach a depth of 6,000-9,000 m.[1] The formations in this basin start with the Cambrian, include all the geological sequence ending with Recent deposits, and are divided into 28 formations, mainly of limestone. In central Saudi Arabia, at the eastern edge of the Precambrian shield, sedimentary rocks mostly of marine origin and moderate thickness are exposed.

The Precambrian shield (The Arabian Shield) is the ancient land mass in the central part of western Saudi Arabia. It is considered to be a continuation of the African Shield. The Red Sea forms a large depression between these two shields. The Arabian Shield extends from the Red Sea eastwards to the point of contact with the sedimentaries. It is composed largely of igneous and volcanic rocks, many of which have been metamorphosed by great tension and twisting. This in turn was caused by the formation of the ancient mountain range, of around 1,610 km. long, which rises in a line parallel to the Red Sea. These rocks are cut in

1. Ministry of Petroleum, Mineral Resources of Saudi Arabia, Bulletin No.1.(Dhahran; Ministry of Petroleum, 1968),p.17

many places by intrusions of granite and other igneous rocks, including a number of both old and comparatively recent lava flows.

1.2 Environmental Limitations

The emphasis of this chapter will be focused on two major aspects. The first is climate and the second is water resources. These two main elements are responsible for the main environmental limitations facing livestock production and development in the country.

1.2.1 Climate

The properties of the climate in terms of air temperature, pressure, relative humidity, wind, air density and solar radiation influence animals by their control over the animals' micro-climate (climatic conditions directly surrounding the animal). However, air temperature, relative humidity and solar radiation are the most important elements that have a direct and decisive control over the suitability of an environment to an animal, especially in a largely arid environment as in Saudi Arabia. The significance of these main elements is derived from their direct influence on the total energy exchange between the animal and the surrounding environment. In order for an animal to survive a given environment over a long period the energy gain must equal the energy loss: hence the energy balance for an animal is expressed by the following equation:

$$\text{Radiation absorbed} - \text{Radiation emitted} \pm \text{convection} \pm \text{conduction} \pm \text{evaporation} \pm \text{metabolic heat} = 0$$ [2]

Under the sun an animal may gain more energy from radiation than it is emitting. If the air temperature is warmer or colder than the animal's external surface temperature, it will gain or lose heat by convection from the atmosphere or conduction from the ground. Evaporation is the loss of heat by sweating, and the metabolic process may release heat or may con-

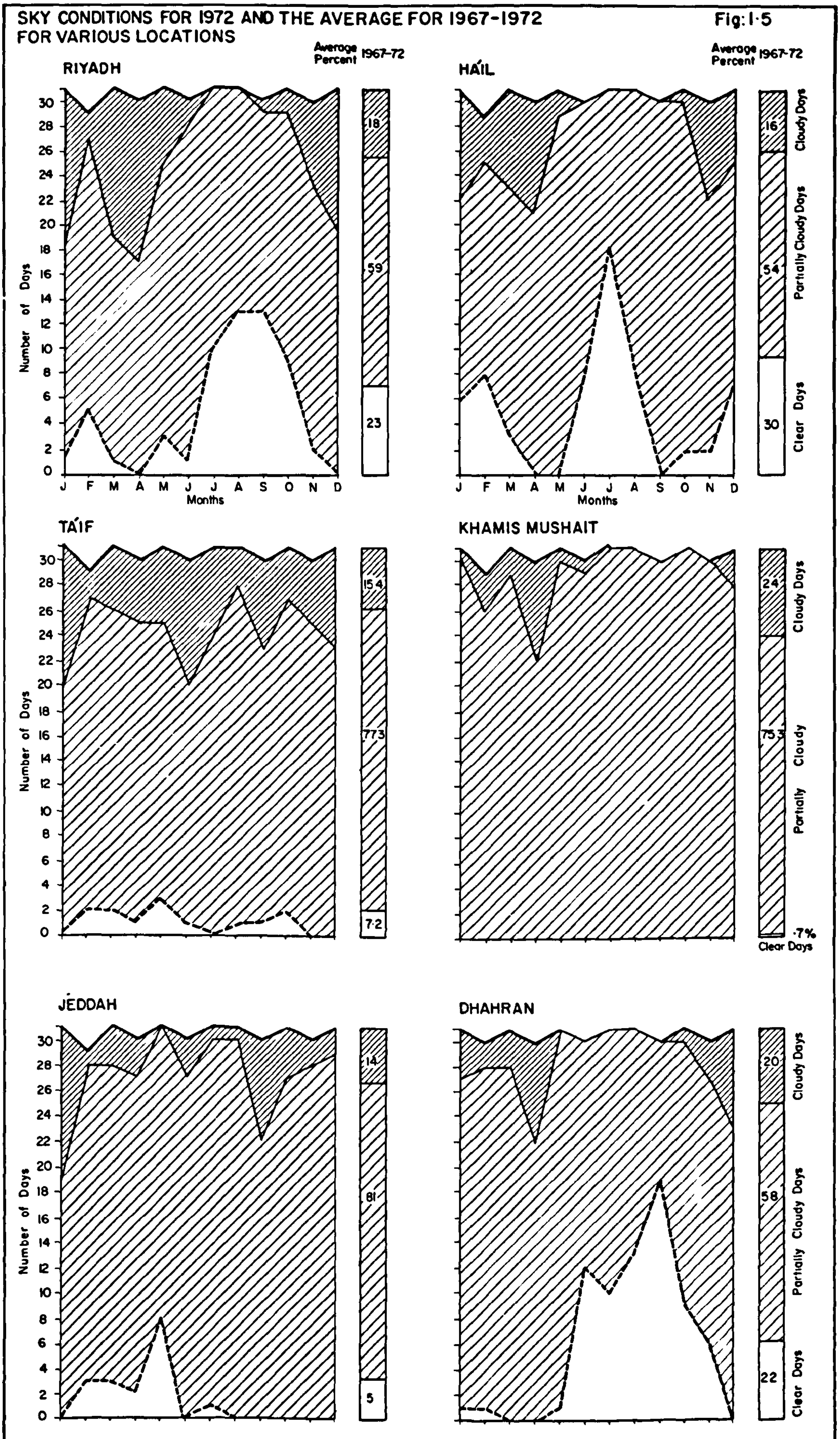
2. Gates, D.M. "Physical Environment" in Hafez, E.S.E. (ed.) Adaption of Domestic Animals, (Philadelphia; Lea & Febiger, 1968), p.47

sume energy. Satisfying and balancing the energy requirements of an animal largely depends on the state of the climatic condition; below is an elaboration on these conditions and their effect on livestock production in Saudi Arabia.

1.2.2 Sunlight (Radiation)

By and large, the country lies in the tropical and sub-tropical zone, lying between latitude 31°N and latitude 16°N; hence the number of hours of daylight during the summer months is considerable. The length of daylight on the 21st June ranges from 14 hours in the north of Saudi Arabia to 13 hours in the south, but during the winter the length of day is considerably less. Furthermore, the number of cloudy days over most of the country is quite small.

Figure 1-5 shows the number of cloudy, partially clear and clear days for six locations that represent a variety of climates and altitudes for twelve months in 1972, and the average number of days for each sky condition for the period 1967-72. The coastal locations of Dhahran and Jeddah show the effect of water bodies (Red Sea and Arabian Gulf) where partially clear days are the most common, especially in the case of Jeddah, where the western mountains act as a barrier, concentrating precipitation: Humidity on the coast is therefore also high, and clear days very few, reaching an average of 5% for 1967-72. Locations at a high altitude, like Taif and Khamis Mushait, have even fewer clear days. In 1972 there were almost no clear days at Khamis Mushait, and an average of only 0.7% for the period of 1967-72. Cloudy days are frequent, amounting to 15.4% in the case of Taif for the period 1967-72. The inland areas of Riyadh and Hail, located at the maximum distance from the sea and of lower elevation, have more clear days; partially clear days are also more numerous. A partially clear condition (with the exception of the winter season and areas located at higher altitudes) does little to



Compiled from data collected from The Ministry of Finance Statistical Year Book for 1973 lower temperature, hence its effect on the animals' micro-climate is similar to that of clear sky. Because of the long periods of daylight during the summer and the marked lack of clouds during the day, solar radiation during the day and ground radiation during the night are very intense. Consequently, the summer months are very hot and the animals experience a wide range of air temperature occurring between day and night, particularly in the region which is not affected by maritime influences.

1.2.3 Air Temperature

As with other climatic elements, air temperature in the country is controlled by three main factors: (a) as elevation increases, temperature decreases, and vice versa. However, Saudi Arabia is mainly a plateau of modest elevation in which the area of land below 800 m. constitutes the major portion of the country, while the higher altitudes exceeding 2,000 m. constitute only about 3% of the country's total land area. Thus over much of the country temperatures are usually high, especially in the summer. (b) Solar radiation is intense most of the year, as shown earlier. (c) Because of the narrowness of the water bodies (relative to the extensive land mass of Arabia), the direction of the prevailing winds and the peculiar layout of the highlands which extend along the Red Sea coastal plain as a barrier, the influence of these water bodies is, on the whole, limited to their immediate vicinity and it is seldom that they play an important part in the control of temperature of the areas beyond the narrow coastal strips.[3]

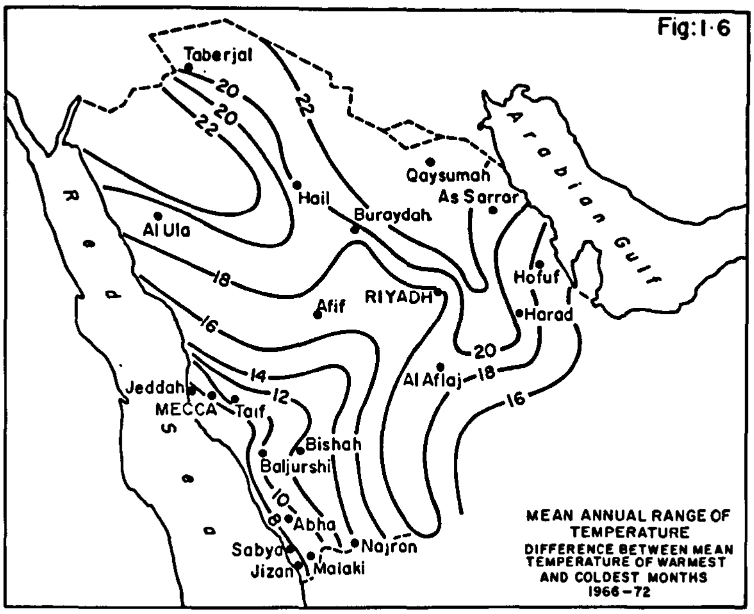
The mean annual temperature is of little significance and, indeed, may be misleading in a study of temperature in an arid area like Saudi Arabia, -- especially in the case of livestock -- because it conceals the maximum and minimum air temperature conditions, which are substantial in the summer and, to a lesser extent, in the winter. The mean

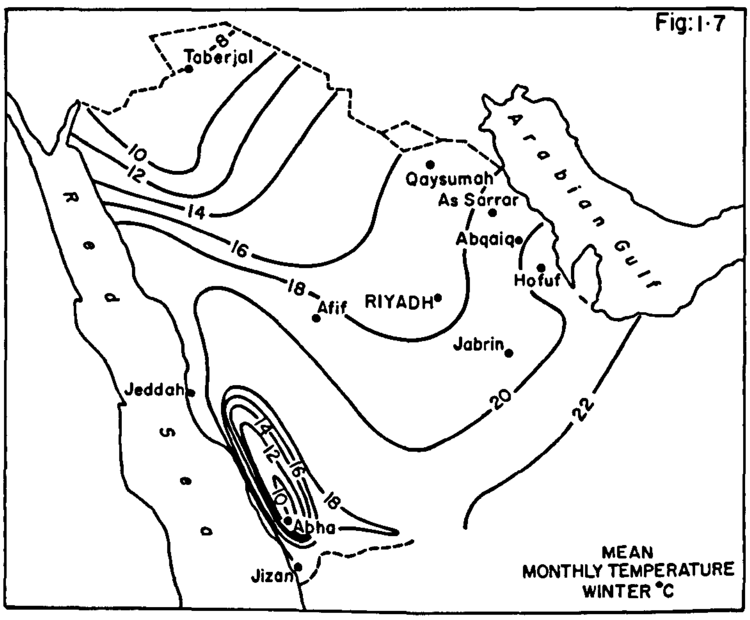
3. al-Blehed, A.S., A Contribution to the Climatic Studies on Saudi Arabia, (Geography Department; Univ. of Durham, M.Sc.,1975), pp.67-68

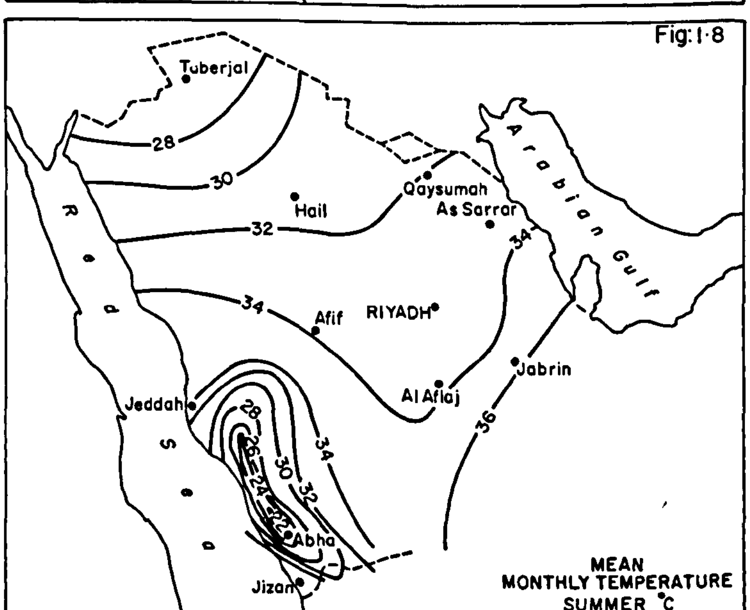
annual range of temperature (the difference between the mean temperature of the warmest months and that of the colder months) shown in Figure 1-6 is an appropriate approach to evaluate temperature in the country. The mean annual range is lowest in the southern section of the coastal plains of the Red Sea where the difference between January and July ranges between 8.0°C in Jizan to 9.0°C in Jeddah. In the coastal plain of the Arabian Gulf the mean annual range is greater than the coastal area: in the west, for example, about 18°C in Hofuf. Inland, and in the north, where the distance from the water bodies is at its greatest and the continental condition becomes dominant, the annual range is greater than in other areas and reaches 20°C in al-Kharj. Thus there are substantial seasonal and monthly variations, and the annual range inland and in the north between the summer and winter months is greater.

The summer is the longest season, lasting from late May to September, and winter months are around three, from early December to February. Spring and autumn are short, transitional periods and the prevailing weather in these two short seasons has the characteristics both of the winter months, when nights are temperate, and the summer months, when days are relatively warm. In winter, (Fig.1-7) the mean monthly temperature is between 14 and 20°C over the major part of Arabia. However, frost over most of the central area is not negligible. In 1968 for example, the country came under the influence of cold waves and the air temperature dropped below freezing in the northern province; snow falls were reported in the Madina mountain areas to the west of Tabuk. In April 1971 a storm left an accumulation of 1.5 m. of snow immediately to the west of Abha in the high western mountains.

During the summer season the country comes under the influence of hot and dry air, and the sun is at its northernmost movement causing intense solar radiation, which in turn causes air temperature to be very







0 km 500

After al-Blehed A.S. and the M.A.W

high during the afternoon. The only area which does not normally experience this situation is the Asir and southern Hijaz highlands. The worst aspect of summer as compared with winter conditions is that the air temperature is persistently high, with maximum temperatures in the day and minimum at night, while in winter the sudden incursion of either cold solar air or hot dry air causes a fluctuation in temperature. Figure 1-8 shows the mean monthly temperature in summer.

It should be stressed that what is really detrimental to livestock production is the maximum and minimum temperatures which, in the case of the first, could last for months over most of the country. The summer heat is so great that extreme maxima of 49°C have been reached at such stations as Riyadh and al-Sulayyil on many occasions.[4] At the border with Jordan and Iraq and at the towns of Qurayyat and Tabarjal absolute maxima of 44°C have been recorded. At al-Sarrar, in the hinterland of the Arabian Gulf, an absolute maximum temperature of 50.6°C was recorded on the 15th July 1967, which is 7.3°C less than the world's maximum of 57.8°C recorded near Tripoli and 6.2°C below the all-time high temperature of 56.7°C recorded for Death Valley in the U.S.A.[5]

The lowest recorded temperature during the period 1966-72 was in Tabarjal, with an absolute minimum temperature of -13.3°C. Other minima include -8.5°C at Sakakah, -11.8°C at Qurayyat, -5°C at Riyadh, and -2°C for coastal towns like Abgaiq.[6]

1.2.4 Humidity

Evaporation from the Red Sea and the Arabian Gulf gives rise to high humidities locally. The coastal plains of Tehama and Jeddah, which are backed by the mountainous barrier of Asir and Hijaz highlands, experience higher humidities as a result of the concentrations of moisture in these

4. *Ibid.*, p.101
5. *Ibid.*
6. *Ibid.*, p.102

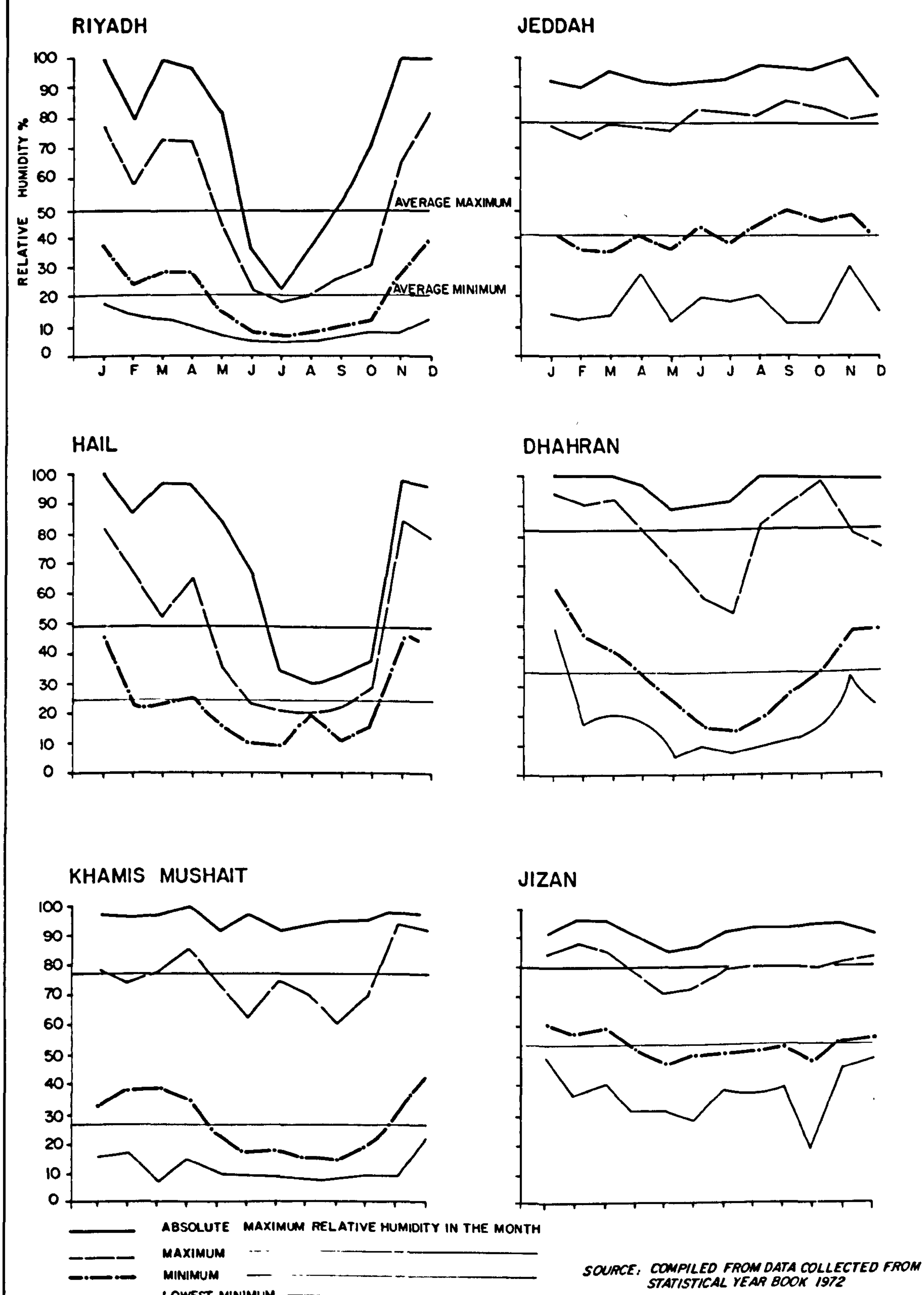
areas. As shown in Figure 1-9 Jeddah has an absolute relative humidity over 90% most of the year and the average maximum is over 75%. Jizan's absolute maximum is over 90% most of the year, except from April to July, and the average maximum around 80%. Dhahran's average maximum is over 80% and the absolute reaches 100% for most of the year. Mountainous areas like KhamisMushait also reach an absolute humidity of over 90% over all the year with an average maximum of around 75%. Such a situation is the result of the high altitude of these areas which allow for higher rainfall, hence high humidity. In desert locations like Hail in the north and Riyadh in the centre, which are at maximum distances from water bodies and at an altitude usually less than 800 m. the humidity is lower than in other areas, with an average maximum of 50% for Hail and Riyadh. In these areas considerable seasonal variation is a common situation: an absolute maximum of 100% could be reached but only in one month or two of a year.

1.3 The effect of arid climate on livestock production

In the previous discussion an effort was made to focus on the extreme environmental conditions (absolute and maximum temperatures and humidity and the intense solar radiation), because: (a) these extremes are persistent for a sizable period, over a large area; (b) the majority of the livestock in the country is raised under pastoral conditions which do very little to overcome these extremes; and (c) it is these extremes that impose the most detrimental effects on animals under arid conditions.

The physiological and biological behaviour and the performance of local and imported animals has never been evaluated experimentally (other than by observation) under Saudi Arabian environment conditions, so as to evaluate the extent of the influence of these climatic conditions on these animals. However, a general impression can be derived from a sizable amount of research done elsewhere on similar animals under similar climatic

Fig 1·9 RELATIVE HUMIDITY FOR VARIOUS LOCATIONS 1972



SOURCE: COMPILED FROM DATA COLLECTED FROM STATISTICAL YEAR BOOK 1972 conditions to those of Saudi Arabia.

Extreme conditions of high and low temperatures and humidity and intense solar radiation that persist for a prolonged period, tend to interfere with the animal's ability to maintain the near-constant internal environment necessary for survival and efficient functioning and performance. As the mean daily temperature falls or increases outside the animal's comfortable range, the rate of cooling by evaporation from the skin and the respiratory tract depends largely upon the degree of relative humidity of the air. If the humidity is low, as it is in the hot dry interior of the country, evaporation may take place rapidly leading to increased skin irritation and general dehydration. High humidity, as in the coastal areas, makes evaporation proceed slowly so as to restrict heat loss and thereby enlarging the animal's thermal balance. Persistent extreme climates adversely reflect two major impacts on the animal. The first is "stress" that results from an increase or decrease in environmental temperatures, and denotes the magnitude of forces external to the body's system that tend to displace them from their resting or basic state.[7] The second is "strain", the measure of internal displacement from the basic state brought about by stress, and also it is an estimate of the level of discomfort experienced by the animals.[8] The animal being subjected to these conditions, an action termed by Adolph as the "adaptagent" (the measurable force applied) and "adaptates" (the measurable changes produced by the animal) takes place as follows; ΔA (the force) $\rightarrow \Delta E$ (the resulting animal response)[9] if ΔE fails to compensate for ΔA, there is shift in the heat balance followed by a chain of action to renew the animal's equilibrium or shift it to a new plateau. If this fails, a progressive stage of failure of the heat

7. McDowell, R.E., Improvement of livestock production in warm climates, (San Francisco; W.H.Freeman & Co., 1972),p.76
8. Ibid.
9. Adolph, E.F., "Perspective of adaptation; some general properties", Amer.Physiol. Soc., Handbook of Physiology, Section 4 (Washington D.C.; 1964),p.30

regulation mechanisms will become evident.[10] It is these situations, if not avoided, that make extremes in an arid area, especially in the summer, detrimental to livestock production.

The most important indicator of the extent of the climatic impact on an animal is its effect on the animal's performance. Taking cattle as an example (because they, more than any other animal, have been increasingly imported into the country from temperate zones) milk yields are relatively unaffected within the temperature range 0° - 21°C. However at a temperature lower than 5°C as well as from 21° - 27°C the yields decrease slowly; above 27°C the decline is much more marked.[11] Furthermore, the optimal environmental temperature for lactation is dependent on the species, breed and their inherent degree of tolerance to heat or cold. For example, the milk yield was observed to decline in Holstein cattle at 21°C, in Brown Swiss and Jersey at about 24°C - 27°C and in the Brahma (similar to the local Saudi Zebu) at 32°C.[12] For temperate cattle, it was suggested that the ideal environment is an air temperature of 13° - 18°C and a relative humidity of 60 - 70%,[13] a situation hardly existing in Saudi Arabia all year round. Yousef, M.K. et al have noted that the range of the thermo-neutral zone (environmental temperature range in which physiological parameters do not change) is approximately the same for Holstein, Jersey, Brown Swiss and Brahma. However, the critical high temperature is 27°C, 30°C, 28°C and 35°C for these breeds respectively.[14]

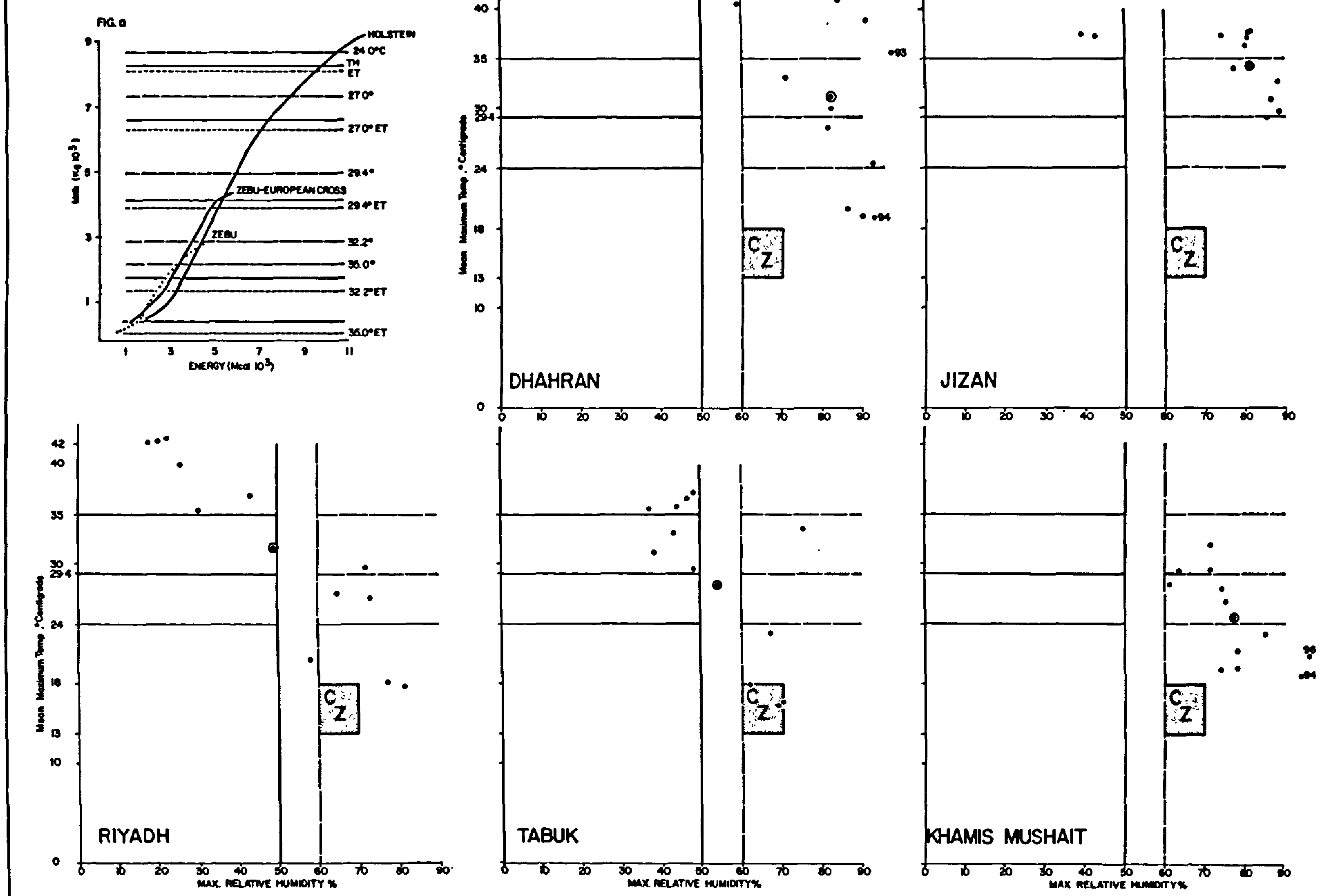
To compare these different critical conditions with that of Saudi Arabia, Figure 1-10 shows the climatic variation for six locations located in areas of different climatic conditions as compared to the critical values arrived at in Figure 1-10a, which illustrates the effects of

10. McDowell, R.E., op.cit.,p.77
11. Hafez, E.S.E. (ed.) Adaptation of domestic animals, p.75
12. Ibid.,p.75
13. McDowell, R.E., op.cit.,p.22
14. Yousef, M.K. et al., "Adaptation of cattle", Hafez (ed.), op.cit.,p.234

FIG. 1-10

THE MAXIMUM TEMPERATURE AND RELATIVE HUMIDITY IN 1972 FOR SIX LOCATIONS IN RELATION TO THE INFLUENCE OF THESE LEVELS AND THERMAL RADIATION ON ENERGY INTAKE AND MILK YIELDS OF THREE CATTLE BREEDS

SOURCE: Compiled from data collected from STATISTICAL YEAR BOOK 1973 and fig a was adapted from Mc Dowell



various levels of temperature, humidity and solar radiation on milk yields, and was adapted from McDowell.[15] The 24.0°, 29.4°, 32.2° and 35.0°C lines represent the expected depression in lactation yields at these temperatures when relative humidities are 50% or less. TH lines represent humidity of 60% or above at the five temperatures; the ET are the effective temperature lines and include an estimate of the additional impact of the average daily thermal radiation at the various temperature levels. The peaks of the curves represent the average milk yields of herds of 100 or more cattle of each type kept under conditions of good feeding and management.

What concerns this discussion is the effect on animals' performance when critical temperature, relative humidity and thermal radiation levels are reached in the different locations shown in Figure 1-10. As shown in Figure 1-10a the milk yield for Holsteins is depressed to 5,000 kg. at the 29.4°C line, and worsens down the curved yield line. However, at the 29.4° line the Zebu and crosses would not be seriously impaired except after the 29°C line in the case of the cross-breds and after the 32.2°C lines in the case of Zebu.

Comparing these results to the six locations in Figure 1-10, it can be seen that the maximum temperature and relative humidity for all these locations make the natural conditions in these areas unsuitable for temperate animals and particularly for Holsteins. For example, the coastal town of Dhahran has only three months of the year when temperatures do not reach 24.0°C and two months of the year below 29.4°C. At the other extreme, for five months of the year maximum temperatures may reach and exceed 35.0°C. With the exception of two months when the maximum relative humidity is less than 60% and more than 50%, the rest

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15. Based on the results arrived at by Missouri Univ., Lousiana Univ., and the U.S.A. Dept. of Agriculture. For more details see McDowell, R.E., op.cit., pp.114-117. Also McDowell, R.E. "Factors in Reducing the Adverse Effects of Climate on Animal Performance" in Shaw, R.H., (ed.) Ground level Climatology, (Washington D.C.; 1967), pp.277-291

of the year - ten months - has a relative humidity of more than 60%, even approaching 100%. In Jizan in every month of the year a maximum temperature of 29°C and over is reached, and seven months are over 35°C; with the exception of two months the humidity is extreme. Jeddah too is in a similar situation and in all of these coastal towns the average maximum temperature and relative humidity are over 29.4°C and over 60% respectively. The inland locations of Riyadh in the interior and Tabuk in the north have considerable variation. In the case of Riyadh, six months have a maximum temperature of over 35°C and the humidity for seven months is lower than 60%. Tabuk has four months of the year when maximum temperatures do not reach 24°C, four months when over 35°C, and seven months with a humidity of less than 60%. Khamis Mushait located in the Asir mountains has only three months when maximum temperatures reach 29.4°C and the humidity is generally higher.

The livestock response to these critical climatic conditions reached most of the year takes two forms. The first form concerns the local and national livestock types: camels, Zebu cattle, sheep and goats and their different breeds and varieties, that have existed in the country for centuries and have evolved a high degree of genetic and physiological adaptation. However, to reach this high degree of adaptation, another but undesirable adaptation has evolved relating to performance, resulting in a low capacity for production so as to cope with the harsh environment with its scarce resources and extreme climatic conditions.

The second type of response concerns the cattle imported from temperate zones: the European cattle. They do not find their ideal range under the natural conditions provided in most of the country throughout most of the year, especially in areas located outside both the western highlands and those areas affected by the Mediterranean climate in the north. However, these conditions are not prohibitive but only restrictive, and can be overcome to a certain extent by efficient management and protection: the ability of so many Jersey cattle raised successfully in the last fifteen years on research stations in different parts of the country testifies to this.

1.4 Water Resources

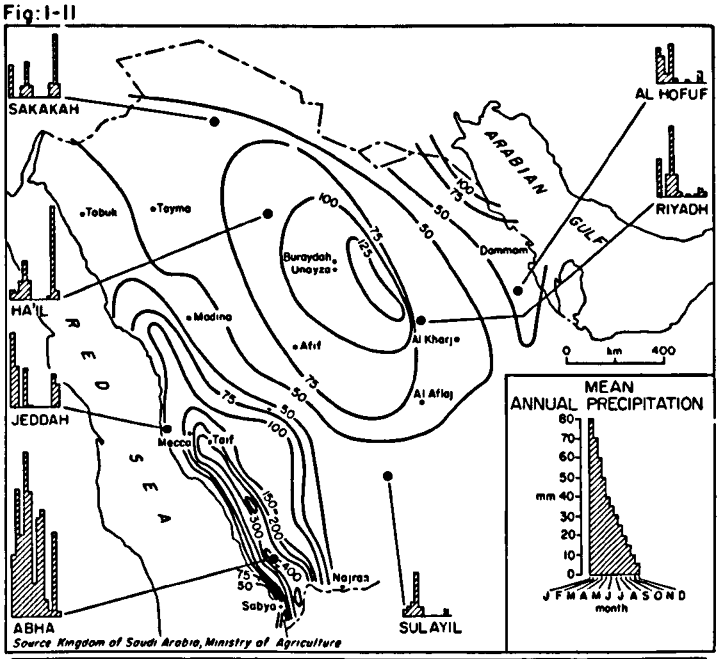
Saudi Arabia has an inadequate, unreliable rainfall, a high level of evaporation, and is the largest country in the world without a river. The country is forced to depend entirely upon two water sources. The first is the limited, irregular precipitation and its runoff; the second is underground water. These sources are intimately associated and are, to a certain degree, two phases of the hydraulic cycle.

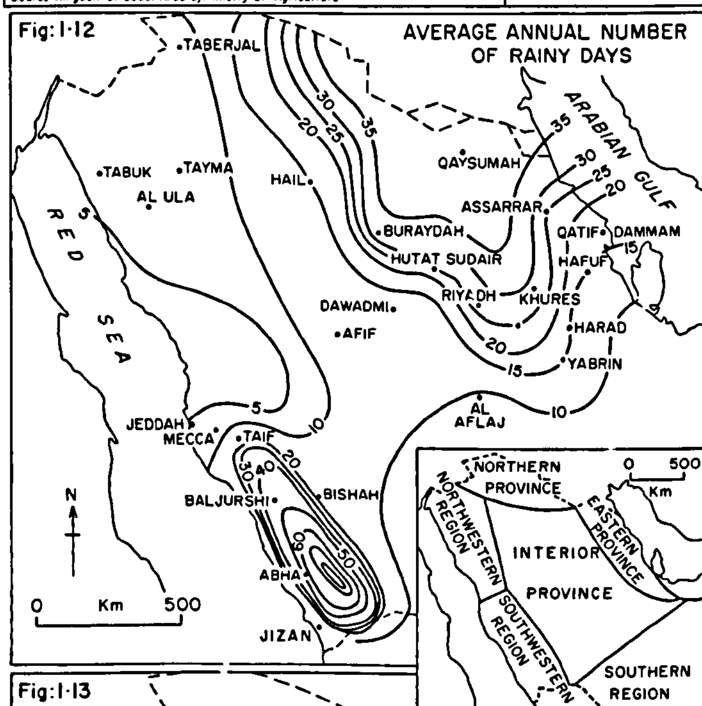
1.4.1 Precipitation

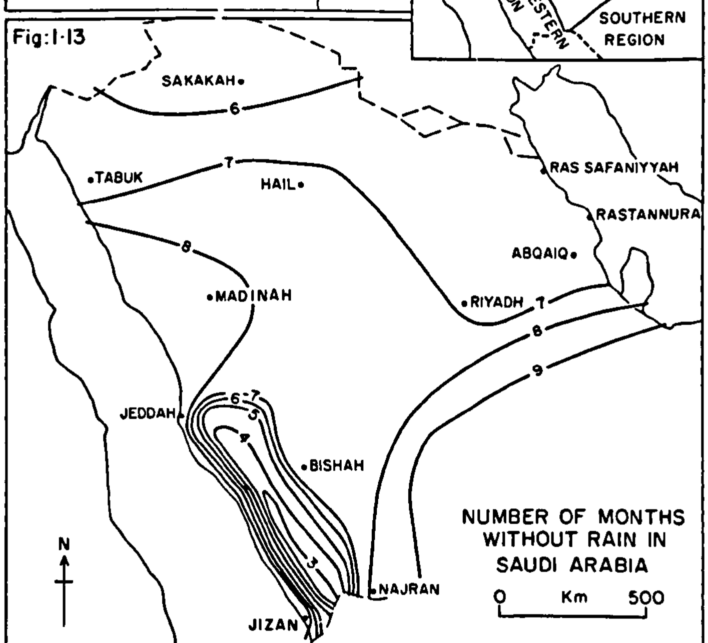
Results obtained from rainfall data recorded from 71 stations distributed over the arid regions of the country show that arid conditions persist over much of the country. Excluding the western highlands, the mean annual rainfall is 85.5 mm.[16] The data recorded from 30 stations indicate that the mountainous areas of Asir and Hijaz have a mean annual rainfall of 319.2 mm.[17] On the whole, rainfall over most of the country is confined to the cool months; the only exception is the western highlands which experience a monsoon rainfall regime. The period of October to April is the main rainy season in the country; though rainfall may occur in September and May, its effect is minimised by the high temperatures in these months. Analysing Figure 1-11, on the basis of the regions shown in Figure 1-12 we can see that the mean annual rainfall in the northern province is less than that of the rest of the arid part of the country. This can probably be attributed to the cyclonic depressions from the Mediterranean which lose most of their

16. al-Blehed, op.cit., p.108
17. Ibid.

Fig: I-11







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moisture when they move across the Palestinian and Jordanian escarpments before arriving in the area; also the tropical disturbances which invade the country from the south do not reach this area.[18] For the whole north-west the mean annual rainfall is normally 50 mm.or less. However, the mean annual rainfall over the high ranges of the mountains located in that area are thought to reach about 100 mm.,but since there are no stations in most of these areas this cannot be verified. Going from the northern areas towards the interior Najd, the mean annual rainfall starts increasing to 75-100 mm.and on the Tuwaiq Escarpment it increases up to 125 mm. This increase is the result of the increase in elevation, the intrusion of the tropical disturbances from the Arabian Sea during the cool season, and the influence of the Mediterranean depressions of the winter season. In the south-western region the mean annual rainfall ranges from 100-150 mm.on the Asir plateau to 400 mm.over the higher parts of the mountains of that area and on some stations may approach 700 mm.[19] In the eastern region rainfall is affected by its proximity to the Arabian Gulf where the rainfall decreases from the north towards the south, i.e. from 100-75 mm.in the north to 74-50 mm.in the south.

During the winter, precipitation occurs over a large area of the country and the percentage value of winter rainfall ranges from over 70% in Hofuf and at Nuriyah on the western and north western coast to less than 10% in some coastal areas on the western coasts at Jizan. On the whole the percentage value of winter precipitation decreases from north to south with the lowest percentage value being found in the Asir highlands, while the highest percentage normally exists in the Arabian Gulf area and in the north and north-west of the country.

During the spring season, March to May, rainfall decreases considerably in the lowlands while the western highlands receive an important

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18. Ibid.,p.115
19. Ibid.,pp.124-126

portion of their annual precipitation, amounting in some areas to 53% of the annual precipitation, as in Bisha, although it is less than 40% in most other stations.[20] Outside the highlands the spring precipitation decreases; in the north-west, in areas like al-Ula and Tabuk, an average of 24.5% and 27% of their annual precipitation respectively is received in this season. The percentage of spring precipitation increases in the interior as one moves in a southern direction, reaching as much as 66% of the annual precipitation in Riyadh, 55.2% in al-Kharj and 74% in al-Sulayyil. Such an increase can be attributed to the frequent domination of this area by the south-east monsoon and associated tropical disturbances during the spring.[21]

In the summer season there are no major changes over most of the country for a period of at least six months, and about 96% of the surface area is dry.[22] However, summer precipitation in the western highlands, particularly the southern part, is regular to the extent that some stations receive as much as 30% of their annual rainfall in this season.

With the exception of the western highlands the number of rainy days in the year is few. As shown in Figure 1-12 the number of rainy days reaches a maximum in the Asir and Hijaz mountains. Outside this region the number of rainy days decreases in every direction.

The irregular and limited precipitation all over Saudi Arabia, with the exception of the western highlands, creates a situation where aridity dominates most of the country, (Fig.1-13). Ninety seven per cent of the surface area of the country receives no precipitation of any form during at least half of the year. Therefore droughts, either seasonal or lasting a number of years, are common in Saudi Arabia, and are a direct result of the irregular and erratic rainfall. In 1965-1975 droughts wiped-out up to 35-37% of the aimal population in some parts

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20. Ibid., pp.124-126
21. Ibid., p.135
22. Ibid., p.137

of the south, and up to 40-65% in the eastern parts of the country. Moreover, the irregular precipitation in the country is characterised by a wide variation in occurrence and intensity. For example, in the interior part of the country the rainfall within one day may amount to or exceed the mean annual rainfall. Riyadh for most of 1970 received no measurable precipitation, but had a series of violent thunderstorms during one week in April 1970 with an accumulated rainfall of more than 50 mm.[23]

1.4.2 Rain and Runoff

Direct runoff occurs annually in the Asir-Jizan areas and irregularly in other parts of the country. Torrential floods occur only after heavy rains or storms. The short steep wadis in the south have more torrential floods than other parts of the country as a result of their high catchment areas in the mountainous regions.

Until recently most of the water needs of the nation were met by runoff that collected in wadi beds and on low land in the form of pools. This is still the only source of water for the mountains in the west and south-west. The inhabitants have developed a very intensive system of terraces to collect soil and store moisture for crop production, and pools for human consumption. Agricultural development in this area, in spite of its suitable environment, cannot be attained until major water controls are introduced. The ranges and grazing areas are the best in the country due to the availability of water most of the year.

Wadis in Saudi Arabia are dry for most of the year until a local thunderstorm fills their catchment areas with torrential runoff. Some wadis may flow once in a number of years (most of the internal wadis). Some flow once or several times a year, as in the south-west. The individual flow may last for hours, or a day, but very few last for a

23. Paseur, J.E., Soil and land classification, (Riyadh; MAW, Dec.1971),p.3

longer time.

The runoff of wadis constitutes the most important surface water for the coastal plains in the west. The annual flow varies from year to year. Wadi Jizan - a medium size wadi - had an estimated maximum flow of 129 million m^3 in 1954 and a minimum flow of 32 million m^3 in 1963.[24] In the south-west, large floods sweep out from the mountains damaging the fertile coastal plain and causing the loss of valuable and badly needed water to the sea.

Runoff and surface water never stayslong enough on the land surface, partly evaporating as a result of the high temperatures. The degree of evaporation varies from one area to another but generally evaporation is high and constitutes a major water waste. The evaporation for the Tihama area has been estimated to be between 6-9 mm. per day[25] and the potential evapotranspiration in the 1,500-3,000 mm. range.[26] Another part of the surface water infiltrates down to add to the underground reserve. Owing to high evaporation rates however this infiltration is (expected to be) small. Even some of this infiltrated water never reaches the groundwater level, but returns to the surface again by capillary action and evaporates.

1.4.3 Groundwater

Shallow groundwater

As shown in Figure 1-4, geologically the country consists of two principal parts, the sedimentary rocks in the east, and the Basement complex in the west. This is almost a natural division as far as water is concerned.

The Basement complex in the west has the poorest prospects of rich groundwater, because it is essentially impermeable. Limited groundwater

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24. Wadi Jizan Dept., Jizan
25. Heket, H., Groundwater Prospect in the Wadi Jizan Plain, (Riyadh; MAW, February 27, 1971), p.4
26. Burdon, D.J., and Otkun, G., "Hydro-Geological Control of Development", International Geological Congress, XXIII, Vol.12, (1969), p.147

is found only in alluvial infilling, in and around wadi beds and in small amounts below the coastal plains of the Red Sea. There is no continuity in water tables. The replenishment of this type of water depends upon yearly rain. A delay in the rainy season or a short drought can easily cause these supplies to be depleted.

For centuries, these limited sources of shallow groundwater in the Basement complex and over the country as a whole were able, most of the time, to keep up with the water needs of the people in that area, the reason being that the human, animal, and agricultural consumption of water was minimal. Agricultural practices were traditional, holdings were small, and the land was manually cultivated. Subsistence crops and domestic animals were thrifty water users. The economic breakthrough in the 1930's led to a sharp growth in urban centres and the necessity for irrigated agriculture which demanded more water. All the major towns that used to depend on these limited sources were faced with the problem of seeking either additional distant sources, deep groundwater, or desalinated water. The seaport of Jeddah (300,000) on the west coast has recently begun to supplement its water supply with desalted water. The capital of Saudi Arabia, Riyadh, which used to depend on the shallow and limited water of Wadi Hanifa for its water supply, now depends mainly on deep groundwater. The industrial oil cities in the east are dependent upon the recently discovered deep groundwater.

Deep Groundwater

The sedimentary basin of the country contains the most important water-bearing formations and is composed mainly of sandstone, limestone, shales, marls and alluvium (Fig.1-4). The deposits of this basin are divided into 28 formations, 20 of which contain varying quantities of groundwater. Recent surveys have proved that at least 9 of them, which cover very large areas, can be considered prolific aquifers.

The general movement of groundwater in the sedimentary formations is in the form of a down-dip to the east, bringing the greatest concentrations of water into the east where springs occur inland at al-Hasa, along the coast at Qatif, beneath the water of the Arabian Gulf and on the off-shore islands. Water quality deteriorates towards the east and the north, from a few hundred parts per million (PPM) to a high level or almost equivalent to that of sea water. Owing to high evaporation, most of these formations are either not recharged or the recharge is very small. If any recharge takes place, it probably occurs where flash runoff from intermittent storms reaches outcrops of the aquifer. The water stored in these formations may have entered during, or before, the pluvial period at the end of the Pleistocene Period. Radio-carbon analysis of water samples indicate that some of the water entered these formations a few thousand to 35,000 years ago,[27] depending upon its remoteness from the outcrop area. These waters are considered to be "non-cyclic"[28] because it would be unnatural for them to participate in the hydraulic cycle within a humanly significant span of time. Most of these waters are fossil waters which have been trapped from long-past periods of abundance and are no longer recharged by fresh supplies.

One of the most important formations is the Umm-er-Rudmah formation, which is considered to be the most prolific. It extends from the Iraqi border in the north, to the Rub'al-Khali in the south. The Wasia aquifer in the north eastern part of the country is rich, but development will be costly because the water is around 2,500 feet (762 m.)below ground level. In the sedimentary basin, a depth of 200-800 feet (61-244 m.) often yields flowing artesian water with a capacity of several thousand gallons (264,172 U.S. gallons = 1m^3). The south eastern part of the

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27. Burdon, D.J., and Otkun, G., op.cit., p.149
28. Chorley, R.J., (ed.) Geographical Hydrology, (London; Methuen & Co., 1971),p.8

country has similar aquifers. The deepest fresh water produced is in Turabah in the Sag formation in the north-west at a depth of 2,252 m. It yields 500 gallons per minute of free-flowing fresh water under 33 m. of pressure at a temperature of 145°F.[29]

The continuous and recent surveys all over the country affirm that the sedimentary zone has a substantial water reserve. It was estimated that, in the region of the great Nafud alone (covering 362,600 sq. km.,one sixth of the whole country), there is in the order of 20,000 cubic km.[30] Aramco studies have shown that Wasia contains more water than the Arabian Gulf.[31]

1.4.4 Water Desalination

In recent years considerable interest in the possibility of applying desalting technology to Saudi Arabia on a large scale has emerged as a counter measure to the unreliable and limited water sources. However, desalination on a small scale is not new. It has been used since 1940 to provide or supplement the water needs of some of the large coastal cities. The argument for desalination is a strong one, because the natural water supply is already short and the competition between human and industrial demands and those of agriculture is increased placing a strain on limited resources.

Lately, the government of Saudi Arabia has started a desalination programme comprised of short and long-range plans. The short-range plan is aimed at correcting the present imbalance in the water situation and supplementing the supply of water in deficient areas. It is assumed that this stage will deal with the urgent human and industrial needs, mainly to improve the quality of and to relieve the pressure on natural water resources. The long-range plan is more orientated towards the future

29. Mishari, H., (Minister of Agriculture and Water), "Towards full water utilization in Saudi Arabia", International Conference on water for Peace, (Washington D.C.; 1967),p.832
30. Otkun, G., Financial Times, (June 23, 1969), p.8
31. Aramco, Aramco Handbook, (Dhahran; Aramco, 1965),p.197

water needs. Research into cost reduction, the efficiency of desalting processes, and water conveyance are the main targets for investment. For the present, the emphasis is on meeting the emergency requirements for water-deficient areas. For this reason six desalination plants are being constructed or planned. The two largest are at Jeddah, on the Red Sea coast, and al-Khober on the Arabian Gulf.

Today desalination technology is mainly used to supply water for domestic and industrial use. It is these uses that have an economical value large enough to pay for its high cost (.65 cents (U.S.) per 1,000 gallons or 3.79 m^3).[32] However, desalination is considered to be too costly for large scale commercial agriculture.[33] Thus as far as the predictable future is concerned, and whatever the advances in desalination technology are, sea water is not expected to be as economical as rainfall, diverted runoff, or easily accessible groundwater. However, progress in the technology of desalination is advantageous to agriculture because if some of the water requirements of large population centres is satisfied by desalination, then the pressure on the already scarce natural water reservoirs can be relaxed, and this would add that amount of water to the stock which is available for agriculture.

1.5 The effect of the limited water resources on livestock development

As has been shown earlier, water resources are limited because precipitation is irregular, scarce and unpredictable over most of the country. Sizable ground resources are only available in the sedimentary parts of the country while the western parts are dependant on runoff and shallow ground resources. The third alternative is desalinated sea water which is still in its early stages. Moreover water from ground resources has a cost that reflects the two inherent characteristics of groundwater in the country. One is the variation in the regional depth of groundwater,

32. Periera, H.C., Land Use and Water Resources, (Cambridge; University Press, 1973), p.16
33. Fried, J.J., and Edlund, M.C., Desalting Technology for Middle Eastern Agriculture, (New York; 1971), p.7

hence sizable drilling, operating, and maintenance costs. The second is the eventual exhaustion of fossil water as an economic proposition. Considering only these two characteristics it can be seen that water is costly. It was estimated that water from a flowing well of average depth (400 m.) costs about 10 cents (U.S.) per m^3.[34]

The logical consequence of the limited and costly water resources is the efficient and conservative use of these resources. However, the opposite is taking place. Irrigation methods used by farmers rely on over-irrigation. For example, in al-Hasa Oasis specialists complain bitterly that plants and soils are receiving more water than they need, hence showing problems caused by over-irrigation. In many parts of the country new and costly deep wells are left discharging fossil water for inefficient uses. Systems of irrigation all over the country, both traditional and modern, rely on open canals and flooding, hence evaporation in many areas in the summer reaches over 35-40%.

The limited water resources have had a profound and adverse effect on livestock production through either direct control of or influence over the type of land uses and quality and quantity of ranges. The present area of the national arable land is 0.24% of the national land of around 220 million hectares. Permanent grassland is only 0.77% and forest is 1.26%; the rest of the land mass of the country, almost 97.7%, is desert ranges. The competition for the use of the cultivable land is fierce between crop and livestock farming, and livestock must become competitive to deserve the use of these limited valuable lands. But this is not presently the case as will be elaborated in later chapters. These ranges, although extensive in size, are seasonal in character, have sparse vegetation, and the fluctuation in quality from one season to another is considerable.

34. Burdon, D.J., and Otkun, G., op.cit., p.152

CHAPTER TWO

al-BADIAH SOCIETY

2.1 The Impact of Environment on Arabian Society

The magnitude of the role of the physical environment in moulding societies and their cultural make-up is still a debatable issue. Nevertheless there is a general agreement among anthropologists and geographers that the environment is one of the influential factors.[1] Certainly the physical-biotic environment alone does not produce a culture, nor can it explain all the variations in cultural make-up between different regions. However, the physical environment, especially in an arid area like Arabia, has intrinsic limitations to which man has to adapt in order to exist.

In Arabia, the arid environment powerfully affected the very survival of man. In order to survive he had to establish a workable socio-ecological formula within nature's limitations. The meagre water resources determined a special kind of land use and imposed a general limitation on the number of people who could be supported permanently in this region. Water is the main factor in determining the spatial pattern of human settlement and so the mode of living, to such an extent that Krader defined the cultures of the arid zones as "those which have traditional means of coping with the problems of water shortage".[2]

2.1.1 al-Hadher versus al-Badiah

Traditionally, wherever water sources were available permanent settlements took place; if not, then pastoralism established itself as the only alternative way of life. Settled areas are rural, small and unevenly distributed all over the country. The only exceptions are the two towns of Mecca and Madina, whose urban character came as the result

1. Forde, D., Habitat, Economy and Society, (London; Methuen & Co., 1970), p.3. James, P.E., Geography of Man, (Boston; Ginn, 1959), p.25. Spencer, J.,and Thomas, E., Introducing Cultural Geography, (New York; Wiley, 1973), p.17
2. Krader, L., "Social Life in the Arid Zones" in Hills, E.S., (ed.) Arid Lands, (London; Methuen & Co.,1957),p.414

of their being the main centres of Islam. Apart from these two relatively large towns, the country was until recently largely made up of two distinctive types of community: one consisted of al-Hadher or settled communities comprising mainly cultivators, and settled in oases. Compared to the desert, oases constitute green colonies surrounded by arid desert; their frontiers are clearly marked by their isolation as green islands. The second community was the al-Badiah who belong to a specific group (tribe) and not to a specific settlement. The dominance of this classification is a distinctive feature of traditional Arabian society[3], differentiating it from the societies of other Middle Eastern countries, whose socio-structure has long consisted of an "ecological trilogy"[4] of three equally strong types of community: city, village, and Badiah.

Historically, al-Hadher and al-Badiah were geographically separate, culturally different, political rivals, but economically inter-dependent. The oases produce food stuffs; al-Badiah produce livestock. These two specialized economies have always shaped the common destiny of the two communities and provided the means of exchange between them.

al-Badiah has always been, and still is, the back-bone of the livestock industry in the country. Its past contribution to livestock is a classical instance of human ingenuity in making a living in spite of a harsh environment. Nevertheless, its present contributions have shrunk as a result of the violent changes that are taking place within and outside this institution. The focus of this chapter will be on its present character, and the changes that are taking place within this institution; and, most important of all, the impact of these changes on the livestock sector.

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3. This classification is a traditional one used by the Arab geographer Ibn Battuba, and is referred to among others by W.B.Fisher, Middle East, (London; Methuen & Co., 1971), p.130
4. English, W.P., "Urbanites, Peasants and Nomads", The Journal of Geography, Vol.66, (Feb. 1967), p.54

2.1.2 al-Badiah versus Nomadism

The word nomadism is used by a great many writers to denote the global pastoral societies that extend from Northern Africa, eastward through Arabia, Turkey and Southern European Russia, all the way to the Gabbi region of Mongolia and Western China. Nomadism is a general and loose term because the extent and characteristics of this way of life vary so greatly from region to region that the term in fact describes different societies in different countries. What nomadism is supposed to represent in the case of Arabia is the well-known society of al-Badiah. Thus al-Badiah or al-Badu (sing. badawi) or their derivatives will be used in this thesis, rather than the words nomadism or nomads which will only be used in a global context. The term al-Badiah is derived from the desert name in Arabic, Sahra or Badiah (al or el stands for "the" in English). Bedwin is a corrupt English version of the word Badawi. Badawin and Bedwan are colloquial plurals of a Badawi.

2.2 al-Badiah

There is little agreement on the definition of a "Bedwin"; Glubb defined Bedwins as "pure desert dwellers alone and therefore, the breeders of camels",[5] thus excluding the great number of Bedwins who roam the desert herding sheep. This definition entertains the thought that if camels go, al-Badiah will also go. Arbos stressed "an entire human group accompanies the flocks and herds in their migration"[6] as a social characteristic of nomadism. Peppelenbosch[7] considered tribal dirah or territory an important criterion of al-Badiah. The weakness in these definitions is that they are based on cultural traits, while cultural traits change or evolve into something else. The dirah, the type of

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5. Glubb, J.B., "The Bedouins and their Influence in History", written for the 1967-8 postgraduate course on Middle East Studies at Harvard University, U.S.A., Sept.1967, p.2
6. Arbos, P., "The Geography of Pastoral Life", The Geographical Review, Vol.13, (1923), p.559
7. Peppelenbosch, P.G.N., "Nomadism on the Arabian Peninsula : A General Appraisal", Tijdschrift Voor Econ. en Soc. Geografie, (Nov./Dec.1968), p.339

animal or the movement accompanying herds are all cultural characteristics modified and changed by time. The most appropriate definition for al-Badawi is one derived from the most stable element in al-Badiah institutions: the use of ranges. Hence the most apt definition of Bedwins is that they are pastoralists who utilize desert ranges to feed their animals.

al-Badiah in Arabia is a well established society with so specialized a culture that Hiti stated, "The Bedwin is no gipsy roaming aimlessly...he represents the best adaptation to desert conditions... Nomadism is as much a scientific mode of living as industrialism is in Detroit or Manchester. It is a reasonable and stoic adjustment to an unfriendly environment".[8] Hiti's phrase "a scientific mode of living" should be interpreted as referring to the Bedwins' ability to attain self-sufficiency in coping with the environmental limitations. Bedwin technology has evolved for centuries and provided al-Badiah with the means to adjust and adapt to the harsh arid environmental conditions. On the other hand this technology has never been scientific or sophisticated enough either to free the Bedwins from environmental limitations or to provide them with the means of modifying some of these limitations.

al-Badiah livelihood is founded upon livestock, livestock products and by-products. Animal husbandry constitutes the principal land use, the leading source of income, the main occupation, and also provides the staple diet apart from dates and grain. Camels, sheep and goats are the animals that are kept by al-Badiah. Socio-politically the kinship-based ethnic society usually called the "tribe" is the prevailing political unit. The main social organisation is patriarchal, "semi-autocratic and semi-democratic",[9] and local in character. Therefore the unification

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8. Hiti, P.K., Short History of the Arabs, (London; Macmillan, 1948), p.7
9. Patani, R., "Middle East as a Culture Area" in Lutfiyya, A.M., and Churchill, C.W., (eds.),Readings in Arab Middle East Societies and Cultures, (Hague; Mouton, 1970), p.197

of tribes into a more closely organised unit or nation was, until recently, a rare occurrence. The only unifications that have ever materialized were in the early days of the Islamic empire, and the more recent establishment of the Kingdom of Saudi Arabia in the 1930's.

2.2.1 The Origin of al-Badiah

al-Badiah in Arabia should be viewed as a transitional human institution; in the sense that it is a temporary human occupational bridge designed to cope with nature's limitations. Historically, al-Badiah evolved where permanent settlement was impossible; whenever a permanent source of water existed, sedentary society appeared. The highly dense and intensely cultivated oases all over the country throughout history can testify to this. For example, the old oasis of al-Hasa has a density of 2,290 persons per sq.mi.[10]

There are several theories about the origin of nomadism as a global phenomenon. The most popular is the theory of Hahn.[11] According to Hahn, pastoral nomadism is a relatively late off-shoot from plough farming in south-west Asia. In the case of Arabia, this theory has been widely supported, and al-Badiah has been accepted as a socio-ecological state evolved in a long, slow cycle process which started in the south-western part of Arabia.[12]

The water resources of south-western Arabia had provided a hospitable habitat for the permanent settlement of man. For obvious climatic reasons cultivated land could not be extended; there were no other sources of livelihood to absorb the surplus of the natural growth of humans in the area. This situation led to the natural or forceful ex-

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10. Calculated from Vidal who estimates that al-Hasa Oasis has 160,000 inhabitants and an area of 70 sq.mi. Vidal, F.S., "Date Culture in the Oasis of al-Hasa", in Ibid., p.206.
11. Sauer, C.O., Agricultural Origins and Dispersals, (The American Geographical Society, 1952), p.84
12. This theory is supported by Bevoist-McChium, J., Arabian Destiny, Translated from the French by Denis Weaver (London; Elek Books, 1957), p.5. Lawrence, T.E., Seven Pillars of Wisdom, (London;1935), Brice, W.C., South-West Asia, (London; University of London Press, LTD.,1966),p.76

pelling of the human surplus towards the bordering desert. Fresh groups were continually pushed out towards the interior desert. With time, the life of these people had to adapt to the desert; they thus became Bedwin and adopted pastoralism as their main land-use system.

The continuous struggle among sedentary people in the south-west to expel the surplus population toward the desert, the struggle among people in the desert for pasture, and the struggle with nature's limitations led to further continuous moves northward to the "Fertile Crescent" (Iraq, Syria, Palestine, and Lebanon). The relative abundance of water and the possibility of cultivation in this area persuaded some Bedwins to take up farming in the region. "Opportunities and their bellies persuaded them of the advantage of possessing goats and then sheep, and lastly they began to sow, if only a little for their animals. They were now no longer Bedwins...and found out that they too were peasants".[13] "Not a family is established in the north whose ancestors did not cross central Arabia at some moment of history".[14] The whole process within this cycle may have taken centuries. It was maintained by raids, natural disasters and droughts, feuds, alliances, conquests and the possibility of finding a suitable habitat.

The major event that accelerated the cycle was the migration toward the north-east and west of the peninsula that accompanied the expansion of Islam. This started in the seventh century and eventually absorbed the great rival empires of Byzantium and Persia. In this period and later, a great migration of Bedwin tribes from the peninsula proper continued towards these newly conquered lands. The exotic rivers and the great riches of these lands fostered a kind of life never imagined by a Bedwin. Great numbers of Bedwins, whether soldiers in the conquering

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13. Lawrence, T.E., op.cit., p.34
14. Bevoist-McChium, J., op.cit., p.8

army or later arrivals, could not resist this opportunity, hence settled in these new lands. There were many tribes who had once been known in the peninsula and then migrated totally to the new lands. One of these tribes was Baker Ben Wueil, whose territory was located between the central area and the Arabian Gulf; most of them migrated to Iraq and Turkey. There were many other tribes who took the same course. All Iraqi Arab tribes have migrated to Iraq from Arabia,[15] and Makarios has pointed out that some Bedwins migrated as far as Russia.[16]

With the exception of some of the inhabitants of the holy cities, Mecca and Madina, and the new immigrants from neighbouring countries, most of the settled population in Saudi Arabia can in varying degrees trace their Bedwin ancestry. At present the vast majority of the largely sedentary population in Saudi Arabia, probably no less than 80%, belong to one or other of the many formerly Bedwin tribes, which number about 100.[17]

Some tribes who were known to be nomads have settled completely to practise cultivation. For instance, one of these tribes is the Tamem, and their territory used to be located in the eastern and central part of the country. However, they have now become totally settled and have abandoned the Bedwin way of life.[18]

Therefore, it should be stressed that nomadism is not and never was an end in itself, but that it is a transitional stage to permanent settlement. It is a state of waiting to be settled somewhere, sometime. For a Bedwin, al-Badiah is best as long as life can offer nothing better. But as soon as the harsh natural causes are modified the tendency towards settlement starts to develop gradually. The process out of al-Badiah, and towards sedentarization,in early times was slow. It may take centuries and

15. el-Jamil, Makki, Bedwins and Wandering Tribes of Iraq, (Arabic), (Baghdad; al-Rabita Press, 1956), p.10
16. A speech by S.A.Makarios quoted in al-Moqtadaf,(Arabic), Dec.1884,p.39
17. Awad, M., "Nomadism in the Arab Lands of the Middle East", in The Problems of the Arid Zones, Proceedings of the Paris Symposium, (UNESCO, 1962), p.326
18. Ibid.

it does not happen abruptly. However the active movement toward a more sedentary life has been a characteristic of the last 100 years.

2.2.2 Classification of al-Badiah

Classification of the global phenomenon of nomadism has been attempted. However, due to the fact that nomadism is a widespread feature and differs from one area to another, these attempts have failed to produce a reasonable standardized classification. The most used classifications are nomadism and semi-nomadism. Semi-nomadism is defined differently by different authorities. Generally this expression is supposed to refer to the state of an ex-nomad who has lost some, but not all, of the basic traits of nomadism. It applies in the case of Arabia to the ex-Bedwin who no longer has pastoralism as his main occupation yet has not acquired the main features of a settler. The term has also been used interchangeably with "semi-settlers" who are not true settlers, but are far from being "pastoralists".

Semi-nomadism or the semi-Bedwin condition is a stage in the social process by which Bedwins evolve a sedentary mode of life. Theoretically it denotes the gulf or the gap that exists between al-Badiah in its truest state and sedentary cultures. In this case, semi-Bedwin fills this gap on a graded scale. al-Badiah and sedentary societies are located at the two opposite ends of this imaginary scale. The distance of a selected group of people from any one of these two ends will point to the degree to which they are semi-Bedwin or semi-settlers. Therefore, the semi-Bedwin is a transitional state connecting the two societies, al-Badiah and sedentary. Moreover, these two cultural systems, in spite of the great differences they have, are not two opposite forms of society, but are stages in the sequential order of the social development of man in Arabia.

Another criterion for classification is based upon the types of animal reared. One group is Abel-el-Ibel (camel herders) whose main activity is camel herding. The other class is the shawiyah (sig. shawi) or the sheep herders. These two types of al-Badiah are so pronounced as to be mentioned by recent observers like Sir John Glubb[19] and H.R.P. Dickson.[20] Such grouping still exists and is based on land use rather than tribal or genealogical considerations. This division has been disputed by a contemporary writer, el-Farra, who has stated that "the nature of sheep and camels and the nature of the grazing grounds can be considered minor issues in the division of the Bedwins". This author stresses that "[a] division of society into camel herders and sheep herders because of difference in available feeds is refuted insofar as it applies to Saudi Arabia". Such an opinion must have been based on the writer's own observations: "At present, camels and sheep graze side by side in different parts of Saudi Arabia".[21] Certainly they do graze side by side in some parts, but not everywhere. The present writer, in his tour of areas on the fringe of the Empty Quarters and in the northern deserts, observed that specialization in camels is the rule rather than the exception. It is only in areas close to water sources that sheep are maintained side by side with camels. This distinction is based on animal land use and is a common phenomenon. The analysis of animal population (Chapter 5) confirmssuch a distinction, which has evolved as a result of three major factors.

(1) The camel's ability to endure long travel with little or no water, and hence their access to areas that sheep cannot reach.

(2) The sheep's short reproduction cycle, which necessitates easy access to the market.

(3) The sheep's grazing preference for tender shrubs, while camels can

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19. Glubb, J.B., War in the Desert, (New York; W.W.Norton & Co.,1960), p.33
20. Dickson, H.R.P., The Arab of the Desert, (London; George Allen & Unwin, 1949), Fifth Impression 1972, pp.109-111
21. el-Farra, T.O., The Effects of Detribalizing the Bedwins on the Internal Cohesion of an Emerging State, The Kingdom of Saudi Arabia, (Univ. of Pittsburgh, Ph.D., 1973), p.55

survive on browsing and harsher shrubs. Therefore camels can utilize the outer parts of the deserts and sheep the inner areas that are close to settled areas. In fact the author believes that a balanced livestock development necessitates the preservation and more intensive delimitation of this division, and the elimination of the greater part of the over-lapping that is taking place in areas where sheep and camels are grazing side by side (Chapter 6).

2.2.3 al-Badiah Population

The size of the population of Bedwin in Saudi Arabia has never been officially established. Different tentative estimates have been given by different authorities (Table 2-1). The variation in these estimates is the inevitable outcome of the following major causes:

First, a national census for Saudi Arabia has never been officially finalized. There are various estimates, made by different authorities, that have been widely quoted since the founding of the Kingdom of Saudi Arabia in 1932. The most reliable is the semi-official census of 1962-63[22] which estimated the population at 3.3 million. However, this estimate was considered to be an under-estimate, and was revised in 1964 to 4.6 millions.[23] Neither the results of this census nor the 1965-66 demographic sample survey have been officially published in detail. Moreover the latest national census of 1974 has not yet been published either. However, it was quoted by some reliable sources as recording a population of around 5 million.[24]

Second, al-Badiah is an ephemeral social institution. It has been changing in the last one hundred years, and more rapidly in the last 40 years, towards a more sedentary character.

Third, the difficulty of drawing a clear line between a Bedwin

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22. Ministry of Finance, Survey of Population, Building and Establishments, unpublished report, (Riyadh; 1963)
23. Kingdom of Saudi Arabia, CPO, Economic Report, unpublished report (1388-89)
24. "Why the Experts went wrong", Newsweek, March 3, 1975, p.32

Table 2-1

Various Estimates for the Bedwin Population

in Saudi Arabia

Estimates	Year	Source	
3,000,000	1938	F. Hamza	a
50-60% of the population	1959	A.Helaise	b
250,000	1962	M.Awad	c
694,013	1962	1962/63 Census	d
200,000-300,000	1966	Handbook for Saudi Arabia	e
1,000,000	1967	P.G.N. Peppelenbosch	f
423,000	1967-1970	The Resource Surveys	g
1,000,000	1969	Faisal Bashir	h
350,000-750,000	1971	W.B.Fisher	i

Sources:

(a) Table 2-2
(b) Helaise, A., "The Bedwin and Tribal Life in Saudi Arabia" Int. Soc. Sci., Vol. 11,(1959),p.532
(c) Awad, M., op.cit.,(1962),p.326
(d) Table 2-3
(e) Walpole, N.C., et al., Area Handbook of Saudi Arabia, (Washington; 1966), p.20
(f) Peppelenbosch, P.G.N., op.cit., (1968), p.340
(g) Table 2-4
(h) Bashir, Faisal, The Case of Nomadism : to settle or not to settle, prepared for the government of Saudi Arabia, (Riyadh; 1969), p.3
(i) Fisher, W.B., op.cit., (1971), p.326

and a semi-Bedwin is a main contributing cause for this divergence in the estimates. No definitions of the difference between these two have as yet gained general acceptance. Some authorities employ a liberal definition of al-Badiah to include some semi-Bedwin. Others are more conservative, and hence produce smaller estimates.

In spite of these inconsistencies, three semi-official estimates for al-Badiah are considered reasonably informative. The first estimate was made in 1932 (Table 2-2) and gave the number of Bedwin as 3 million, whereas the number of settlers was 2,300,000. At this period it was clear that al-Badiah were the predominant community - as high as 58.7 of the total population.

Table 2-2

The National Population Estimate for Saudi Arabia in 1932

Political Region	Bedwins	Settlers
Hijaz	700,000	400,000
Asir	250,000	650,000
Tihana	200,000	10,000
Najd	1,300,000	800,000
al-Hasa	200,000	100,000
Other areas	350,000	150,000
Total	3,000,000	2,110,000

Source: Hamza, F., The Heart of Arabia, (1933), p.78

The 1962-63 semi-official census estimated Bedwins as around 694,013 or 21% of the population of approximately 3,303,330 million (Table 2-3). According to this estimate 40% (272,033) of this nomadic population was concentrated in and around urban and rural areas, hence they would be considered semi-Bedwins. The rest (421,980) are found around water holes all over the country.

The third estimate was made in 1965-70 as a part of the "Water and Agricultural Resources Survey" by the Ministry of Agriculture (Table 2-4).

Table 2-3

The National Population Estimate for Saudi Arabia 1962/63

Size of Group[1]	No. of places	Total	Population settled	Nomads
20,000 & over	11	830,086	828,503	1,583
10,000-19,999	11	139,730	119,870	19,860
5,000-9,999	23	153,774	146,039	7,735
2,000-4,999	100	298,374	249,549	48,825
1,000-1,999	201	271,405	227,534	43,871
500-999	495	339,023	277,194	61,829
less than 500	5,274	847,958	759,628	88,330
Total cities & villages	6,115	2,880,350	2,608,317	272,033
Water holes	2,090	421,980	-	421,980
TOTAL	8,205	3,302,330	2,608,317	694,013

(1) Towns and villages

Source: Ministry of Finance, Statistics Departments, Survey of Population, Building and Establishment (1962/63) unpublished report (Riyadh; 1964)

Table 2-4

The National Population Estimates by Resource Survey for most of the country 1967-70

Area Number	In 000 sq.miles	Population 000	Pastoralists 000
I	229,770	400	150
II & III	140,340	687	153
IV	65,205	167	none
V	224,802	270	120
VI	120,474	1,216	none
Total	780,591	2,740	423
VII	397,440	-	-
VIII	173,880	-	-

Source: Summarised from Dr.L.A.Brown, Report to the Minister of Agriculture, unpublished report, (MAW; 1971)

Its major disadvantage is that it did not cover the whole country. However this estimate gives an indication of the present pattern of al-Badiah distribution. Area four in this survey is the main part of the central province called Najd. This province is considered (by recent writers)[23] as an area with a sizable number of Bedwins. However, the survey declared it to have almost no Bedwin population. This contradiction may be explained by the fact that urban settlement has been extensive in the last few years; and the recent droughts of the 1960s have also made it difficult for al-Badiah to exist in that area.

These estimates confirm that in the last 40 years the decline of al-Badiah has been substantial, the proportion of Bedwin dropping from 58% in 1932 to 21% in 1962 and 15% in 1966-67. Moreover it is expected to be lower in the 1970's, because it was estimated that the annual decline in the al-Badiah population is over 2%.[24] In the light of these estimates, <u>the historical reputation of Arabia as the home and "reservoir" of al-Badiah and reference to the Bedwin as the dominant society in Arabia is truly out-dated and should be modified.</u>

2.3 The Process of Bedwin Settlement

The continuous decline in the Bedwin population has been induced by the recent and most intense active exodus towards settlement the country has ever experienced in its history. The move towards settlement has been of two types, induced and spontaneous.

2.3.1 Induced Settlement

"Induced" here refers to the official government policy of encouraging Bedwin to settle. It involves the "detribalization"[25] of the Bedwin tribes. Implementation of the policy began with a colony-type settlement called al-Hijar, started as early as 1912.

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23. Peppelenbosch, P.G.N., op.cit., p.340.
24. Calculated from Central Dept., of Statistics, Ministry of Finance, by Ital Consult, Socio-Economic Development for the Western Region, Part 3, (Rome; 1964), p.14
25. A term used by el-Farra, T.O., op.cit.

al-Hijars

The al-Hijras (in Arabic, settlements of people who have abandoned the state of al-Badiah for the state of sedentary life) idea was mainly a political one, aimed at breaking down Bedwin individualism and tribal alliances,and finally ending the tribe's archaic particularism. King Abdulaziz Ibn Saud (born in Riyadh, December 1880, and died in 1953), the founder of Saudi Arabia, was the man behind these colonies and he hoped to transform a large part of al-Badiah into a settled society. al-Hijar settlements were Ibn Saud's means to this end and were based on the normal village economy, which was mainly agricultural. Each settlement has its own name and tribal group. About seventy colonies, with a population of 2,000 to 10,000 each, sprang up between 1912 and 1927. Some of these colonies have become centres of trade. Artawiyah, which was the first colony, became in 1927 the biggest and most flourishing settlement, an important grain centre in the Dahna desert.[26] The population of this colony was estimated to be 12,000 in 1939.[27] By 1932 there were about 200 Hijars,[28] mainly in the central part of the country. The population of these colonies was estimated to be 250,000 to 300,000 in 1932.[29]

The al-Hijar project was the first of its kind in the Middle East; it was a genuinely native idea and was based on the local needs and social requirements of al-Badiah in the country, in the sense that it aimed to create a new brand of settlement that facilitated combinations of social, economic, religious and military objectives.

Socially, the main objective was to stabilize the Bedwin by inducing them to accept a sedentary way of life. It was believed that such a change would make an end to their feuds, over the control of

26. Rihani, A., Ibn Sa'oud of Arabia His People and His Land, (London; Constable & Co., 1928),p.193
27. Frood, McKie, "Recent Economic and Social Development in Saudi Arabia", Geography, Vol. 24, (1939), p.162
28. Hamza, F., The Heart of Arabia, (Arabic), (Mecca; Salafia Press,1933), p.87
29. Ibid., p.87

ranges, water points, and other tribal conflicts. Politically, in addition to the strategic importance of fixing the Bedwins to the soil, their colonies would provide the nucleus of a permanent army that could be called upon at any time. Religion was the basic moral force behind this type of settlement. These settlements became religious centres and a means of teaching true Islam to al-Badiah.

Inasmuch as the al-Hijar project has done a lot for the stability of the country, it has also encouraged the decline of al-Badiah and animal numbers have decreased, especially the number of camels, because some tribes embraced the idea of settlement so readily at that time that they:

> Sold their livestock and settled on the soil. The selling of the camels was first encouraged, nay ordered, because it argued against the nomadic life and helped to make converts for a religion and a roof.[30]

Nevertheless, the government later realized that such a move would deprive the country of its valuable livestock, so a religious campaign was organized to reverse this trend.

Compared to recent costly projects, the investment in these colonies was minimal: the main prerequisites were shallow wells and volunteers. The government, which was at that time in a poor economic state, gave them little money and discouraged other Bedwins from joining merely for the sake of profit. Experienced villagers were brought to the colonies to teach Bedwins to till the land. The water and land rights were shared among them and the state helped to build the mosque and some brick houses.

After the success of the government in stabilizing and uniting the country in the 1930's, the enthusiasm towards al-Hijar cooled down due mainly to the fact that the political need for them as the nucleus of of a permanent army had declined and they were later replaced in this

30. Rihani, A., op.cit., p.195

role by the regular army. Also some of these colonies were located in areas that lack permanent water sources. Some vanished, others stagnated, but a large number grew to become major cities or large villages. This settlement project was not the last.

Wadi Sirhan Settlement

Droughts in the 1950's revived the idea for settling the affected Bedwin in the northern part of the Kingdom. In 1959 a settlement project was started in Wadi Sirhan (an enlarged low basin extending 300 km. from the Saudi-Jordanian border to a point about 60 km.west of Sakakah. It extends from N.W. to S.E. and ranges up to 50 km.in width. The project was temporary and aimed at activating the settlement of Bedwin tribes in Wadi Sirhan. The government had by 1962 spent more than SR 6,000,000, and more money still was spent on large administration buildings which are now completely abandoned (Plate 2-1). The project was not successful, and its administration and planning were blamed for that. The consulting company who evaluated the project later stated:

> Resettlement of Bedwins in the Wadi Sirhan by the government has been of questionable success, these people have seen little if any advantage in becoming subsistence land holders, some have settled merely to benefit from the money subsidy provided.[31]

The project was not successful in attaining its settlement's objectives. However, the Bedwin attitude as observed by the author is positive to the idea of farming, indeed they liked the idea and thought that farming was a good business. One of the main reasons for the failure of the project was the lack of a better and more elaborate extension and planning organization. In most cases these new Bedwin farmers made their own decisions in selecting the land, seeds and the system of irrigation, and usually these decisions were the wrong ones. In December 1974 the author visited the area almost 15 years after the project started; un-

31. Parson Basil/Consultant, An Emergency Area Report for the Qasim, Wadi As Sirhan, Al Jawf and Sakakah, prepared from the Ministry of Agriculture and Water, (Riyadh; 1966), p.35

Plate 2-1 Abandoned buildings in Wadi Sirhan Project in Taparjal. For lack of planning, large investments in recent settlement projects have produced few benefits and have resulted in a waste of costly facilities.

Plate 2-2 An adequately-maintained Bedwin farm in Wadi Sirhan area.

expectedly he found that the idea of farming is still being pursued enthusiastically by the Bedwins with very little governmental guidance. They are mostly on their own and have little use or benefit from the agricultural extensions in Sakakah, 400 km.S.E. The fact that farming lasted that long clearly indicates that the desire to farm is there. However, very few have managed to develop relatively modern farms like that in Plate 2-2, and most of them are still putting up with what could be called elementary, transitional, Bedwin farming. Primitive and basic in character, it is nevertheless not largely subsistence in nature. They cultivate garden vegetables and dates mostly for the market. Their farming infra-structure and layout is inefficient and backward, (Plate 2-3), trial and error is their main guide. Some farmers around Sakakah enthusiastically started rice cultivation in a few areas, relying on governmental offices for loans to purchase rice-processing machinery, and knowing little if anything of the complicated technology involved. It is worth pointing out that northern Bedwins displayed more positive and practical attitudes towards farming than the ones seen by the author in the south who did not have so strong a desire for agricultural settlements.

Faisal Settlement Project

The most modern concept of settlement was introduced in the form of a large irrigation project: the "King Faisal Settlement Project" at Haradh. The project's initial costs were more than SR 170,000,000 and it was supposed to reclaim 4,000 hectares with 50 electrical pumped deep wells. The project was ready for inauguration in 1970, but it was then realised that Bedwin settlements were not possible. The reasons for this change of plan were many (Chapter 3). The most obvious one was the fact that a socio-economic study of al-Badiah, their needs, and the changing state of their culture had never been properly undertaken. Also it was later realized that this part of the country was no longer the

Plate 2-3 A newly developed Bedwin farm in Wadi Sirhan area (Taparjal).

Plate 2-4 Large trucks are in common use by Bedwins, especially in the northern deserts (Hammad).

same as it had been in the 1920's, and that it now offers more opportunities for spontaneous settlements by means other than agriculture. Thus the project was changed into a sheep farm to employ and train a few Bedwins rather than settle them on a farming basis permanently.

The al-Hijar experiment in settlement was no doubt the most successful of the three for the simple reason that it was thought out, implemented and sustained by local ideas and based on local needs. The last two projects did not have much success because they were in many ways out of touch with the main needs of al-Badiah. The competition of urban centres, business and other employment opportunities presented the Bedwins with more attractive settlement alternatives than these projects. These settlements (W. Sirhan and Haradh) were thought to be in their layout and details too foreign to Bedwin society. As Faisal Bashir noted:

> We import everything, and this ironically enough includes even the ideas of settling African tribes in Africa or Red Indians in the U.S.A. as applicable to Bedwin in Arabia ...we must abandon out-right acceptance of all imported settlement ideas so as to create our own...which have the highest chance of success.[32]

An important reason for this failure is the identification of the idea of settlements with crop agriculture only, whereas this type of agriculture is not the only means of settlement, especially in a country that offers other possibilities, i.e. industry and livestock. Successful agriculture is a complicated task that needs a lot of experience and capital, which Bedwins lack.

Finally another main reason for these failures is the fact that there has never been a clear established policy to deal with the whole problem of al-Badiah as a socio-economic and land use sector. Therefore every government agency makesits own decisions that usually conflict with other agencies.

32. Bashir, Faisal, op.cit., p.7

2.3.2 Spontaneous Settlement

Induced settlement has ignited and activated the whole process of settlement, which has then been spontaneously maintained and accelerated. Spontaneous settlement is very active and results from a combination of environmental, political, economic and social factors, all putting pressure on the Bedwin to leave his traditional way of life for a new one. It is distinguished by a more accentuated exodus, which is difficult to quantify, but is, however, evidenced by the numerous settlements in huts, mainly of sheeting and tents that have sprung up around the urban centres and are largely inhabited by Bedwins. Numerous officials and tribal leaders have confirmed this type of spontaneous settlement. In Raniah Bedwins have declined by as much as 75% and are still declining.[33] The sheikh of the Shararat tribe in Wadi Sirhan stated that a third of his tribe has settled.[34] Such a trend has created a great pressure on the limited government agencies and services (schools, hospitals etc.), and consequently numerous committees have been formed mainly to evaluate and recommend the services needed. Dealing in detail with all of these factors is outside the scope of this thesis. However, what follows are the main points that need stressing.

Environmental Factors: Environmental factors have played a major role in contributing to the spontaneous sedentarization of nomads in Saudi Arabia. In the 1930's and again in the mid-1950's the country experienced prolonged drought and the desert became more barren year after year. Though there are climatic reasons, ironically, modern technology deserves part of the blame. Pumped wells and the limited vaccination available so increased the number of animals that the range-carrying capacity was exceeded, hence ranges were badly over-grazed, and were further damaged by uncontrolled grazing. Thus pastoral opportunities

33. Ital Consult, op.cit.,(1974),p.151
34. Interview with Sheikh Asheg al-Lahawi, Dec. 1974

gradually decreased, consequently encouraging sedentarization to proceed quietly but at an accelerated pace.

Political Factors: The emergence of the state in 1932 accelerated spontaneous settlement to the extent of causing a fundamental modification within Arabian society. This is due to the fact that the concept of the modern state is not compatible with tribal organization. Indeed, the two are mutual opposites. While tribal institutions thrive on Gasu, raids, vague territories, clan alliances and continuous movement, the state is founded upon international and internal boundaries, treaties and bilateral agreements. Consequently, the traditional movement of the Bedwin was drastically limited. Tribal territories and rights were abolished in 1925,[35] and this eliminated the self-government of the tribes, subjecting them to state control.

Economic Factors: The recently developed oil industry has given greater dimensions to life in the country than the old ways. Oil introduced new types of settlement, new towns and totally new ways of life. On the whole, workers employed by the oil industry are not as numerous as some have suggested. Aramco, the largest oil company in the country, does not have more than 13,000 workers; some are foreigners, the majority are ex-farmers and no more than 30% are Bedwin. The most important effects have been derived financial benefits which have increased national activity and contributed greatly to the settlement of Bedwins. The improved transportation network has increased the Bedwin contact with the outside world. The contact with more advanced cultures has produced major cultural changes; Bedwins have grown accustomed to regular employment, which they find more convenient and rewarding than the migratory way of life or farming.

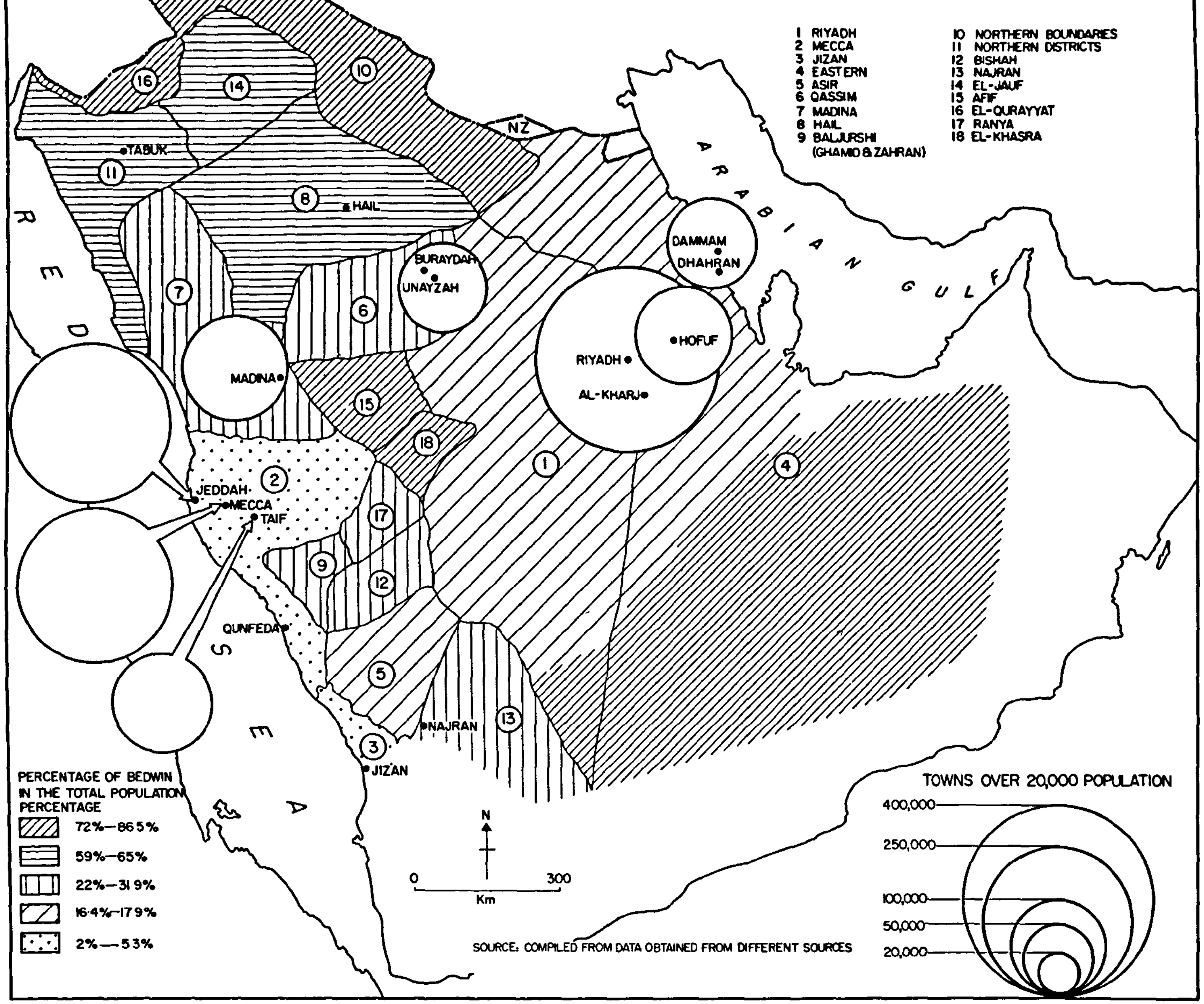
35. Walpole, N.C., et al., op.cit., p.219

Urbanization: The expanding urbanization of the last twenty years was also a fundamental social change and a factor inducing sedentarization. Whereas rural and Bedwin societies were the dominant communities in the late 1920's, now urban areas are the most important cultural centres. Urban areas contain some 33% of the population. New urban centres sprang up in the 1930's after the discovery of oil; among the most famous are Dammam, al-Khober, Dhahran, Abgaig, Rastanorra, and there are many others. Some were previously hardly known; others like Abgaig did not even exist before the oil discoveries. Other towns were founded along the pipeline in the north. These northern towns, like Turaif, Ar'ar, al-Qaysomah, are largely populated with Bedwin who lived in the area in earlier times. Figure 2-1 illustrates the distribution of al-Badiah population in 1962/63 among the eighteen administrative districts and indicates that only a few areas in the central region and some of the northern areas had a large percentage of Bedwins. The concentration of al-Badiah seems to take place in areas located at distances from large urban centres, like the northern boundaries, and the north western parts of the central area of the country. Interviews with informed people as well as the author's own observation (field work 1974) around the northern edges of the Empty Quarter, confirm that almost all the inhabitants of the Empty Quarter (very small in number) are Bedwins.

Cultural Changes: In recent years many elements of the Bedwin culture have changed drastically; the raiding, trade caravans and hunting that once provided valuable supplementary income are now no more. Herding of camels and sheep has become increasingly market-orientated rather than a status symbol or a means of subsistence as in the past. Compared to other nomads the Arabian Bedwins were noted by F.A.O. for being in most cases "more advanced economically and they are already in a market economy".[36]

36. Demiryven, A.S., The improvement of Nomadic and Transhumance Animal Production Systems, Report by F.A.O. No.AGA/MISC/74/3, (Rome; 1974), p.10

Fig.2·1 THE DISTRIBUTION OF AL-BADIAH AS A PERCENTAGE OF TOTAL REGIONAL POPULATION (%)



The camel in its traditional role as the main vehicle of transportation, has been largely displaced by cars. This transformation has been so drastic that the author throughout his extensive tour of the northern and southern deserts saw very little camel transportation except for the purpose of herding camels. Cars are now the vehicles used by Bedwins to scout for ranges, migrate, transport animals to the water or bring water to them, and move their animals to the market. Parked cars beside the tent are becoming a landscape feature. The size and make of car has become a symbol of wealth and status. al-Badiah in the north usually display more wealth and own large trucks of German make (Plate 2-4), whereas in the south the less expensive small Japanese trucks are the common ones (Plate 2-5). The black Arabian tent still dominates, neither mobile houses nor large white tents have replaced it due to its lightness and the ease with which it can be folded, and it is moreover still made in Arabia (Plate 2-6). Diet too is changing; rice, vegetables, fruits and canned foods are becoming necessities. The physique of the average Bedwin has also changed from being slim and light to being large; as a Ruala elder said, "The new generation of today are too fat, too big, too spoiled and too choosy to be Bedwins".

Education, permanent jobs and city glamour are attracting the new Bedwin generations. The author saw very few of the 15-40 age group in the desert. Thus it is not surprising that what seems the approaching end of al-Badiah is becoming the major topic of discussion around camp fires in Bedwin camps. A Dausari elder said sadly:

> I can neither force my off-spring to stay with me on the fringes of the Empty Quarter, nor can I honestly say that it is not good for them to go to the city. Young people are simply migrating, in any case if we asked them to stay they would never listen.

Finally, a very good reason for settlements was the fact that the Bedwin had neither romantic illusions about his harsh environment nor a

Plate 2-5 Small trucks are commonly used by Bedwins in the southern deserts (Wadi Dwasir).

Plate 2-6 The traditional Black Arabian tent is still used by al-Badiah and still woven locally (Wadi Dwasir).

dogma that prevented him from looking for a better one. This attitude made the process of settlement occur smoothly and naturally.

2.4 The Impact of the Decline of al-Badiah on the Livestock Sector

Certainly this accelerating decline in al-Badiah population has caused great harm to the livestock industry. However, it should be stressed that this decline was initially a symptom of the deteriorating situation of the livestock industry rather than the main cause for it. Moreover it is mainly the accelerating aspect of this decline that has caused considerable damage to the industry. The impact of this decline on the livestock industry is complex and certainly entails positive as well as negative effects. There are three main positive aspects:

(1) The decline is not spatially uniform. It has affected various areas differently. Some good ranges that are far from urban areas still hold large numbers of their Bedwin population, as in the case of the northern and southern deserts. Areas close to urban centres are the ones most affected. Regional variations in the decline of al-Badiah are a natural reflection of the declining state of range resources around urban areas. Therefore some type of regional specialization in the use of ranges is gradually evolving. This is a favourable trend that could - if guided - lead to a better use of resources. This trend toward settlement, although substantial, should not be interpreted as necessarily indicating the approaching end of al-Badiah; on the contrary, it is a healthy trend at least in one main respect, and that is the relaxation of the mounting pressure on ranges. The present condition of ranges is so poor that they cannot maintain the numbers of animals already grazing.

(2) The Kingdom with its industrial programmes and ambitious development plan needs to divert a large part of the population from the traditional sectors i.e. agriculture and livestock rearing, into the new modern sectors. Therefore it is only to be expected that a large number

of these migrating Bedwins will be employed in the modern sectors. Pastoralism at present can afford to do without a large part of the Bedwin population, especially the older members and the small pastoralists who lack capital. Pastoralism can still develop and flourish with fewer people. What really matters is the kind of people who stay; if some of them are able, efficient and well advised, then having fewer pastoralists is for the better.

(3) In certain cases the decline of al-Badiah is an unavoidable development, induced by the very low per capita income provided by pastoralism. It was estimated in 1973 that a Bedwin family of nine people in an average year in the western region has a gross income of SR 2,200, which sinks in poor years to SR 1,350.[37] On a national basis it was estimated in 1969 that Bedwin per capita income is the lowest in the country with about SR 338 per person.[38] This decline in al-Badiah is helpful in encouraging the small income pastoralist to leave the desert for a secure job in the city. Pastoralists who stay, with government support and better services, could easily achieve a higher income.

Besides these positive effects there are three major negative ones, and these are as follows:

(1) In the past and especially in the last 30 years al-Badiah has acquired the reputation of being a backward and under-privileged society. This reputation derived from the classical conflicts between al-Badiah and al-Hadher (settlement) societies. Settled communities considered al-Badiah brutal in their raids (in the past), illiterate and uncultured as a society. Furthermore the campaigns organized in the past to encourage Bedwin settlement, especially the al-Hijar project, dramatized the relative Bedwin backwardness so as to persuade them that the change to settlement

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37. Ital Consult, op.cit., 1974, p.23

38. Bashir, Faisal, The Case of Nomadism: to Settle or not to Settle, (Riyadh CPO.; March 18, 1969), p.4

is the road from the world of ignorance (al-Badiah) to a new world of enlightment and culture (settled communities). The relative sense of prosperity enjoyed by settled society and the active continuous exodus of Bedwins to settlements have so strengthened this feeling that many Bedwins have come to accept this negative view as having some merit. "After all", some say, "The desert offers only isolation and ignorance". A sizable proportion of Bedwins go so far as to blame the al-Badiah way of life for their "unfortunate situation". Demoralizing slogans portraying the worst aspects of al-Badiah are common, e.g. "al-Badiah is a suspect thief, so let us get rid of it, it has dominated us for so long". Such a view has been encouraged and made to seem probable by the trend toward migration: The development of pastoralism and hence livestock production cannot take place until such misunderstanding is eliminated - after all pastoralism is a highly professional sector of vital importance and economic value to the nation.

(2) A major disadvantage of this migration is its spontaneity and unorganized nature. Both the <u>leavers and stayers</u> acted individually with no national policy to guide and control the change they had to go through. The leavers did not receive the needed training to qualify them for better opportunities. The stayers had no guidance in the ways of making a better income and more efficient use of the desert. The extension services provided by the government to farmers has never been matched by services for the pastoralists. Desert activities have not been improved to overcome marketing, investment and management problems. What efforts are being made to help pastoralists are still in their early stages, and anyway they lack deep understanding of al-Badiah problems and needs. On the whole the leavers had a greater chance of making a comfortable living, while the majority of the stayers are still undergoing their harsh way of life. This state of affairs has left the helpless feeling

that the desert does not offer the security the city can offer, hence the Bedwin feeling of being left out is inevitable.

(3) It should be stressed that it is the type of people who migrated rather than their number which is important. Pastoralism as a result of this migration has lost a considerable number of its leading and active social elements. The trend toward settlement has not merely affected the rank and file, but much more so the elite, the rich and influential tribal leaders who used to be the large animal owners, and who have capital to invest. By losing them, al-Badiah lost a vital part of its tribal organization and moral support. Another harmful aspect is the sizable departure of the energetic younger generation (15-40 year olds) in search of education, employment and city glamour. The role of the young in the desert is vital, for they are the animal herders who spend their whole time moving their animals from one range to another; in addition their strong herds provide help around the household. Their migration created a great vacuum that had to be filled by the elders. The elders suddenly realized that they had to add to their advisory, management and household activities the demanding task of herding the animals. This new role put more pressure on them, especially the very old. As a result many households had to pack up and leave the desert for ever, or unwillingly replace their camels with less demanding animals like goats and sheep, or attempt a drastic reduction in the number of animals. The rich, who are the few, were fortunate in being able to use hired labour. Hence a new cost element was added that few pastoral operations can really afford. Thus pastoralism as a dynamic socio-economic activity has suffered. Indeed, pastoralism cannot be expected to flourish while the most vital part of its man-power is moving away to other sectors of the economy. So far there has been no substantial reversal of this trend, and there is no foreseeable likelihood of such

a reversal. No type of modern desert rancher has so far evolved, nor have the livestock farmers tried to utilize desert ranges. This man-power drain and the absence of any replacement has led to a situation where pastoralism is increasingly suffering from a skilled man-power shortage in a country that is already faced with an unfavourable structure of active population,[39] and a steady flow of migration towards urban areas.[40]

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39. Although there is no calculated ratio for the structure of active population in Saudi Arabia, such a structure should be very similar to that of neighbouring countries in the M.E. The estimated structure for some of these countries was calculated by the U.N. to be 100 inactive persons to every 100 active, as against a corresponding ratio of about 60% in the industrial world. UNESOB, Studies on Selected Development Problems in Various Countries in the Middle East, (Paris; UNESCO, 1969),p.59

40. A number of cities in the country have actually experienced a rate of growth exceeding 4%. Riyadh the capital has grown at a rate of approximately 10% per annum.

CHAPTER THREE

INSTITUTIONAL LIMITATIONS

THE MINISTRY OF AGRICULTURE AND WATER

3.1 The Importance of the MAW

The Ministry of Agriculture was established by a Royal Decree on 18/4/1373,A.H. (25/12/1954)[1] and became officially known as the Ministry of Agriculture and Water (MAW) in 1963.[2] The Ministry is "the competent authority for the development of agriculture and water resources in the Kingdom".[3] Its main objectives are to "optimize the use of resources to achieve a gradual but sustained growth in output".[4]

The MAW is the principal agricultural institution in the country, because the country has no other national (private or public) institutions that deal with agricultural activities i.e. marketing bodies, co-operatives, agricultural societies, research institutions etc. Consequently the MAW is not only a policy-making body but it also initiates and provides services that could have been provided by the farming community itself. This situation has been aggravated by the farming community's assumption that the MAW is responsible for all their needs, to such a point that one of the early Ministers complained:

> The MAW provided farmers with some assistance and agricultural services of a commercial value in order to initiate conscientiousness and alarm the mind to aspects that were not known before. However, what has been done has led to the dangerous trend that some believe that the MAW's duty is to provide tractors and seed, maintain their machines, supply spare parts, drill wells and do all that is needed for their cultivation. If we went along with these ideas, then even doubling the budget would not suffice.[5]

This problem still exists, because the MAW has not been able to introduce, either through direct or indirect means, a suitable framework in which the agricultural community can cope with their own problems and the pro-

1. Royal Decree No.5/71/1149651 on 18/4/1373.
2. "MAW" will be used instead of "MA" throughout the thesis.
3. MAW, Ministry of Agriculture during one year, (Riyadh; 1964), p.3
4. CPO, Report of the Central Planning Organization 1394,A.H.,(Riyadh; 1974),p.109
5. Translated from the Minister's introduction to the MAW, Report on the Works and Projects of the MAW through 1376,77,78, (Riyadh; 1958),p.1

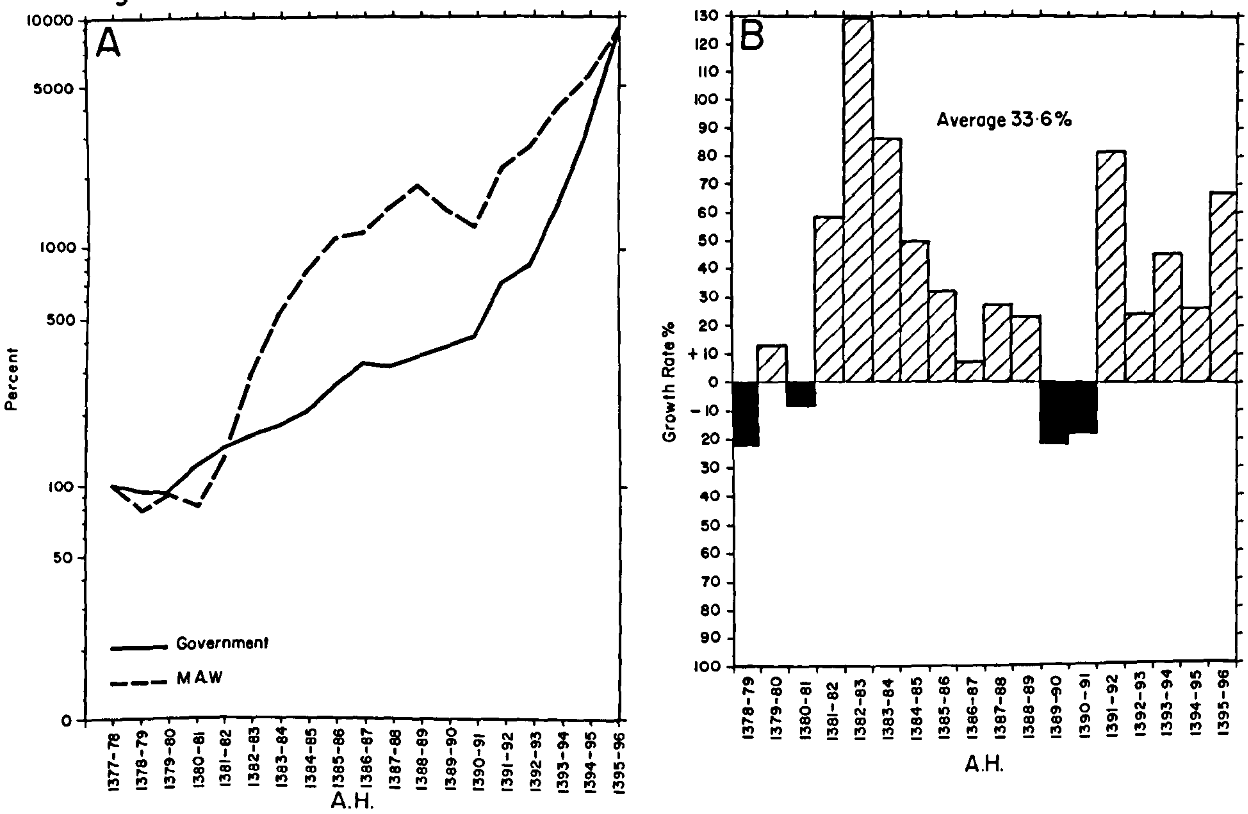
blems associated with the efficient use of their resources. Furthermore, present trends seem to indicate that the MAW is taking on more responsibilities rather than disposing of them. The fact that badly needed local and national agricultural institutions, services and organizations have not evolved to take over these responsibilities i.e. marketing bodies, organizations for crop and livestock commodities, agricultural industries and processing and the encouragement of private institutions gradually illustrates how a vicious circle has evolved whereby farmers and the MAW blame each other for not getting on with agricultural development.

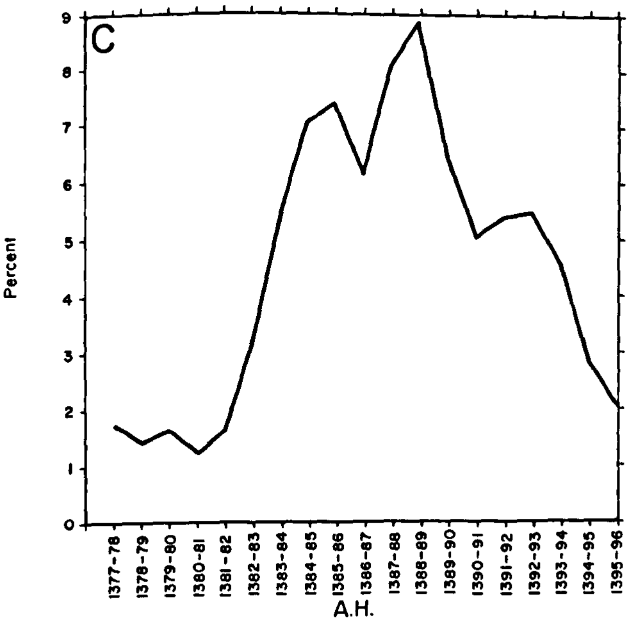
The answers are not simple and, indeed, the MAW faces major difficulties, similar in certain aspects to those faced by comparable institutions in many other under-developed nations. There are three main MAW difficulties which seem particularly damaging: (1) the MAW organizational structure, (2) MAW man-power and (3) the MAW regional structure. Based on the author's service in the MAW (1967-1972) and his field work in December 1974, it is his opinion that these three difficulties are critical obstacles: he might even go further to state that agricultural development cannot be approached wisely without overcoming these difficulties.

3.1.1 Financial Resources

The financial needs of the MAW, specially since the late 1960s, have never been a major problem, a situation rarely found in most other parts of the world. At present, for all practical purposes, the MAW can obtain all the funds that it can absorb. This situation is illustrated in Figure 3-1a and Table 3-1 which reveal a degree of abundance very few nations can have. Table 3-1 shows the annual budget of the MAW in relation to the national budget for the last 18 years and indicates a staggering rate of growth from a budget of around SR 26.0 millions in 1377/78 (approx.1957/58) to around SR 2179.4 millions in 1395/96 (approx.

Fig: 3·1





A Progress of the Budget Appropriation of the Saudi Government and the M.A.W. from 1377/78 to 1395/96 in percentages where 1377/78 = 100%

B Rate of growth per annum of the M.A.W. Budjet from 1378/79 to 1395/96

C M.A.W. Budget as a percentage of the Government Budget for 1377/78 to 1395/96 AH ≈ 1957/58 to 1975/76

Source: Compiled from data in Table 3·1

Table 3-1

Allocation and percentage of the total Government and the MAW Annual Budgets from 1377/78-1395/96

(000,000)+

No.	Years	Government Budgets	%	MAW Budget	%	% MAW in Government Budget	% MAW rate of change per annum
1	1377/78	1,500	100	26	100	1.7	
2	1378/79	1,410	94.0	20.4	78.5	1.4	-21.5
3	1379/80	1,405	93.7	23	88.5	1.6	12.7
4	1380/81	1,786	119.1	21.3	81.9	1.2	-7.4
5	1381/82	2,166	144.4	33.8	130.0	1.6	58.7
6	1382/83	2,452.5	163.5	77.4	297.7	3.2	12.9
7	1383/84	2,686	179.1	144.3	555	5.4	86.4
8	1384/85	3,112	207.5	216.5	832.7	7.0	50.0
9	1385/86	3,961	264.1	287.7	1,106.5	7.3	32.9
10	1386/87	5,025	335.0	308	1,184.6	6.1	7.1
11	1387/88	4,937	329.1	394.1	1,515.8	8.0	2.8
12	1388/89	5,535.5	369.0	487.5	1,875.0	8.8	23.7
13	1389/90	5,966	397.7	382.3	1,470.4	6.4	-21.6
14	1390/91	6,380	425.3	312.5	1,201.9	5	-18.3
15	1391/92	10,782	718.8	568.6	2,186.9	5.3	82.0
16	1392/93	13,200	880.0	708.1	2,723.5	5.4	24.5
17	1393/94	22,810	1,520.7	1,031.9	3,868.8	4.5	45.7
18	1394/95	45,743	3,049.5	1,303.2	5,012.3	2.8	26.3
19	1395/96	110,935	7,395.7	2,179.4	8,378.5	2	67.2
	Average						33.6

Source: Compiled from al-Madina al-Murawara, No.3430, June 10, 1975 and Ministry of Finance, Statistical Yearbook, 1973

+ Including appropriation for projects, other expenditure, and subsidies for reduction in the cost of living

1975/76). Comparing the rate of growth which took place in the subsequent 18 years with that of the index year (1377/78 = 100), Figure 3-1a indicates that after 1381/82 (approx.1961/62) the MAW budget soared so as to reach in 1975/76 the staggering rate of 8378.5% of the index year. As Figure 3-1a shows, since 1381/82 the rate of growth attained by the MAW budget has been far greater than that of the national budget, and the gap has started to narrow only over the last few years.

Figure 3-1b shows that the annual growth rate attained by the MAW budget for the last 18 years is indeed impressive, averaging 33.6% per annum and reaching as high as 129% in 1382/83, 86.4% in 1383/84, and 82.0% in 1391/92. In 1395/96 (approx.1975/76) it increased by as much as 67.2% of the previous year's growth rate.

Figure 3-1c shows that the MAW's share of the national budget was highest in the period 1383/84 to 1388/89, reaching 8.8% in 1388/89 (approx.1968/69).

The sudden fluctuations in the MAW budget for this 18 year period are apparent in all of these figures, but they can be explained by focusing on Figure 3-1b which magnifies these fluctuations. The negative growth rates in 1378/79 and 1380/81 (approx.1958/59 and 1960/61) reflect the state of the national economy which at that time faced a financial crisis. This began in the mid 1950's, and caused a sudden levelling off of the oil revenue, accompanied by increased deficit spending by the government, which resulted in serious balance-of-payments problems. The crisis was brought to an end only after the successful implementation of a strict stabilization programme established in 1958.

The small rate of growth attained in 1386/87 (approx.1966/67) was caused by the 1967 Middle East War which resulted in the government restricting its spending and allocating SR 662.4 millions of aid to Arab countries; for the first time taxes were introduced as a part of the adjustment programme.

The sizable negative growth rates for 1389/90 and 1390/91 (approx. 1969/70 and 1970/71) have a totally different cause. In this period the MAW became responsible for the operation of two of its largest land reclamation projects, namely the Hassa and Haradh irrigation projects which proved difficult to operate and maintain. The MAW had to mobilize the majority of its resources to run these projects. For this reason it was decided that the MAW must not initiate any new large-scale projects, but rather must concentrate on running what it already has. Therefore, these two negative growth rates did not result from the lack of funds but mainly from the MAW's inability to absorb more funds.

3.2 The Organizational Structure of the MAW

The MAW in its early years and up to the late 1950's operated through a simple organizational structure similar to that shown in Figure 3-2. This structure proved to be too small and too simple to carry out the increasing MAW responsibilities specially in the early 1960's when the budget as well as the responsibilities of the MAW started to escalate.

In the late 1950's the Saudi government called on the International Bank for Reconstruction and Development to suggest a general plan for an appropriate approach to economic development for the country as a whole. The Bank in its final report dealt at length with the MAW and stressed, among other things, the urgent need to reorganize the MAW's organizational structure to enable it to cope with its expected wide responsibilities. Most of the recommendations made by the Bank were implemented by the MAW in 1966 and the whole structure of the MAW was reorganized as shown in Figure 3-3. The concept of general departments was introduced and each department was made up of sections. However, this reorganization did not overcome certain major handicaps, the most important being:

(1) The ideal chart shown in Figure 3-3 was not followed by a wider delegation of authority. Decision-making in the MAW at all levels and for all administrative aspects remained centralised, causing accumulation and delay of work. The few Directors General, the two deputies and the Minister became so overwhelmed with paper work that they had little time to spare for planning. The reorganized structure remained "formalistic", that is "real people and units are doing different things from those mentioned in the chart".[6] The new reorganization has only displaced but not replaced the older one and major practices held over from earlier organizations still affect in fundamental ways the actual operation of a supposedly new organizational structure.

(2) The reorganization did not implement an important suggestion that was stressed in the Bank's recommendations; that was the establishment of two Ministries, one for Agriculture and the other for Water, because as the Bank argued:

> the development and regulation of water are closely related to agriculture in Saudi Arabia, but substantially are vastly different and, therefore, should be separated from the present MAW. Water requires an entirely different approach and set-up from agriculture since it has to be regulated and controlled as well as developed.[7]

The disregarding of this recommendation resulted in a number of problems, the most important being that the MAW found it increasingly difficult to devote enough time and equal effort to both the agricultural and water sectors as is illustrated in Tables 3-2, 3-3 and 3-4.

Table 3-2 summarizes the distribution of the MAW's project budgets between agricultural and water projects for 1964, 1972 and 1974. The project budgets for the agricultural sector are the smallest, amounting to 25.1% of a total MAW project budget of around SR 87.2 million in

6. Riggs, W.F., Administration in Developing Countries, The Theory of Prismatic Society, (Boston; Houghton Mifflin & Co., 1964),p.17
7. International Bank for Reconstruction and Development Mission to Saudi Arabia, Approach to the Economic Development of Saudi Arabia, Report No.AS.82 (Washington,D.C; November 1,1960),p.13

FIG. 3·4

THE CHART FOR THE AGRICULTURAL SECTOR

Derived from MAW Sources

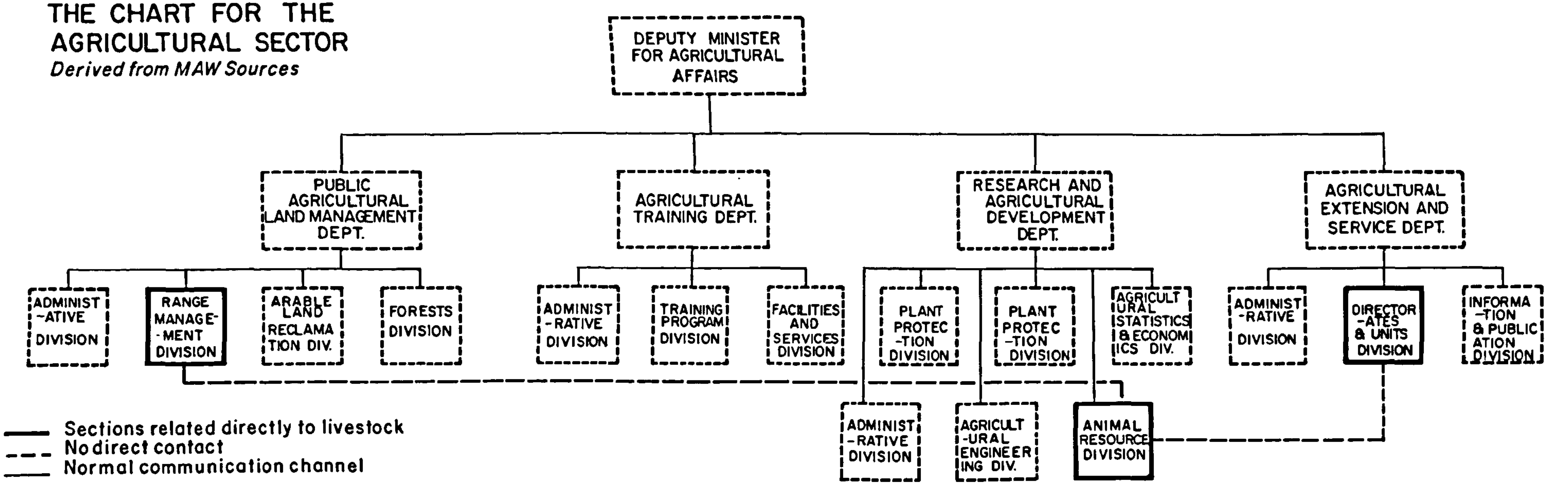


FIG. 3·2

THE MAW ORGANISATION UP TO 1960

Derived from MAW Sources

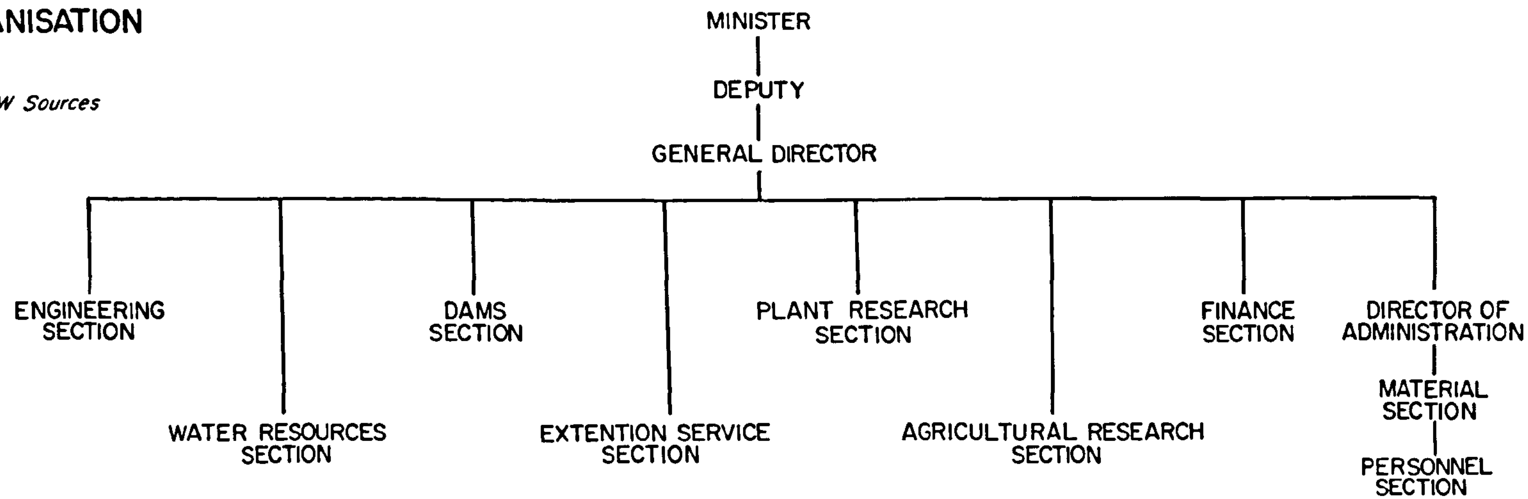
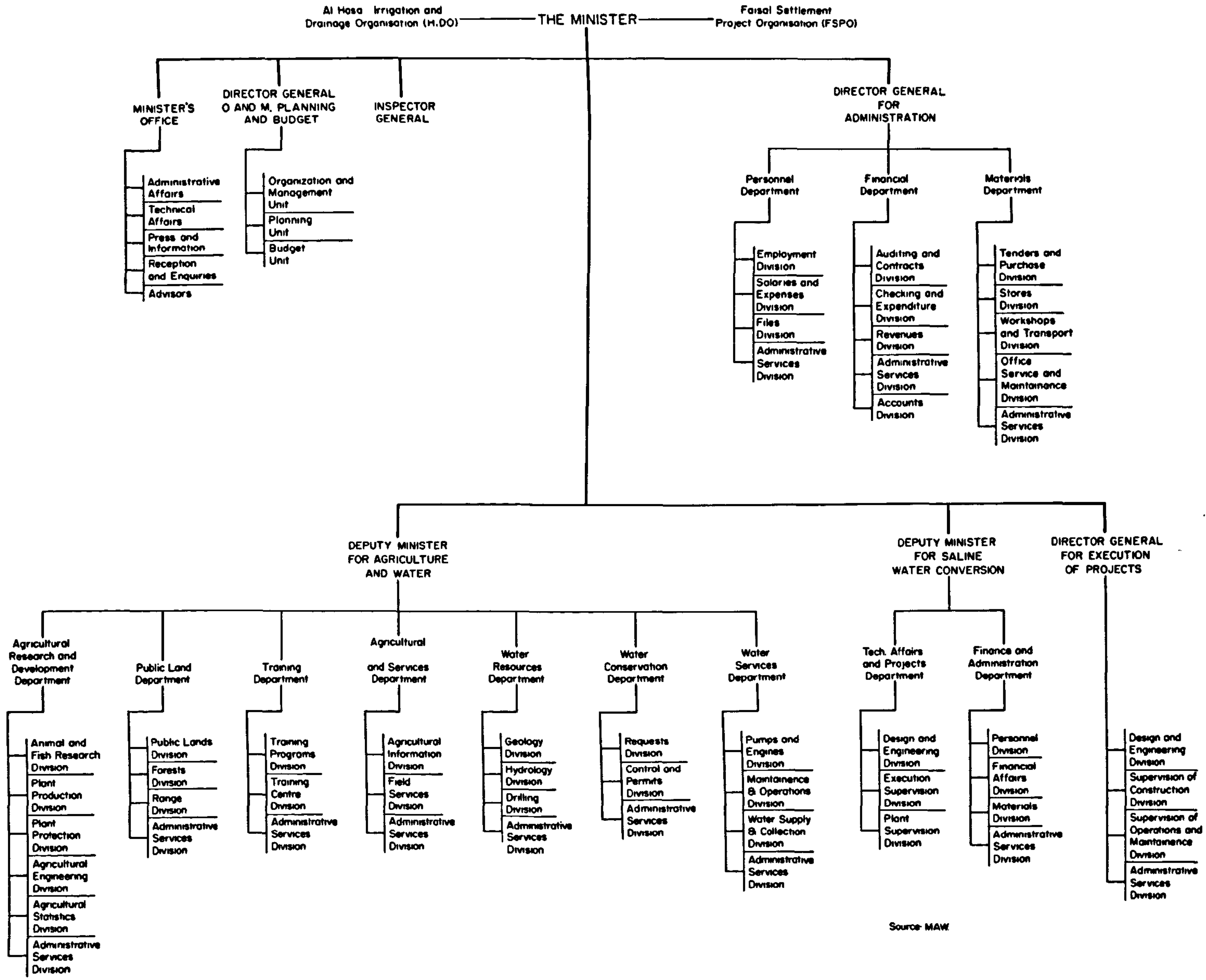


Fig 3·3 ORGANIZATION CHART OF THE MAW
1392-1972



Source: MAW

1964 to 9.6% of SR 548.6 million in 1972 and 23.1% of a total project budget of SR 1013.8 million in 1974 while the water sector received the largest proportion,no less than around 75% throughout these three years.

Table 3-2

The distribution of the MAW Project Budgets between agricultural and water projects in SR millions and % for 1964, 1972 and 1974

Year	Total MAW	Agri.Projs.	%	Water Projs.	%
1964	87.2	21.9	25.1	65.3	74.9
1972	548.6	52.4	9.6	496.2	90.4
1974	1013.8	234.6	23.1	763.5	75.3 .

Source: Compiled from MAW Budget allocations for 1964, 1972, 1974 (unpublished)

Taking 1974 as an example Table 3-3 indicates that 75.3% of the project budget totalling SR 763.3 million was devoted to desalination and water projects for urban and rural drinking use. The agricultural sector received only 23.1% of the budget, mainly for dams and other aspects of agricultural development. As shown in Table 3-4 projects related to livestock production amounted to a total of SR 11.7 million, which is only 5% of the project budget allocated to the agricultural sector of around SR 234.6 million and 1.2% of the total MAW project budget. This lack of stress on the agricultural sector illustrates the obvious inequality between water and agricultural sectors.

(3) A major weakness in the reorganization of the MAW is indicated in Figure 3-3 and 3-4 where agricultural production i.e. crops and livestock, is not represented at the departmental level. It is only at the section-level that activities connected with livestock and crop production are specified. Thus the objectives behind the administering of agricultural development were not stressed, and if agriculture is generally understood to mean both the cultivation of crops and the rearing of live-

Table 3-3

The distribution of MAW Project Budgets between water and agriculture for 1394/95 (1974) in 000,000 SR and %

Dept	Use	Allocation		%
Water	Desalination	285.5		
	Water projects	478		
	Total		763.5	75.3
Agriculture	Agricultural dev.	82.3		
	Research and training	10.1		
	Irrigation and drainage	45.2		
	Dams	97.0		
	Total		234.6	23.1
	Construction	15.7		1.6
Absolute Total		1,013.8		100

Source: MAW Budget 1394/95 (1974)

Table 3-4

Project Budget allocation for livestock and related activities for 1394/95 (1974) in 000 and % of the total agricultural and MAW Project Budgets

Activity	Allocations
Range development	1,972
Livestock and fishery development	2,223
Haradh	535
Riyadh central laboratory	2,500
Veterinarian programme	2,600
Plant and animal quarantine	1,880
Total livestock budget	11,710
Agricultural projects	234,600
Total MAW project budget	1,013,800

Source: MAW Budget 1394/95 (1974)

stock, then the MAW organization must specify their priority on the departmental level or even higher.

(4) The services and responsibilities related to livestock are divided between departments and sections. As shown in Figure 3-4 the Research Department has one small section dealing with livestock research and development. The Public Land Department has a section for range management and in the Extension Department a sub-section of the units section is responsible for veterinary services. This set-up has created enormous problems for the co-ordinating and planning of livestock activities. Furthermore, communications among all these sections dealing with livestock development are made through formal approaches on a departmental level. Each of these sections plans its own needs within the overall need of its own department, rather than in relation to the overall need of livestock production. This situation has not only been criticised by the MAW specialists but also by outsiders. The F.A.O. regional animal production and health officer in a memorandum dated June 4,1970 to the Director of the livestock section complained that:

> There are a number of grave disadvantages stemming from this division of control of the services and this represents one of the most important factors at present limiting the development of the industry. It seems essential, for example, under the conditions current in Saudi Arabia, for the Veterinary Field Services, the diagnostic laboratory and the quarantine services to be technically co-ordinated and directed under one authority.[8]

3.3. MAW Man-power

The MAW has always faced major problems with recruiting staff. In 1974, as shown in Table 3-5, out of around 4,848 jobs available in the MAW 875 or 18% of these jobs were vacant. The number is gradually growing due to the total lack of qualified Saudi personnel in some fields and to a partial lack in other fields. The shortage is mainly

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8. Faulkner, D.E., Memorandum to Dr.Micheimied, June 4, 1970.

in the number of qualified specialists, administrators and supporting technical staff. This problem has always been a chronic one as far back as the MAW's early days. As early as 1958 the Minister of MAW complained that:

> The MAW faces many difficulties in getting qualified specialists and administrators. Agricultural specialists in neighbouring countries are needed by their own governments and can only be recruited by borrowing them from their governments which face similar shortages. Borrowing specialists takes a lot of time and anyway we do not get the ones we want. Competent administrators specially in the field of finance are few in the country.[9]

Table 3-5

MAW Employment and Percentages of vacancies and non-Saudis (1974)

	No.	%
No.jobs	4,848	100
Vacant	875	18
No.employed	3,973	100
Non-Saudis	430	11

Thirteen years later, in 1970, the situation was worse as a result of a mounting demand for qualified staff. A study of the MAW man-power stated that:

> In a survey conducted by the Organization and Management Unit, into the major problems facing senior MAW officials, 17 out of 22 pointed out that one of the most pertinent problems they face was the deficiency of qualified Saudi personnel in the MAW.[10]

3.3.1 Shortages in Qualified Staff

The extent of the shortage of qualified staff is illustrated in Table 3-6. Staff with science degrees in agriculture and related fields amount only to 8.7%. Graduates in business administration, literature and related subjects constitute only 1.4%. Diploma holders from technical and elementary agricultural training schools make up only 12.6%

9. Translated from the Introduction of the Minister of Agriculture and Water, MAW Report 1376-1378 (1958), p.2
10. MAW, Study of Man-power, (Riyadh; MAW, 1970), p.1

and the rest, around 79.0% of the MAW personnel, have high school, intermediate and lesser educational backgrounds.

Table 3-6

The distribution of MAW staff according to qualifications (1974)

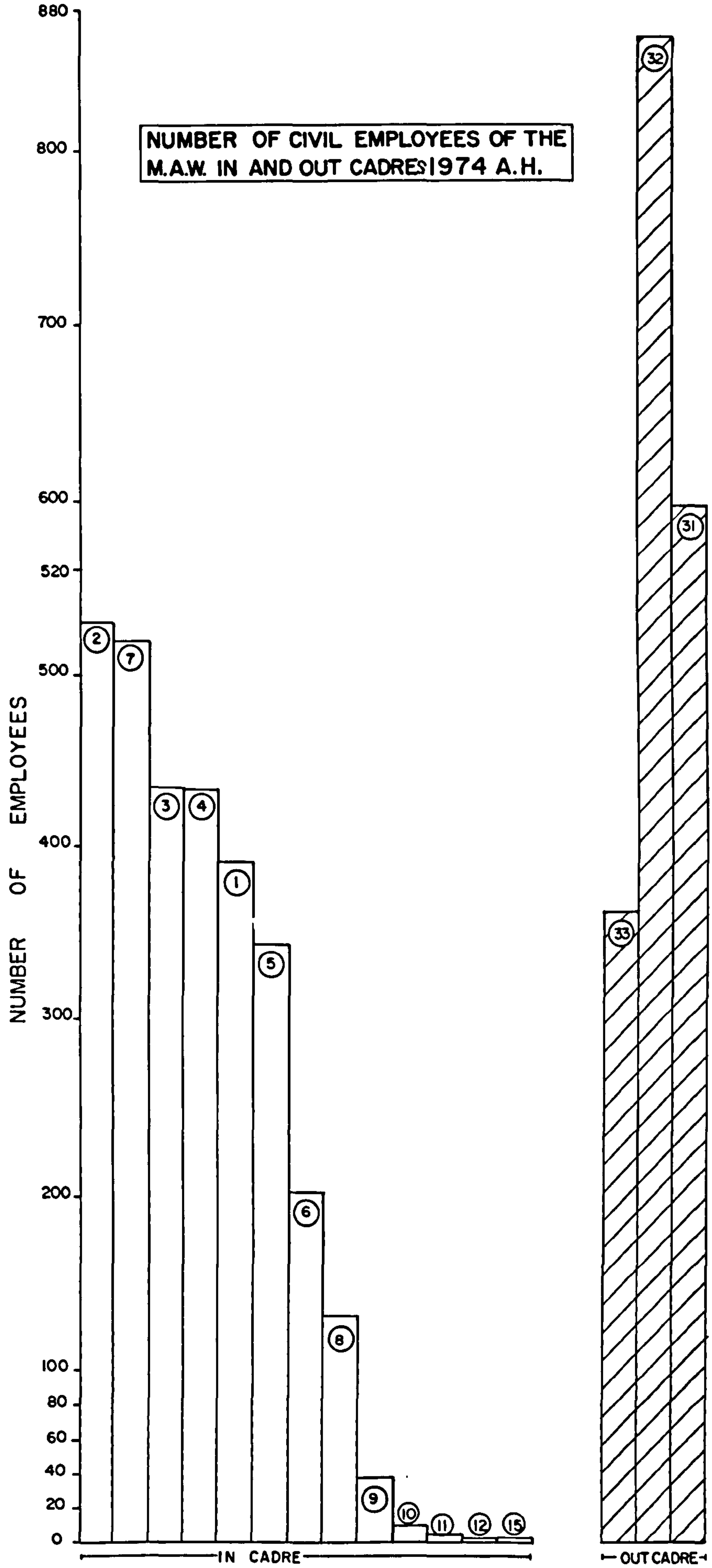
	No.	%
No. employees	3,973	100
University degree	345	8.7
Non-science degree	55	1.4
Agricultural schools	499	12.6
High school and less	3,074	77.4

Source: Field work (1974)

This obvious shortage of qualified staff is reflected in the MAW employment structure. As with the Saudi government as a whole, the MAW has two employment cadres: one is the "in-cadre", which offers the largest pay and social securities and includes the main body of the MAW, specially its senior and junior staff, the other is the "out-cadre", which usually caters for the lower paid personnel with no academic and technical background. As shown in Figure 3-5 the lower "in-cadre" grades 2, 3, 4, and 1 are predominant and at the same time they are the grades which require the lowest qualifications and most of the employees in these grades occupy simple clerical positions. The only exception is grade 7 which is particularly large since it is the grade where holders of a university degree in science usually start, while senior administrative staff are eventually promoted to it. "Out-cadre" grades 32, 31 and 30 are on the whole predominant in the MAW's employment and consist mainly of labourers, guards, drivers etc. There are few employees in grades 8-15 specially, 10, 11, 12 and 15 which include only 19 members of the staff.

The shortage of qualified staff has particularly damaged the

Fig: 3·5



Source: Compiled from the Personnel and Budjet Section's Office Circulars. Budgets and personnel information in the M.A.W. (Fieldwork 1974) decision-making bodies at all levels, both within the MAW headquarters from section to department level and, higher, and in the regions from directorates and units to field officers.

Traditionally the "Ministerial Office" has always been a political one, based on individual merits, political ability and administrative talents, hence agricultural qualifications have not always been the parameter. However, agricultural backgrounds in the case of the "Deputy Office", and particularly of the agricultural sector have always been the rule. The only departure from this rule was in 1973 when the deputy offices for water and agriculture were consolidated into one office. The deputy assigned for the job was not selected on the basis of technical background but mainly on his administrative background. To provide the new deputy with the needed technical support a firm was contracted and stationed in the MAW headquarters in Riyadh. The firm was assigned the task of agricultural programming and was directly responsible to the deputy. This development is new, in the sense that the MAW has for the first time involved a commercial firm in its daily administrative activities.

Table 3-7

The qualifications of the heads of the main MAW departments and regional posts (1974)

	Departments	Directorates	Units	Offices	Total
Total	14	12	21	32	79
Vacancies	2	-	4	8	14
Occupied	12	12	17	24	65
University degree (Ag)	5	3	-	1	9
University degree (Sci)	2	1	-	-	3
University degree (Arts)	4	-	1	1	6
Diploma (Ag)	-	3	9	6	18
High School	-	1	3	-	4
Intermediate	-	1	-	8	9
Elementary	1	3	4	7	15
None	-	-	-	1	1

Source: Field work (1974)

Table 3-7 summarizes the qualifications of the heads of the MAW's main departments in the MAW headquarters and its regional branches and it shows that out of 79 posts 14 are vacant, 9 posts are held by personnel with agriculture degrees, 3 with science degrees, 6 with university degrees in art, literature, business and political sciences, 18 with agricultural diplomas and 29 with only a background of high school or less. It is apparent that most of the posts are held by personnel with no technical background and the majority have limited educational experience. This situation reveals three major organizational trends. The first is that the MAW's decision-making body is administrative in character. Secondly, specialists and technical staff play a supporting rather than a decision-making role, because they hold few posts at the decision-making levels, and so are not in a position to make decisions. A third trend is that there is an obvious lack of correlation between the job's requirements and the holder's background, a situation which results in most cases in the wrong person being in the wrong job and vice versa.

The shortage of technically qualified staff at the decision-making levels of the MAW is due, among other reasons, to: (a) the limited number of higher grades (10 and over), which include only 18 posts; (b) these grades are allocated to the job rather than the person, hence they are only given to departmental directors and higher offices of an administrative or managerial character; (c) there are no posts within the higher grades that are reserved for the services of highly competent specialists. Thus a specialist (e.g. hydrologist, geologist, animal and plan specialist etc) has no chance of being promoted to a highly paid grade, no matter how qualified he becomes in his field, until he is chosen for a managerial job which tends to be administrative in character.

3.3.2 The shortage of Staff in Livestock Sections

As with other sections of the MAW, livestock and related activities suffer greatly from the shortage of specialised staff. As shown in Figure 3-4, the main departments dealing with livestock and related activities are the Research Department, Public Land Management and the Extension Department, and there is one section in each of these departments that is concerned mainly with livestock.

Table 3-8

Number of staff in the Livestock Section of the Department of Agriculture and Research (1974)

Total jobs	13
Vacant	3
Number of employees	10
M.A. (Science)	1
Ph.D. (Animal Production)	1
B.Sc.	4
Veterinarian	2
Agri. Diploma	2

Source: Field work (1974)

The Department of Agriculture and Research has 194 employees but only 10 out of this number man the livestock section. Table 3-8 lists the number and qualifications of this small team. Although well-qualified, the team is too small,[11] especially when one considers the fact that this section is responsible for:

> Research into the problems involved in breeding and producing improved strains, into animal diseases, production and diagnoses, into fisheries, veterinary medicine and milk products. The section supervises veterinary quarantines and lays down their regulations.[12]

However, the functions outlined above are not the only activities. The department also deals with other aspects of livestock production: it proposes regulations, makes studies, and provides answers to public and government enquiries. Thus one can see that the staff are too few

11. Not including staff working in research stations.
12. MAW, Ministry of Agriculture and Water during one year 1966, (Riyadh; MAW, 1966), p.32

for the enormous tasks they are supposed to perform.

The Public Land Department includes the range section which is responsible for:

> Regulating the conservation, utilization and development of ranges. It conducts research work on range plants and tries to spread the best strains of these. The [section] undertakes research work on the prevention of soil erosion.[13]

Considering these wide responsibilites and the fact that the country has over 97% of its land mass classified as ranges, one can see that this section needs a large staff. Out of the 114 employees in the Public Land Department only 9 are allocated to this section; in 1974 4 posts were vacant; thus 5 staff members were employed and only 3 held university degrees in science.

The Extension Services Department has a sub-section of the Units Division dealing with the veterinary aspects of livestock and this sub-section is supposed to:

> Organize...veterinary services. It conserves animal resources through the treatments rendered and through promoting the understanding of the people in this concern.[14]

However, the number of veterinaries employed in 1974 by this sub-section was 43, who were distributed around the country. The number is very small if one considers the vast area of the country and the total national animal population.

3.3.3 Alternatives to overcome the shortage

The seriousness of the shortage of qualified staff, specially Saudi staff, has led the MAW to rely heavily on three alternatives. The earliest and still the most common is the recruitment of specialists from outside the country. As shown in Table 3-5, foreign nationals in the MAW in 1974 approached 11% of the total MAW employment. Considering the fact that these non-Saudis are usually recruited for technical jobs,

13. Ibid.,p.35
14. Ibid.,p.34

their numbers may represent up to 50% or more of the MAW qualified staff.

The second alternative is a reliance on international consulting companies to do major surveys, studies, planning, evaluation and the supervision of important projects. Since 1960 the majority of large-scale projects (studies, surveys, consulting and implementation) have been carried out this way. The largest resource survey ever done in the country was the Area Survey (1968-1970) which was executed by three international consulting companies. Furthermore, this survey was planned and supervised by an F.A.O. team. The evaluation, summarization and the analysis of the almost 100 volumes produced by the Area Survey was contracted to the Stanford Research Institute (SRI) in 1970, simply because the MAW specialists are limited in number, over-worked and very few are competent in this field.

The third alternative is to utilize the assistance of international institutions for research programmes in the form of a joint venture: the MAW participates with cash and in-kind (land and facilities) and the foreign institutes mainly provide the expertise. For example, the University College of North Wales, Bangor (UCNW), in 1970 undertook a joint research and development project in animal production and applied sciences in Saudi Arabia, and the Leichtweise-Institute of the Technical University Braunschweig,Germany, undertook joint research in water and irrigation problems. While the first two alternatives were to overcome the shortage of competent staff the third alternative not only overcomes this shortage but more significantly provides needed continuity in research, which in the past used to be interrupted by either the termination of the contracts of non-Saudis or the promotion and changes that affect the few Saudis who undertake research. However, none of these alternatives has solved all the MAW man-power problems or helped in solving the problem of the lack of qualified staff at the decision-making levels because the regulations insist on the saudization of these posts.

3.4 MAW Regional Structure

The fact that the country is vast in size and the agricultural lands are located in scattered oases made it necessary to provide a regional organization for the MAW. As indicated in Figure 3-6, the MAW is represented by a sizable number of branches distributed over the country. There are 13 directorates with wider authorities than units or offices; they represent the MAW and are suppose to co-ordinate all of its activities in their areas. There are 21 units with lesser authority and fewer staff, which are responsible for smaller areas than the directorates. The MAW offices are the smallest branches with the least authority, and are responsible for limited areas: there are around 30 of these. The MAW regional branches (directorates, units, offices) are formally responsible to the Unit Section of the Extension Service of the MAW, which is in itself a handicap, because the Extension Department is under-staffed. Out of 210 jobs allocated to the Extension Department in 1974, around 130 jobs were not occupied, and only 80 were filled; 18 employees have university degrees in agriculture and science and 14 have diplomas in agriculture. The rest have clerical jobs.

The MAW headquarters in Riyadh, sorely pressed by the shortage of qualified staff, has reserved for itself the largest share, causing a serious shortage in the number of qualified staff for the MAW regional branches. As indicated in Table 3-7, the regional posts at all levels suffer more from the lack of qualified staff than the MAW headquarters.

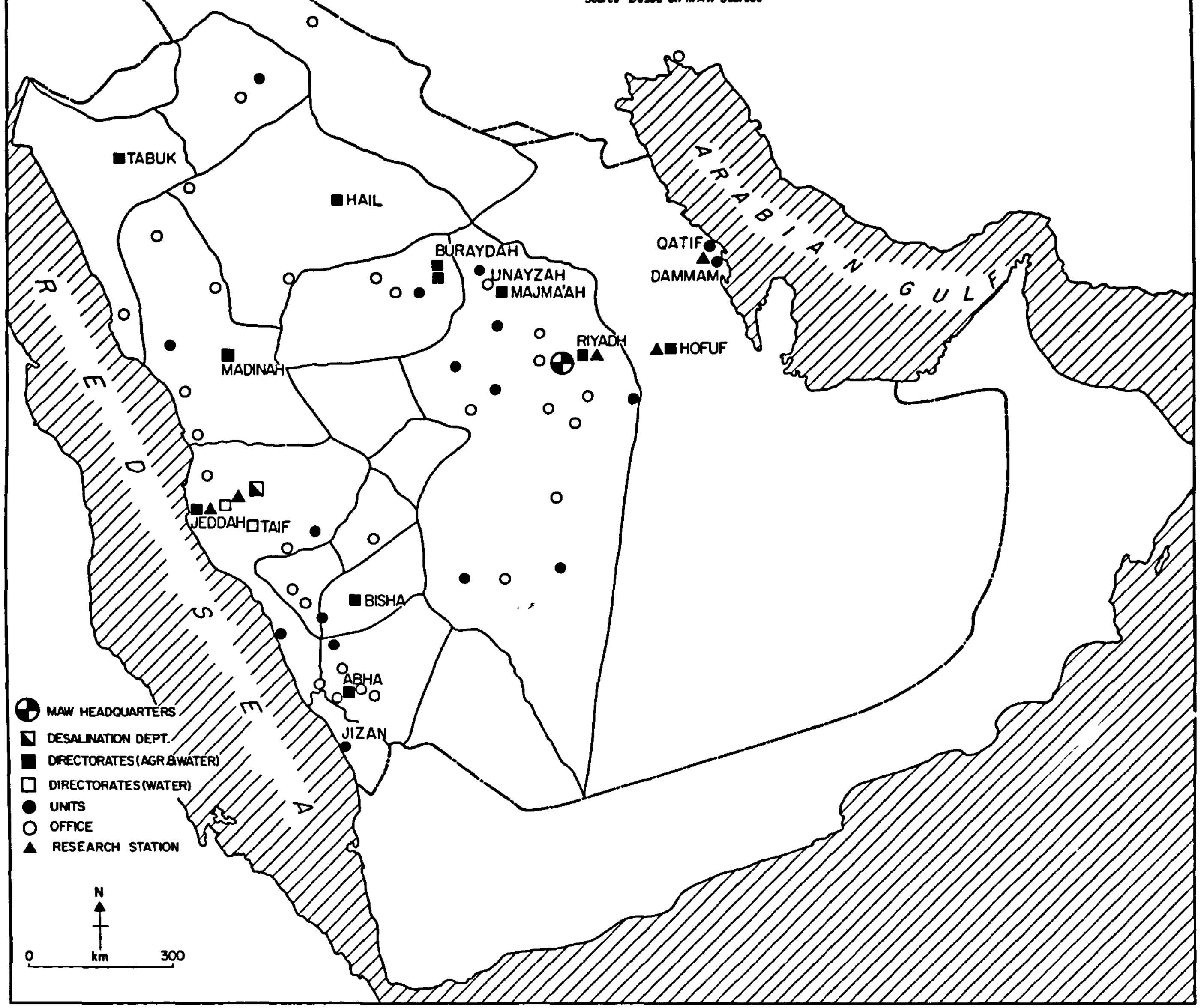
3.4.1 The distribution and structure of the MAW's regional activities

An insight into the nature of the MAW's regional structure necessitates the selection of measurable evaluative criteria. The most important MAW regional activities are the providing of information and services to

Fig: 3·6

THE DISTRIBUTION AND LOCATION OF THE MAIN MAW BRANCHES(1974) ACCORDING TO ADMINISTRATIVE DISTRICTS

Source Based on MAW Sources



the farmers and the gathering of information about their farming and local resources, and these can be measured in terms of the total MAW staff, the total MAW expenditure or the investment per region. Unfortunately, the latter cannot be detailed on a regional basis, because the MAW budget - even in its most detailed form - does not adequately specify the MAW's regional expenditure or investment; this is because expenditure is allocated and is normally spent by the MAW on a departmental basis. However, the number of staff allocated to each region is available in the MAW files and personnel information, which the author was fortunate to be able to inspect. Although the total staff allocated to each region is too great to indicate any regional character, the information available made it possible to separate the number of staff that have specialized or agricultural backgrounds. On this basis, two criteria can be evolved; one is the total staff provided by the MAW to each region and the other is the proportion of technical staff. A third and different criterion is the agricultural potential of the regions and this can be measured by the total cultivated area in hectares or by either the private investment or agricultural output in terms of products or their sales. However, neither of the latter two figures can be derived from any available sources. On the other hand, information on the total regional cultivated area is available.

Table 3-9 lists the total staff, the number of technical staff and the total cultivated area in hectares for each region. Although Table 3-9 shows the variations among the regions in all of these three variables, it does not clarify the nature of the relationship between the variables in a given region compared to the nation as a whole. However, a clearer picture can be obtained if a method can be devised of using both the total number of staff and the number of technical staff, together with the absolute amount of cultivated area, so as to indicate not merely the absolute value of each but also their relationship to one another on a regional and national basis.

Table 3-9

The distribution of MAW staff and the cultivated area (1974) per region

Region	Total No. Staff	Technical Staff	Cultivated area (hectares)
Central	554	104	35,064
Qassim	269	58	21,045
Eastern	148	66	6,947
Northern	284	52	6,266
Western	520	79	35,640
Southern	278	44	32,697
Coastal South	315	50	387,066

Source: Data for staff was obtained in field work 1974 and for cultivated area from MAW survey for 1971/72 census.

For this purpose a cartographic device named "Mercedes" has been adopted from Barbour.[15] This device makes it possible to represent side by side, at each point, mapped data for the three variables in such a way that each can be observed both in its national distribution and in its relation to the other two variables at the same point. A map thus constructed gives a composite picture of the entire MAW structure by region and serves two purposes. On the one hand, each variable may be regarded as plotted in its own right, so that by using the absolute scale it is possible to read off and compare the absolute cultivated area, and the technical and total staff in each region plotted. At the same time, these three scales employed have been so related that the radii represent a common scale of percentages for each variable, 100 per cent being in each case the total for the MAW of all the regions represented. Thus,

15. Barbour, K.M., The Growth, Location and Structure of Industry in Egypt, (London; Praeger, 1972), pp.103-106

for each region, it is possible to observe whether the MAW branches, taken as a whole, are balanced by the MAW's present standard and related in their staff requirements, and whether the ratio of the number of staff to the size of the cultivated area is abnormally high, low or indifferent. Such a helpful device should not be expected to indicate the degree of correlation between any two values; all that can be said in this matter is that where the three radii are similar, we are close to the national MAW structural norm for the relationships of staff per hectare and technical staff per hectare.

It is obvious from Figure 3-7 that the distribution of the MAW's regional activities is neither based on specific regional criteria nor on regional agricultural potentials. This can be illustrated by the extreme case of the Coastal South, where the total cultivated area is the largest in the country but the total number of staff and technical staff is smaller than in other regions with less agricultural potentialities. Other regions with substantially less land have proportionally more of the national distribution of these two variables, for example the Northern Region, where the cultivated area is the smallest but the number of staff and technical staff is as large as that of the Coastal South. The central region has almost the largest number of staff of both kinds but the cultivated area is not the largest.

The two variables, MAW total staff and technical staff, are distributed indifferently and even irrationally. The situation in the Eastern region is a very good example where the percentage of the MAW's technical staff allocated to this region is larger than the percentage of the total staff. It is obvious that the number or type of staff varies from one area to another and is not related to the regional agricultural requirements measured by the size of the cultivated area which differs from one area to another. Therefore, if the sizable sum spent in the

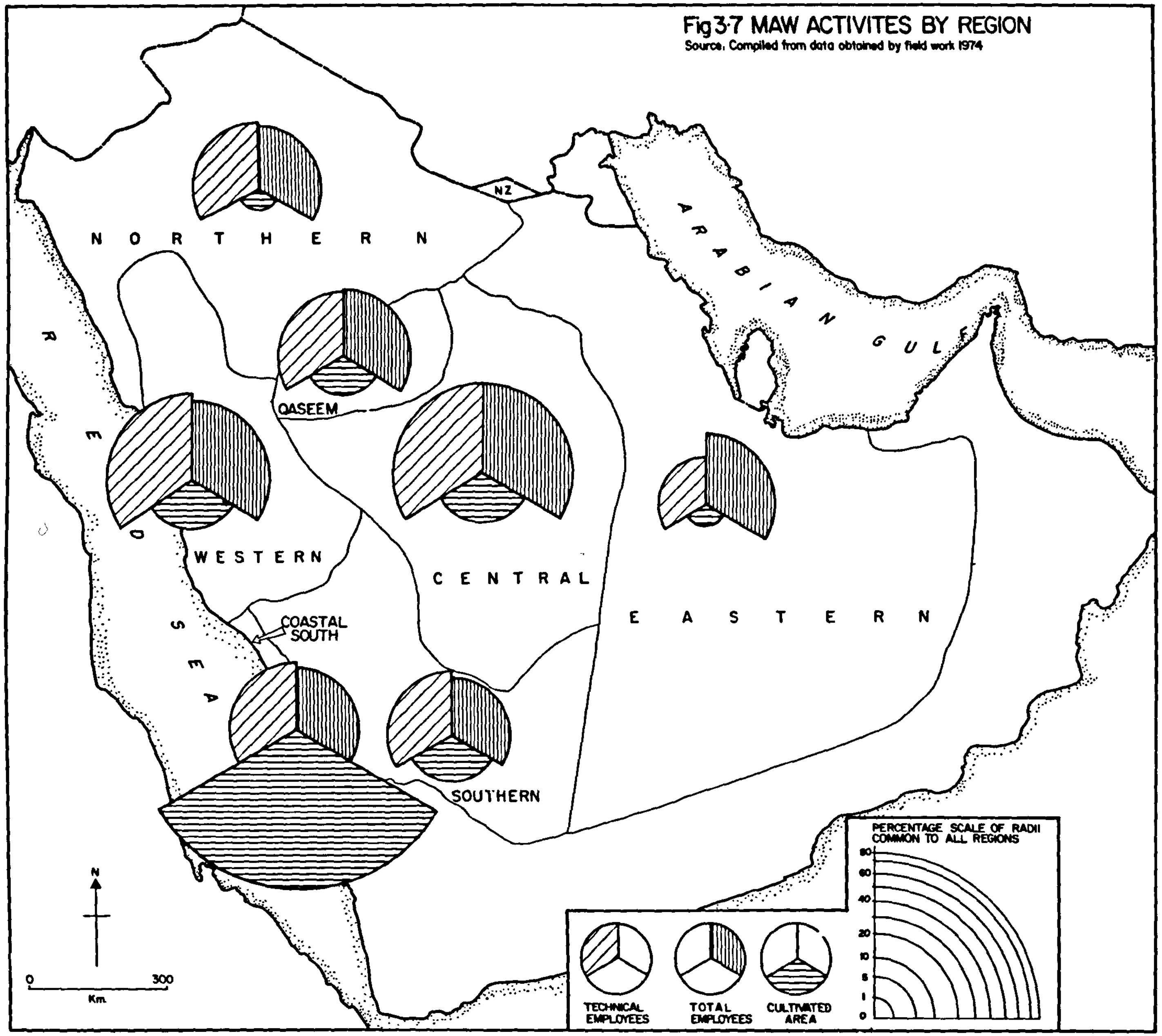


Fig 3·7 MAW ACTIVITES BY REGION
Source. Compiled from data obtained by field work 1974

form of salaries, facilities, equipment etc., for the staff in every region is considered an indication of the MAW's regional investment, then one can conclude that the MAW's investment in regional agricultural development is not balanced because it is not related to the variation in the regional potentials for agricultural development.

3.4.2 The distribution of MAW Veterinarians

Table 3-10

The Regional Distribution of the MAW Veterinarians

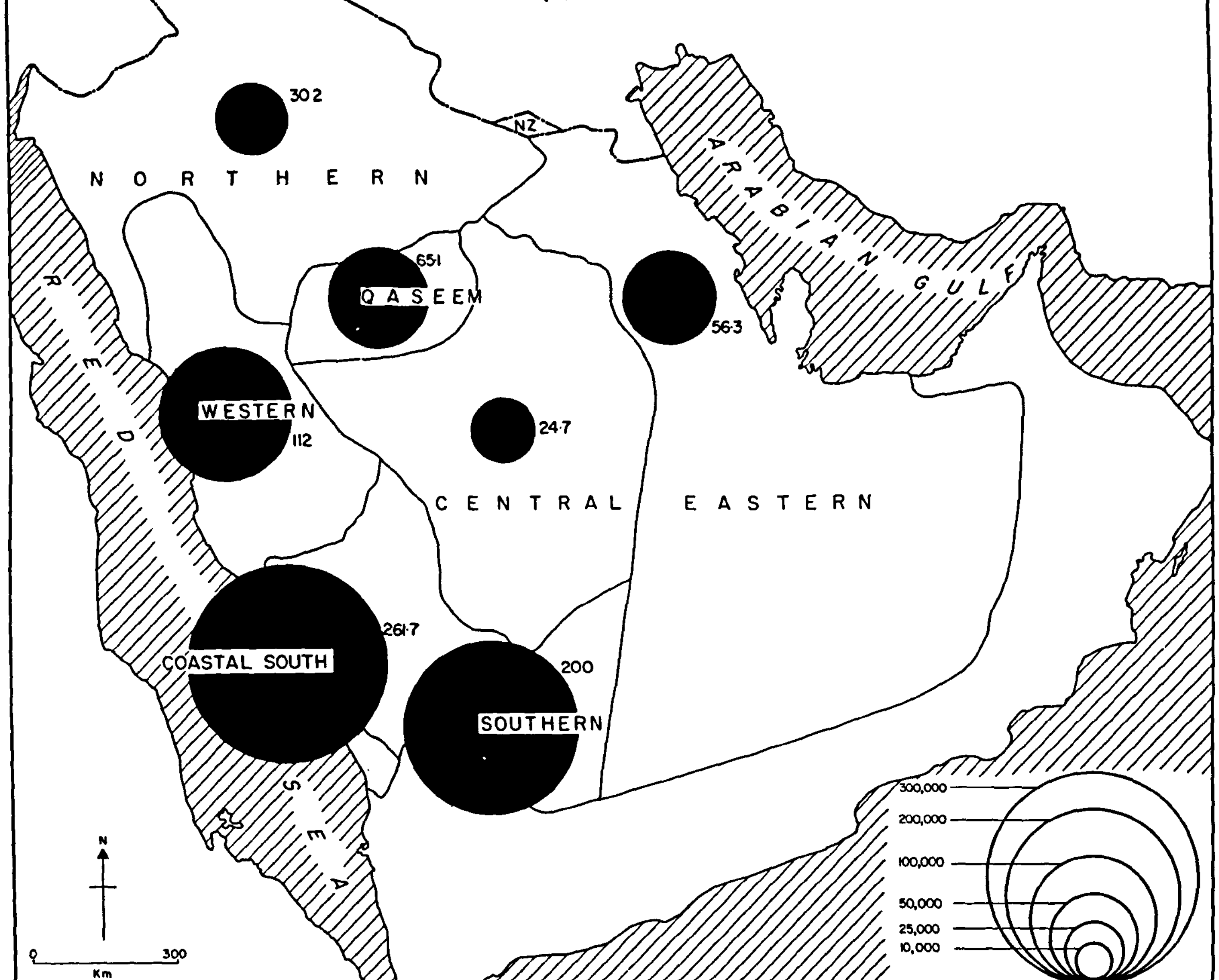
Region	No. Vets.	No. Animal Units*
Eastern	3	168,770
Northern	7	211,292
Central	11	271,533
Qassim	5	325,554
Southern	7	1,400,188
Coastal South	2	523,346
Western	8	896,281
Total	43	3,796,964

* in agricultural areas (excluding pastoral areas)

Source: Number of vets from the MAW Extension Department 1974, Animal Units, Chapter 5.

The present distribution of the MAW's 43 veterinarians also demonstrates regional disparities. Table 3-10 shows that they are relatively numerous in some areas and very few in others. This unbalanced distribution is illustrated by Figure 3-8 which shows that the regional ratio of veterinarians to animal units is large in some regions and small in others. For example, the Central Region has around 24.6 thousand animal units per veterinarian. On the other hand, the Coastal South has 261.6 thousand animal units served by one veterinarian. This unequal ratio applies only to the livestock population estimated by the

Fig. 3·8 THE DISTRIBUTION OF THE REGIONAL ANIMAL POPULATION IN AGRICULTURAL AREAS PER VETERINARIAN
(THOUSAND ANIMAL UNITS/VET 1974)



SOURCE: COMPILED FROM INFORMATION OBTAINED FROM MAW EXT SERVICE DEPT AND ANIMAL SECTION 1974

MAW for the agricultural areas of the country, hence it does not necessarily include the pastoral animal population. Therefore, these ratios are under-estimates, because the total regional animal population has never been estimated (Chapter 5). However, the national ratio (per veterinarian) derived from the total national animal population (Chapter 5), is unrealistically large and amounts to one veterinarian per 270.6 thousand A.U. Such a large ratio makes it almost impossible to provide reasonable veterinary services.

3.4.3 Main Causes for MAW Regional Difficulties

Basically what is happening in the regions is that, by having too many branches, the MAW is spread too thin, regardless of its limited ability to provide these branches with the required essentials. This fact is not new and the MAW realised it as early as 1958, when the then Minister of Agriculture complained that:

> The vast areas of the country and the scattered and diffracted nature of the MAW's regional offices all over the country, coupled with limited budgets, makes accomplishments very small and beneficial only to very few farmers in all areas.

The Minister went on to state that:

> If it was up to the MAW...it would have preferred to concentrate its efforts and regional reorganization in such a way that only a few areas would be provided with the most ideal services possible.[16]

The MAW authorities interviewed by the author recognise that the MAW, burdened as it is by its inefficient organization and ponderous administrative procedure, and most of all by the shortage in qualified staff, is unable to utilize efficiently its numerous scattered branches. Many are aware of the need for a considerable reduction in the number of these branches and the consolidation of some of them, but this would involve the closure of some branches and the communities that have these branches in their areas would certainly campaign actively against this.

16. Translated from the Introduction by the Minister of Agriculture and Water (1958), op.cit.

Experience proves that pressure groups will succeed in reversing any closures. Some MAW authorities tend to blame earlier MAW administrations for increasing the number of regional branches. However, this is not the cause of the problem, but is a symptom of a more far-reaching problem which is the fact that the early branches were so inefficient that communities located some distance from these branches did not get the same benefits as communities located closer to them. Consequently the further a community was from an MAW branch, and the fewer benefits it got, the more persistent it became in pressing for its own MAW branch.
The continuous demand of agricultural communities for MAW branches made at all levels including the highest (where there is generally more sympathy for the public) usually succeeded. Furthermore, this unyielding demand for MAW branches was frequently influenced by political, social and other economic factors.

In addition to the agricultural benefits farmers can get from a branch, they get other benefits. Interviews conducted with a number of MAW authorities and leading members of the community revealed other gains. A new branch provides its locality (particularly areas with limited resources) with benefits such as employment for a number of citizens, expenditure in the form of high rent and purchasing power, and political control at least over the area around it by restricting the agricultural services to its own locality.

If the request for a branch is not accepted at the MAW headquarters, which is usually the case, the leading personalities of that area start bombarding the higher authorities (up to His Majesty) with telegrams, visits, and pressure from all directions, arguing their urgent needs and pointing to the failure of the MAW branch closest to them to satisfy their requirements. The validity of their arguments persuades the higher authorities to order the MAW to establish a branch. This situation can easily be appreciated from the following quotation:

> The MAW under pressure of successive and continuous requests, and faced with orders, cannot in most cases object, but implements these requests; accordingly the MAW dilutes vastly its efforts and facilities, making efficient administration difficult to attain.[17]

These regional difficulties have always been known by the MAW and efforts towards overcoming them is a major MAW policy. In 1958 a drive towards the decentralization of the MAW was pursued, dividing the country into eight agricultural areas. Three of these areas: Riyadh, Hasa and Jeddah, were established in the late 1950's. It was planned at that time that these three areas would be provided with all the necessary administrative and technical facilities so as to be able to manage their own affairs with minimal interference from MAW. However, the idea was not pursued in later years. In 1972 the idea re-emerged in the form of a major regional reorganization programme, starting by co-ordinating all the MAW branches in 'Asir under one main body. Efforts have been made to provide this branch with all the requirements necessary to do its duties and hence to become an example to follow.

3.5 Consequences for Livestock Development

The few examples that follow reveal how vital is the efficiency of an institution such as the MAW to agricultural development and particularly to livestock development in the country. This fact has become internationally recognised and the reports of the International Banks in various under-developed countries demonstrate a growing awareness of the administrative obstacle to development: "a factor that has been neglected in economic development".[18]

Collectively the MAW's difficulties have produced disappointing results, especially in the fields of land reclamation, research and agricultural policy. Some aspects of these fields will be briefly described

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17. Ibid.
18. Riggs, W.F., op.cit., p.243

so as to illustrate the fundamental importance of the MAW in agricultural development and particularly livestock.

3.5.1 The Hofuf and Faisal Settlement Projects

The Hofuf Irrigation and Drainage Project (HIDP) and the Faisal Settlement Organization (FSO) are the two main land reclamation projects. They were started in 1967 and 1966 respectively and were inaugurated in 1971, costing an initial investment of around SR 700 million.

The HIDP project was implemented for the ancient oasis of al-Hofuf. A considerable irrigated agriculture has existed there for many thousands of years. The oasis is supplied by highly productive artesian springs which were being inefficiently utilized and which it was calculated were sufficient to supply 20,000 hectares, instead of the 8,000 hectares generally under cultivation. On this basis, a modernization scheme for water distribution and a drainage system for the oasis was planned and executed in direct conjunction with the development of the oasis. The project was a major civil engineering task. It involved the sealing of some springs and the development of others and the construction of approximately 1,200 km. of underground concrete canals and a matching drainage system. The distribution system includes high capacity pumping stations and reservoirs. As a result of this project approximately 12,000 hectares of new land is ready to be brought into cultivation and 8,000 hectares has been improved.

The modernization of the irrigation and drainage system was not matched with a modernization of farming and land use methods. Agricultural development for that reclaimed area (cropping patterns, water use, land use, size and methods of farming, livestock and crop types etc.)has not been proposed or planned so as to be implemented when needed, either gradually while the project was in progress or even in its final stages. When the project was handed to the MAW, farmers expressed overwhelming concern about the impossibility of adapting their old farming methods to the new modern system. The MAW had to start almost from scratch to do what a specialist in 1971 described as "a searching enquiry...into how the agriculture of the old oasis can be reorganized...The economic utilization of the new lands is under continuous study".[19]

FSO, a similar project for the Haradh area, lies in the central part of the country, approximately 270 km.south-southwest of Riyadh. The purpose of the project was to "provide for the thousand nomadic families to be settled the necessary housing facilities, public service centres, domestic water, electric power and communication facilities".[20] The project was a package deal, completed in 1971, with 52 deep wells, a 20 mw. gas turbine power station, a 40 hectare experimental farm and a 300 km.concrete canal water distribution system, almost 200 km. of roads, 88 km.of fencing, administration buildings and a housing complex.

When FSO was handed to the MAW a similar problem to that of the Hofuf project emerged. The only difference is that the Hofuf project was badly needed to do what it was implemented for; while the need for the FSO, as described in its objectives, was not pressing nor demanding at the time of completion; that is to settle the Bedwins. The complexities of this problem are beyond this discussion. However, this lack of need can be explained by the fact that the settlement process of the Bedwins of the Haradh area, with its convenient location between the main urban centres in the country (Riyadh and the oil areas), has been progressing spontaneously. The leaders of the al-Murra tribe (the main beneficiaries) in that area have confirmed that a very large number of their people have already settled in Riyadh and the oil areas, and

19. Cresswell, E., Notes on some aspects of the work of the MAW, (Riyadh; 1970), p.17
20. Akkad, H.A., "The Nomadic Problem and the Implementation of a Nomadic Settlement Scheme in Saudi Arabia" in Land Policy in the Near East,compiled by el-Ghonemy, M.R., (F.A.O.; 1967),p.300

this explains the small al-Murra population (estimated at about 14,000[21]) spread all over the country. Moreover, the FSO focuses on an agricultural type of settlement that does not conform with the socio-economic preferences of the al-Murra whose desire to settle can easily and more efficiently be satisfied by other alternatives i.e. industry, government employment and others. The vital data, collected on the basis of interviews with the al-Murra[22] conducted by a consulting company, which indicated the al-Murra's desire to farm, were rejected by Speetzen who emphasised that:

> Agricultural production will demand a permanent labour input. The al-Murra were not aware of this when they were asked their views on agriculture. Therefore, the author [Speetzen] doubts whether they had a complete grasp of the meaning of agriculture.[23]

3.5.2 Livestock Research

From the establishment in 1964 of the Department of Agriculture, Research and Development until 1970 its overall accomplishments can be summarized by quoting its director, who states:

> No matter how the possibilities indicated by the sub-reports are interpreted to be encouraging, there is no doubt that not a great deal of systematic applied research has been achieved by the department in the past...[Due to] poor organization and a difficult administration system, aggravated by a lack of appropriate staff and finance.

He warned that:

> Without [overcoming these problems] it is impossible for there to be a proper exploitation of the national investment in agriculture and livestock whether this be old investment or new investment.[24]

To overcome these problems and to attain better results a new approach was initiated through reputable international institutions. In

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21. Cole, D.P., The Social and Economic structure of al-Murra: a Saudi Arabian Bedwin Tribe, (Univ. of California, Berkeley,Ph.D. Sept.1971),p.1
22. Elaborated in Wakuti,Market Study FSF (Zug; 1970),p.67 and referred to in detail in Speetzen, H., Land Settlement Projects and Agricultural Development: An Analysis of Development: Factors and Processes based on four case studies in Ghana, Libya and Saudi Arabia, (Univ. of Durham, Ph.D. 1974)
23. Ibid.,p.25
24. Akkad, H., A Review of Past Work, Present situation policies and programmes for the next five years, (Riyadh; MAW, 1970),pp.6-7

1970 an agreement was made between the MAW and the University College of North Wales, Bangor (UCNW) to undertake joint research and development in animal production and allied sciences in Saudi Arabia. This agreement is designed to provide for:

(a) The continuation and expansion of research and development in animal and forage crop production and allied subjects with a view to raising the productivity and reproductivity of cattle and sheep in Saudi Arabia and to maximise the return per unit of water used for forage production.

(b) Making available to the extension service and the agricultural community research results permitting the development of recommendations of practices to increase agricultural production and efficiency.

(c) The training of Saudi technicians in the fields of research and technology relevant to the subject of the agreement.[25]

The present writer, a participant in the early stages of this agreement and later an observer (field work 1974), has found that the work concerning research and training is impressive, as indicated by first-hand up-to-date information published in numerous reports. In the fields of science and training the UCNW's contribution, considering the administrative problems faced, has been successful and productive. What did not evolve successfully was the second objective concerning a liaison with the extension service. This was mainly the MAW's responsibility. Until 1974 a clear approach towards this objective did not evolve hence the MAW and the farmers have not really benefited. Among the reasons for this failure are:

(a) The lack of qualified Saudi staff, and the failure to create highly paid posts to suit qualified Saudis. This made it impossible to find a competent Saudi co-manager comparable to the UCNW field manager, who is highly qualified. (b) When the joint venture was implemented the

25. MAW and UCNW, An Agreement of co-operation between MAW and UCNW, (Bangor and Riyadh; 1973),p.1

appropriate Saudi organisation was never specified. Hence there was no authorized competent administrative staff, with the result that the research team was totally dependent on the MAW headquarters in Riyadh for its daily activities. (c) Suitable communication channels with the farmers, either directly or through the MAW, have not been organized. Hence the information and advice the farmer needs to improve his practices have never been properly made known to the research team.

3.5.3 Agricultural Subsidies

In November 1974 the MAW submitted to His Majesty a proposal for sheep and camel subsidies. The main objective was "to induce an increase in meat production in the country and to improve the situation of the Bedwins and those who deal with livestock production".[26] Indeed this subsidy is badly needed to encourage pastoralism and to reduce Bedwin migration. However, the main weakness of this subsidy is its approach and method of implementation. The MAW lacks reliable information about animal population, regional characteristics, animal types, owners, type or size of ownership, (Chapter 5) marketing channels, and other vital related information. In the absence of such information the framework of these subsidies had to be based on two unreliable sources: (a) the traditional Islamic form of taxes Zakat which demand a fee (tax) to be paid on every animal owned in excess of 40 head in the case of sheep and 5 in the case of camels. But many pastoralists do not comply properly with Zakat hence any estimates obtained will be distorted. (b) The organization of a committee made up of Kharasin (assessors or appraisers) and clerks to be dispatched to water points at the beginning of summer each year to estimate the number of animals.

The subsidy proposed was SR 10 per head of sheep or 5% of the estimated price and SR 50 per head of camels or 5% of its local price. Both

26. A letter to His Majesty by H.E.The Minister of Agriculture, Ref.No.1 11419 dated 28/10/1394

of these subsidies were estimated to amount to SR 19.6 and SR 26.2 millions for sheep and camels respectively.

One major point the author has stressed in the MAW (field work 1974) is that although the subsidy idea is sound, the method of implementation will end up doing more damage than good, because it will encourage pastoralists to increase the number of their animals beyond what the ranges can support, and they are already experiencing a total deterioration (Chapter 7). This subsidy would have been more helpful if it was paid on the basis of "off-take": i.e. the animals that are sold out of the pastoral herds to be slaughtered. In this way meat for consumption would increase, while at the same time pastoralists would be encouraged to get rid of their young animals which are ready for slaughter as soon as possible and also the old unproductive ones, which would relieve the ranges. Another important weakness of these subsidies is that, after the committee was established, neither a follow-up body was set up to improve on the subsidies, nor was a permanent organization established to administer the subsidy programme.

PART TWO

LIVESTOCK TYPES AND DISTRIBUTION

INTRODUCTION

It is only natural that the plans for the development of livestock in any country must be based on the available resources and their spatial allocation. "What and where?" are the two most important questions to answer; thus this part deals mainly with livestock types and their spatial patterns. This aspect is one of the subjects most neglected by agricultural planners in the country and the relevant data are - in most cases - scarce and scattered. Census coverage is partial; national estimates are crude and incomplete, and are derived from casual observation rather than scientific methods. Therefore there are not enough data to provide complete answers to many vital questions about animals and their spatial trends. In spite of these limitations some picture must be gained of the animals and their potential; most important of all, we must ask where they are, what areas can support what numbers, and what are the present distributional patterns? It is essential that these questions are answered - at least approximately - so as to help in formulating national plans for the development of this sector. It is the job of a researcher to try to get material of the greatest possible accuracy and then to make the best of it; but if this is not possible, as in the present case, then we cannot afford the luxury of discounting the available imperfect data if nothing better is available.

The contents of this part are based on MAW studies, reports, surveys and regional censuses. The most valuable are the MAW census of 1968 and 1970/71 and the Resource Surveys of 1968-70 although both are incomplete and cover parts but not all of the country.

The end results are contained in the following two chapters. Chapter Four deals with livestock types, and in particular their location, main characteristics and their economic significance and potential for development. Chapter Five deals with the animal population, composition, structure, and regional concentration and specialization. Twenty six districts were delineated by the author to provide a regional picture to identify regional trends. With the help of a computer a number of statistical methods were employed, some of them for the first time - as far as the author knows - in livestock spatial analysis. All these methods are widely used by industrial geographers, and the author found them both enlightening and helpful: with some improvements they could well serve agriculturalists as well as agricultural geographers.

Before proceeding to analyse livestock types, their numbers must be converted into some common unit, so that they can be compared, and some measure of their relative importance must be devised. The impracticability of using numbers alone as a basis for comparing the relative importance of different classes of livestock is at once apparent, for it would clearly be meaningless to equate, say, one goat with a larger animal like a camel. It is therefore necessary to convert the various livestock types into livestock or animal units. (A.U.).

The animal unit system, introduced as a method of data comparison and classification by Bennett-Jones in 1954,[1] is one of standard equivalents weighted according to the estimated general feed requirements of selected classes of livestock, which is itself based on Kellner's work on starch equivalents.[2]

The animal units used in this study follow the MAW's definition of sheep and goats as one animal unit, and cattle and camels as five animal units each.

1. Morgan, W.B., and Munton, R.J.C., Agricultural Geography, (London; Methuen & Co.Ltd, 1970), p.106
2. Ibid.

CHAPTER FOUR

LIVESTOCK TYPES

This chapter provides a brief evaluation of the most important national animal breeds and varieties, their main characteristics and their regional significance. Some of these animals are referred to as types, because they are distinguishable by some phenotypic characteristics, while others are identified as breeds, of rather specific standards of phenotypic traits[1] and sufficient homogeneity in certain traits.[2] Variety is used when it is difficult to find uniform characteristics which can be considered as a basis for defining a breed, as in the case of camels. The main types of livestock raised in the country are camels, cattle, sheep and goats and each type with the exception of camels has several breeds. Some of these animals are indigenous to the country as in the case of the camel, some sheep breeds - Najdi - and some goats. Some are admixtures of local types and groups introduced from elsewhere, and others are recently introduced - European cattle. The main advantages, disadvantages, economic significance and socio-economic values, will be stressed in this chapter. As to these animals' direct relationship with other subjects dealt with in this thesis, this will be dealt with when the need arises, as has happened already in earlier chapters.

4.1 Camels

Camels in the world are grouped into two classes; the dromedary *Camelus dromedarius* with a single hump and the Bacterian *Camelus bactrianus* with two humps. The only camel class known in Arabia is the one humped dromedary.[3] The Arabian Peninsula is assumed to be the domesticating

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1. McDowell, R.E., Improvement of Livestock Production in Warm Climates, (San Francisco; W.H.Freeman & Co.,1972),p.264
2. Cole, H.H., and Ronning, M., (eds.)Animal Agriculture: The Biology of Domestic Animals and their Use by Man, (San Francisco; W.H.Freeman & Co., 1974),p.270
3. Mikesell, M.K., reported that the Bacterian have never been seen in the Peninsula. The nearest place was in Syria at the beginning of the 19th century, "Notes on the Dispersal of the Dromedary", South Western Journal of Anthropology, Vol.11, 3, p.900

centre for the camel. Even though there is no archaeological or paleontological evidence, such an assumption is supported by the ancient Arabian reputation for dromedary breeding.[4]

4.1.1 Varieties

The variations within the camel population in the country are not pronounced as to form distinctive camel breeds. However, there are some marked variations that can be noted, mainly in the camels' colour, muscular built, milk production and distribution. On the basis of these traits two varieties of camel can be recognised. (a) The Mojhim variety, is the largest in the country, with a heavy head, strong neck, and large feet adapted to sandy ground. Females are noted for their milk yields. This variety is common along the western border of the Empty Quarter and also in the northern region (Plate 4-1). (b) The Omani variety originated on the Oman coast of the Arabian Gulf and were bred originally for riding purposes and are noted for their speed. They are small in size with a light head and slender neck. Milk production is moderate. Between these two varieties there are wide variations in colour and size, due to the different ecological habitats. Camels of the south are in many cases blackish while the northern ones tend to be dun-coloured. The varieties in the western and southern coastal areas are small, light brown or fawn.

4.1.2 Economic Importance

The camel has always been a principal animal in Saudi Arabia, largely because of its outstanding adaptability to the poorest parts of the desert. Furthermore, the camel produces a sizable share of the national needs of animal protein. Milk yields can reach more than 2,000 L under natural conditions during a lactation period of about 400 days. Meat yields are estimated at 54% - 62% of an average animal live weight of 332-400 kg.[5]

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4. Ibid., p.908
5. Ital Consult., Water and Agricultural Development Surveys for Areas II and III, Final Report, Agricultural Development Stock raising, Prepared for MAW (Rome; Ital Consult, 1969), pp.21-25

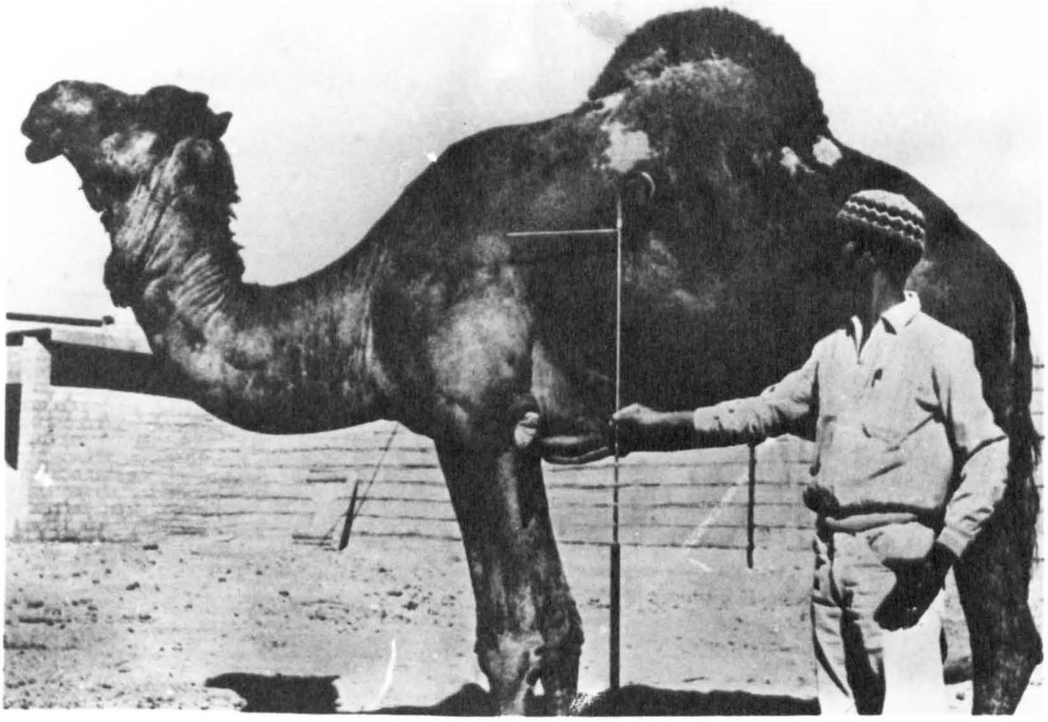
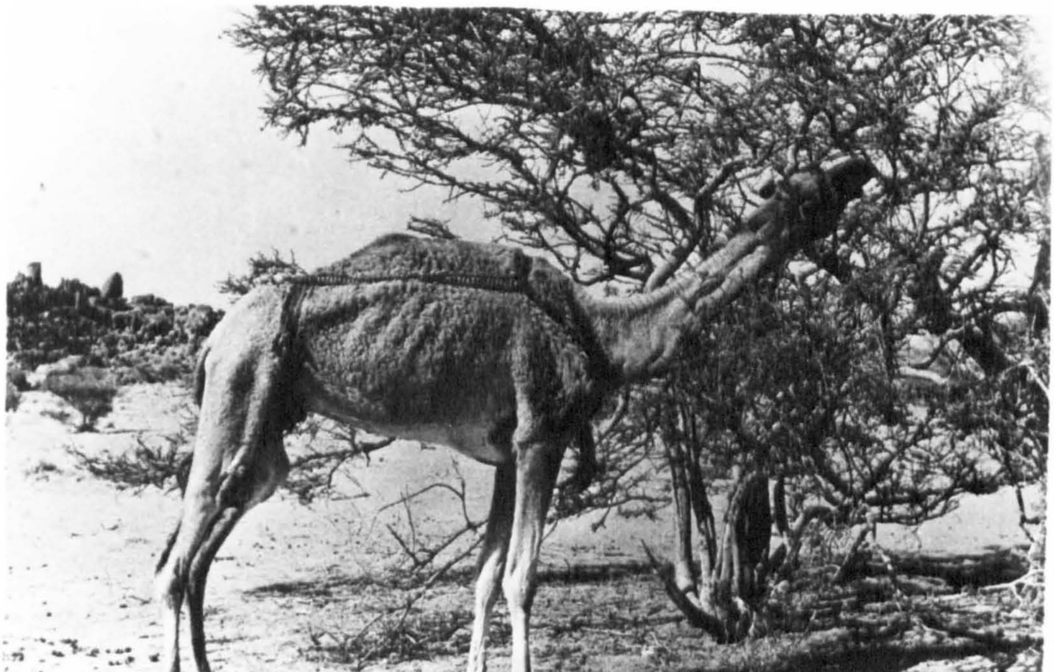


Plate 4-1 Mojhim camel: the largest and the most common type of camel in the country (Najran).

Plate 4-2 Camels graze ground vegetation and browse trees to a height of 2.7 metres. If not controlled they can cause a great deal of damage to ranges (Tihama).



Meat weight, as estimated by the kind of animal slaughtered in the main urban and rural centres in Saudi Arabia for the period 1967-1972 (Table 4-1), indicates that camels provided an average of almost 35% of the meat slaughtered for those areas followed by sheep, while cattle and goats were a poor third and fourth. Although it seems that camels have lost their national lead they still rank second in number to sheep, constituting over 34% of the national animal population in A.U. (Table 4-2).[6]

The significance of the camel's adaptation to the desert lies not only in its utilization of a large range of desert vegetation, but more important is its ability to travel on foot over long distances for months at a time, to isolated areas of difficult terrain and away from water sources i.e. the Empty Quarter and An-Nafud. This endurance make the camel require long periods of pasturing with a minimum of human control so that it is considered "the only domestic animal that has not been much modified by domestication".[7] It is for this reason that camels are not usually raised in agricultural areas where other tractable species (sheep, goats and cattle) are easily cared for. The camel's high degree of endurance of extreme desert conditions is attributed mainly to two factors, (a) the ability to stand dehydration and (b) the ability to survive on poor ranges.

These advantages result from the camel's possessing more fully developed physiological and behavioural mechanisms for coping with heat and aridity than any other domestic animal in the country. It can withstand considerable dehydration and tolerates a loss of 27% of its body weight without any apparent ill effects.[8] In climates as extreme as those of the Empty Quarter and the coastal low lands the camel exhibits a slow rate of water loss, by allowing its temperature to fluctuate by

6. An Adjusted Table see Table 5-3
7. Zeuner, F.E., A History of Domesticated Animals, (London; Hutchinson, 1963), p.363
8. Schmidt-Nielson, K., Desert Animals: Physiological Problems of Heat and Water, (Oxford; Clarendon Press, 1965), p.70

Table 4-1

Average Percentage of Meat Weight Estimated by kind of animals slaughtered in the main centres in Saudi Arabia for the period 1967-1972 (%)

Type	Ave
Camels	35.3
Cattle	15.8
Sheep	32.5
Goats	16.4

Source: Derived from Ministry of Finance, CDS Statistical Yearbook, 1973, A.D. (Riyadh; 1973)

Table 4-2

Estimated Percentage of Animal Types in the total animal population in A.U. for 1974.

Type	Ave
Cattle	14.4
Camel	34.2
Sheep	36.5
Goats	14.9

Source: Derived from the adjusted estimate Chapter 5, Table 5-3 as much as 5-6 degrees, thereby saving water through heat storage.[9] Surrounded by high ambient temperatures the camel also employs water-saving devices by reducing faecal, urinary and evaporative water loss. Camels were observed to last without water for as long as 45 days in a moderate climate of 22°C[10] and to tolerate water of a 3.9 - 5.5 NaCl solution, which is more concentrated than sea water.[11]

4.1.3 Trends and Potentials

The traditional role of the camel as a transportation vehicle for man and goods was of enormous benefit to the inhabitants of the Arabian Peninsula to such a point that its domestication was considered "the turning point in the history of the desert". It was called "the ship of the desert", and until the recent introduction of automobiles in the last 30 years, the era as far back as the beginning of the domestication of the camel was called "the camel era"- at least for Arabia - because the camel made it possible for the inhabitants to penetrate and utilize the desert, migrate, fight their wars and establish their control over the desert. Lately modern means of transport have swiftly replaced the camel for transportation purposes. Thus the camel's role as a "beast of burden" has lately come almost to an end.

Another important economic use that has declined greatly is the traditional processing and utilization of the camel's by-products (fibre and leather). The processing of these products has decreased to such an extent that most hides are now disposed of as waste. Bedwins have become used to imported finished materials which are ready to use and save labour.

Camel milk and meat are becoming the main economic aspect of camel herding. Milk is of vital importance to the well-being of the whole pastoral community, and the camel provides the community with a supply

9. Maloiy, G.M.D., Comparative Physiology of Desert Animals, (London; Academic Press,1972),p.249
10.Ibid., p.245
11.Ibid., p.243

of milk which is more abundant than that enjoyed by the rural and to a lesser extent the urban communities whom socio-economic circumstances do not allow to keep dairy animals or find fresh milk in the market. Camel milk has never been and still is not produced for commercial ends because, traditionally, it is used for the household, or for offering to guests, and selling it has been considered to denote an inhospitable attitude. Up to this moment, the processing of camel's milk for commercial ends has not been attempted, but on the whole a great number of pastoralists questioned by the author have shown new commercial attitudes and do not see anything against the idea of selling milk. Such a tendency indicates the substantial cultural changes affecting al-Badiah in recent times (Chapter 2). However, camel's milk at present, as with any other perishable product, is consumed in situ by pastoral populations.

Among camel products, meat has gained the largest market after sheep (Table 4-1) due to the fact that the camel can be driven on foot to the most distant ranges and markets, and its meat is a familiarly accepted product to the larger part of the community. Consequently, pastoralists are now raising camels mainly for meat production.

The most important critical trend is the recent argument against increasing or maintaining camels as a basic part of the country's live-stock wealth. Such an opinion has been voiced by leading specialists in the field. B.W. Allred, an F.A.O. range specialist and an inter-national authority on range development and conservation, advocated that:

> As camels are low producers and range destroyers, the government should give them, [Pastoralists] an incentive payment to dispose of all except those needed for family transportation to move camps and to supply water for herds.[12]

Due to the fact that camel transportation has been increasingly replaced by automobiles, such a statement would, if implemented, lead to the

12. Allred, B.W., Range Management Training Handbook for Saudi Arabia, (F.A.O; Rome, 1968), p.4

elimination of the camel from the Arabian scene. The fact that this opinion has not been either rejected or commented on by the MAW specialists seems to indicate that there is a certain degree of appreciation for such a proposal.

Allred's opinion is assumed to be based on and derived from a number of reasons that are disputable. The main ones are the following: (1) The strongest argument against camels is their destructive grazing behaviour devouring every edible plant in poor seasons or on poor ranges, from the ground to a maximum height of around 2.7 m.high (Plate 4-2). Indeed, the camel is noted for being unselective in its grazing and browsing habits and there are few plants that camels would not consume. Camels have developed upper lips sensitive enough to pick up small vegetation and leaves in trees and around branches. Also, as Hafez pointed out, hard tissues are present around the mouth which are impervious to xerophilous vegetation that provides a main portion of the animal's diet.[13] With such advantages camels left on their own can do a great deal of damage and destruction to ranges. However, for the camel to be blamed for range destruction is an overall simplification of range problems in Saudi Arabia. All animals for their part equally contribute to over-grazing problems, however over-grazing is not caused by only one particular animal type, but is caused by having many of one type or of all types on one range or another to the point of over-stocking (Chapter 7). It is reasonable to conclude that camels are merely adding to rather than causing, the destruction which is also brought about by sheep, goats, man's misuse and the lack of conservation of range resources. (2) The second argument against the camel is that it is a low producer because it (a) reproduces only about five times in its useful life of 17-18 years, female camels bear young every 2-3 years, the first part-

13. Hafez, E.S.E. (ed.) Adaptation of Domestic Animals,(Philadelphia; Lea & Fabiger, 1968),p.63

urition occurring at about six years and the last at about 16 years,[14] (b) considering the camel's size, the milk and meat yield is considered to be low compared to smaller animals. This argument misses the whole significance of the economic value of camels, and that is their ability to survive on the poorest ranges producing and reproducing valuable products. Moreover, the areas they utilize could hardly be used by a more useful animal; furthermore, these areas can not be so far utilized for other uses. The camel's patterns of land use is of a different nature from that of sheep, cattle and goats (Chapter 6): it can utilize areas that are either too meagre or too distant for other animals - hence, it need not, if well-managed, overlap with other "more useful animals". Thus, from the standpoint of the camel's production yields, they could even be considered more significant than sheep, a point emphasised by Knut Schmidt-Nielson, who stresses that:

> It is true that production is more rapid in a small animal but the maintenance expense per kilogram is also higher. It has been shown that the production per unit feed is approximately independent of body size of the animal...for a given amount of feed camels should produce approximately the same amount of meat as sheep. Due to the larger grazing area, more feed is available to the camel and productivity should be considered higher.[15]

(3) <u>Psychologically induced socio-economic changes</u>. The recent gradual but substantial increase in the nation's income from oil has induced the introduction of western values and way of life, causing a major change in taste, preference and diet of the urban population because; (a) the increase in income has enabled many to afford the more expensive lamb and mutton; (b) the western negative attitude towards camel meat, because of its unfamiliarity with it, has precipitated a similar attitude to camel meat by the westernized and usually most urbanized sector of the population; (c) most of the camel meat sold in the market is usually

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14. Ital Consult, <u>op.cit.</u>, p.23
15. Schmidt-Nielson, K., "Animals and Arid Conditions" in White, G.F., (ed.),<u>Future of Arid Lands</u>, Pubn.No.43 (Washington,D.C; Am.Ass.Adv. Sci.,1956),pp.368-382

from old animals - the pastoralists interviewed in the north and the south sell their camel males when they are five years old - hence, most of the meat sold is not tender but hard and fibrous.

The camels' meat is consumed mainly by rural and pastoral communities and the ones with less income. Modern supermarkets, large hotels, and social receptions deal mainly with lamb and mutton and not with camel meat. However, although the effect of this trend is gaining some ground it is slow and has been deterred from doing major damage to the camel market by the following factors; (a) camel meat prices are relatively less than that of lamb and mutton, hence it is attractive to many (b) culturally camel meat and milk is still considered an acceptable diet (c) the socio-economic familiarity with camel management, uses and rearing is too strong a cultural trait to be eradicated so quickly. However, these points cannot be expected to halt this trend for ever. This trend seems to the author most detrimental and could if not halted affect the camel's position in the future. The camel's strength lies in its ability to produce and reproduce in the harshest environment with very little input, thus producing a valuable source of protein for the nation. As Schmidt-Nielson suggests:

> the camel offers a most obvious solution to increase meat production in arid zones.[16]

4.2 Sheep

The sheep population is by far the largest of all animal types in the country (camels, cattle and goats), constituting 36.5% of the nation's animal units, as shown in Table 4-2. Lamb and mutton are the most popular meats in the country and are universally preferred. For the period 1387-1392 (approx.1967-1972), as shown in Table 4-1 lamb and mutton constituted an average of 32.5% of the total meat slaughtered in

16. Ibid.

the main urban and rural centres and ranked a close second to camels andequal to the total quantity of meat of both cattle and goats slaughtered in these areas.

4.2.1 Sheep Breeds and their Regional Significance

While there has been a considerable crossing among the native breeds, there are several distinctive types of sheep with sufficiently marked characteristics to qualify as breeds. However, very few individuals of these breeds are of a totally pure-bred nature. On the whole all these breeds can be considered either large or medium to small breeds. Their main characteristics and performances are summarized in Table 4-3. The main large breeds are the Najdi, Awasi, and Arabi, the smaller ones are the Harri, Absi, and Yemeni. The main significance of each of these breeds is their inherent adaptation to the various environments in the different geographical regions. The larger ones are adapted to the plateaus, the smaller ones to the highlands.

4.2.2 Large Breeds

Najdi Breed (Plate 4-3)

The Najdi breed belongs mainly to the central region but is also found in sizable numbers in the northern and eastern regions. The breed forms an extremely valuable genetic strain which makes it ideal for the central area. In this area Najdis have strongly confirmed characteristics, and perfect adaptability to environmental conditions. They withstand the extreme heat and cold and can utilize poor ranges. Young animals grow rapidly and adults soon recover lost weight after the summer months.

The Najdi is not restricted only to its homeland in the central area or only to the eastern and northern regions but is found in the highlands between the Hijaz and Asir chains and the Empty Quarter desert. However, the breed in this area is smaller and lighter in weight. They show the effect of a sizable degree of crossing with other local breeds

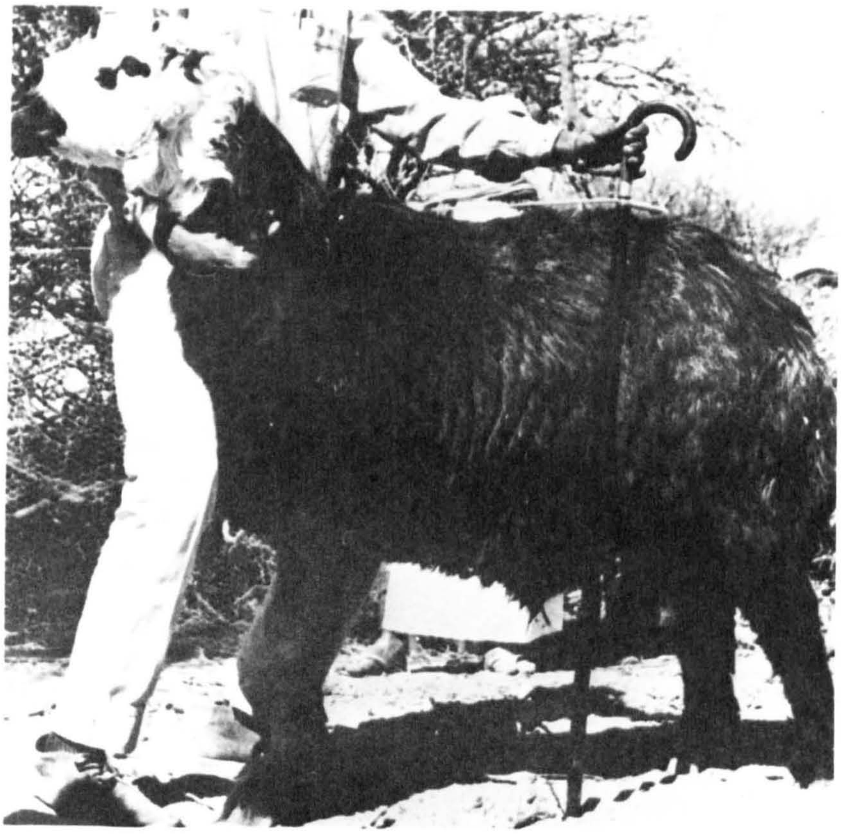

Plate 4-3 Najdi sheep, a large size breed are widespread in the central region (Hofuf).

Plate 4-4 Awasi sheep are the most common breed in the northern areas.

Table 4-3

Rates of development and performance for main sheep breeds in Saudi Arabia under natural conditions

	Najdi	Awasi	Arabi	Harri	Hebsi	Yemen Breed
Distribution	Central areas	North	Western areas	Along Hijaz mountains	Asir, Hijaz mountains	Yemen border
Birth wt. (kg)	2-4	2.5-4	2-5	1.5-2	1.5	1.5
Adult wt. (kg)	35-60	35-60	40-70	29	27-30	28
Lambing (month)	13-18	13-18	17-18	17-18	17-18	17-18
Last lambing (years)	4.5	4.5	4.5	4.5	4.5	4.5
Useful life (years)	5	5	5	5	5	5
Births	4-8	4-8	4	4	4	4
Fleece wt. (kg)	1.5-3	1.5-2.5	2-3	1	neg.	neg.
Milk production/lact.	50-75	50-75	50-60	35	30	45
Meat yield (%)	53-58	50-55	55-58	53-56	52-56	52-56

Source: Collected from various MAW sources for animals under natural conditions and based on observations.

Note neg. = negligible

and in general are less productive, especially in pastoral units. This situation has largely been attributed, among other factors, to a continuous process of natural selection caused by the environment of this area which is less suited to these animals compared to the breeds of this area because of its considerable metabolic activity and productive capacity. The Najdi's performance in its main areas under natural conditions is considered by pastoralists to be reasonable and better than other breeds under the same circumstances. Under improved circumstances their potentials respond favourably, giving a birth-rate higher than 130% with the possibility of three lambings in 26 months and 5-10% doubles. One of the most significant aspects of this breed is its reproduction cycle which is not highly influenced by the season; hence, with controlled mating, it is possible to obtain births spread over the entire year.

Experimentally this breed showed a favourable response to feeding and management. On the Hofuf Research Station,[17] the comparative fattening ability was tested for two groups of ten ram lambs, one group purchased from local Bedwins, the other selected from the flock at the Research Centre. The Bedwin lambs weight gain was 1.15 kg/week and for the Hofuf lambs 0.75 kg/week. These results proved to be slightly better than the growth rate achieved with Awasi sheep by Pervez and Bhattachara (1971)[18] in Beirut and by Appelman (1970)[19] working with Najdi and Arabi ram lambs in Qatif, Saudi Arabia. Moreover, this experiment was conducted entirely on alfalfa, and it is the opinion of the author that it is doubtful that their full potential growth rates were realized, hence their gains were lower than the weekly gains at Hofuf for similar lambs given diets incorporating concentrates, as shown by Farnworth and Robinson (1972).[20]

17. Ramadan, M.Y., and Robinson, W.I., Growth Rates and Voluntary Feed Intakes of Najdi Ram Lambs fed on alfalfa, Publication No.3, (Hofuf; 1972),p.5
18. Ibid.
19. Ibid.
20. Ibid.

The Najdi breed has attracted more attention, scientifically in the Hofuf Research Centre and commercially by being far the most popular with farming communities in the central area. Moreover, the Haradh sheep project relies mainly on this breed, raising up to 30,000 in 1974. Such emphasis on this breed resulted from (a) the Najdi being the most common breed in the central region, hence the farming and urban markets are familiar with it (b) other breeds did not get the same attention because of the lack of any research facilities in their areas. Thus, this emphasis is local in character and other breeds should be studied and given more attention to realise their potentials which are largely unknown.

The Najdi breed has its major drawbacks. Its maternal ability is not highly developed and it is noted for abandoning its lamb after birth to starve. Poor conformation of the udder causes an enormous death rate at lambing. The breed has a very high sensitivity to mastitis, and a sensitivity to mineral deficiency in particular as regards copper.[21] For many years it has been going through a continuous, uncontrolled inner- and cross-breeding, hence it has developed a substantial degree of unconformity and a great many disadvantages. The tail is too long and too heavy, weighing up to 5 kg. and so requires a lot of energy to maintain and travel with. The quality of the long hairy fleece is poor and is frequently absorbed by the lambs, leading to frequent intestinal obstruction. Najdi grazing behaviour is criticized by pastoralists as being labour demanding as a result of its dispersal in the range.

The Awasi and Arabi Breeds

Both these breeds are found over-lapping in the same areas, and cross-breeding among them is common. The Awasi (Plate 4-4) is a northern breed, common along all the northern borders with Iraq and is considered,

21. SCET, Socio-economic Development Plan, Central Region, Agriculture and Livestock, Prepared for Central Planning Organization, (Riyadh; CPO, May 1974),p.67

to a great extent, a Syrian and to a lesser extent an Iraqi breed. The breed is noted for its production of both meat and milk. The milk yield under natural but favourable conditions is estimated to be 60 kg. per lactation. Improved feeding has doubled the milk yield experimentally to 181 kg. in 168-190 days in Turkey and 168 kg. in Syria.[22] A more staggering improvement was obtained after several years of selection in the Lebanon from 50 kg. to 350 kg. per lactation.[23] However, in the case of Saudi Arabia very little research has been devoted to this animal apart from a few experiments done regarding weight gain which indicated that Awasi males have a higher feed conversion efficiency than males of the Najdi breed but gain in weight is on the whole similar. The breed is favoured in the north for its disciplined behaviour of following the herder and its ability to endure the cold winter in that area. Its fleece is more valuable than that of the Najdi and is preferred in the northern markets to the Najdi.

The Arabi constitutes one of the two major breeds in the eastern province, the other being the Najdi. The breed resembles the Najdi and the two are regularly cross-bred. Like the Awasi it is a multi-purpose animal, kept for the production of meat, milk and traditionally for carpet wool. Mature rams under desirable conditions may exceed 85 kg. live weight. This breed has received so far less attention than the other two breeds mentioned earlier. In an experiment by Appelman[24] it was pointed out that there was little difference in fattening abilities and slaughtering results between Najdi and Arabi yearling rams. The dry matter conversion tended to be better in the Arabi while the Najdi produced a heavier carcass.

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22. Mason, L.L., The Sheep Breeds of the Mediterranean, Published by arrangement with F.A.O., (Edinburgh; T. & A. Constable Ltd., 1967),p.149
23. Choueiri, E., "Role of Sheep Milk in the Economy of the Near East and Mediterranean Countries" in Proc.Second World Conf. on Anim.Prod., (St.Paul, Minnesota; American Dairy Science Association and American Society of Animal Science, 1969),p.411
24. Appelman, H., "Fattening Trial with Yearling Rams of the Saudi Arabian, Najdi and Arabi Breeds", North J.Agric.Sci., Vol.18, (1970),pp.84-88

4.2.3 Medium to Small Breeds

Harri

This breed is medium in size (Plate 4-5) and predominates along the Yemen borders spreading to the Red Sea coastal plains to near Jeddah and over to the Asir and Hijaz mountains, hence it is sometimes called the Hijazi breed. The breed is fairly important in the western parts of the country and also in the horn of Africa. It is considered a dual purpose animal for meat and milk. The fleece is considered to be of a textile quality to such an extent that it was suggested that some individuals may have marino or ramboulet blood,[25] an assumption difficult to substantiate. This breed as compared to earlier ones, does not have high productivity and this is perhaps a result of its outstanding ecological adaptability to the harsh and mountainous localities it inhabits where range lands are poor and animals have to cover ragged terrain. Their smaller size allows them to have a smaller feed requirement than other larger breeds.

The Absi and Yemeni Breeds

The Absi is smaller than the Harri, (Plate 4-6) and is frugal and strong. It is noted for its adaptability to mountainous and rocky areas, hence it is called Hajari which is derived from the Arabic word for "rock". It has assumed the typical characteristics of a mountain breed, being small in size and compact in body. The breed is raised mostly in the Asir and Hijaz mountains and in some valleys it is the dominant or even the only animal. The high ecological adaptation of this breed is so extreme as to be detrimental to its production capacity, which is poor. The breed under natural conditions weighs around an average of 30 kg. Milk production is low and the fleece is negligible.

The Yemeni (Plate 4-7) breed is smaller than the Absi, is noted

25. Sogreah Consult., Pilot Project for Range and Animal Production Development, (Riyadh; MAW, 1969),p.66

Plate 4-5 Harri sheep predominate along the Yemen border and in the south-western mountains

Plate 4-6 Absi sheep, noted for their adaptability to mountains and rocky areas. Found mainly in Asir and Hijaz mountains.

Plate 4-7 Yemeni sheep noted for their hardiness and frugality, and raised mainly in areas adjacent to Yemen.

for its hardiness and frugality and is mainly raised for its meat. Uniformity among animals is common which indicates a certain degree of in-breeding. Table 4-3 gives a summary of the breed's main characteristics and as with the Absi and Harri no research has been done on it: from observations these breeds would respond positively, but naturally differently, to improvements in feeding or management as a whole.

4.3 Goats

Goats have a wider geographical distribution in the country than sheep, cattle and camels. However, they rank third in the total animal population in the country, constituting almost 15% of the national total animal population in A.U. (Table 4-2). Also they rank third in their contribution to the total meat production in the main urban and rural centres, coming very close to cattle and producing 16.4% of the meat produced in these areas (Table 4-1). They are raised in oases, highlands, arid deserts and urban areas. Some survive in the hardest ecological conditions, and all play an important subsistence role in the diets of their owners.

The goat population in the country may be sub-divided into three types. The first comprises dairy goats, which are specialised milk producers and have well established dairy conformations, e.g. the Masry breed. Dairy breeds are relatively large in size and have evolved under favourable nutritional regimes. They are raised in households and on farms, and are managed with relative care, rarely being raised under pastoral conditions. The second type consists of semi-dual-purpose goats. They constitute the majority of the goat population and they are more widely dispersed around the country. Though they are dual-purpose animals (milk and meat), milk constitutes the major product. The third type is meat-producing goats of which there is only one breed (the Tihama breed) raised in the highlands of the south-western part of the country. They are hardy, small and less productive, but widely disseminated over regions which are subject to marked fluctuations in seasonal nutritive trends. The following gives an insight into the regional significance of the main goat breeds in the country:

4.3.1 The Masry Breed

This breed (Plate 4-8) was originally Egyptian from which it takes the name Masry. Strains of this breed are widespread in most Middle Eastern countries and it is largely a household animal. It is kept by urban and rural communities to supply their daily milk needs. It is more common in the Red Sea coastal towns and this could be attributed to the pilgrims, the majority of whom came from the Red Sea Basin. The breed shows little resistance to arid ranges, hence it is restricted to farming areas and households which can provide this animal with the minimum care and protection needed.

The breed is valued for its abundant milk production which reaches 120 kg. per lactation. It has a well developed udder. With improved conditions the rate of milk production could be raised. Meat is a minor product and plays a secondary role. It is only the males that are slaughtered for meat, but dairy goats are usually slaughtered when they are too old to produce milk.

4.3.2 Balady

This breed (Plate 4-9) is widely dispersed over the country. It does not limit itself to a particular habitat, and is kept by oasis farmers and desert nomads. It demands less care than the Masry breed, but is raised in less degraded environments where feeding conditions are somewhat better than in extremely arid environments. Milk production reaches 60 kg. The Balady is mainly a dairy goat, although the meat yield is also valuable. It produces milk steadily, even during periods of drought, and is therefore greatly appreciated by dwellers in semi-

Plate 4-8 The Masry goat is largely a household animal, and found in both urban and rural communities.

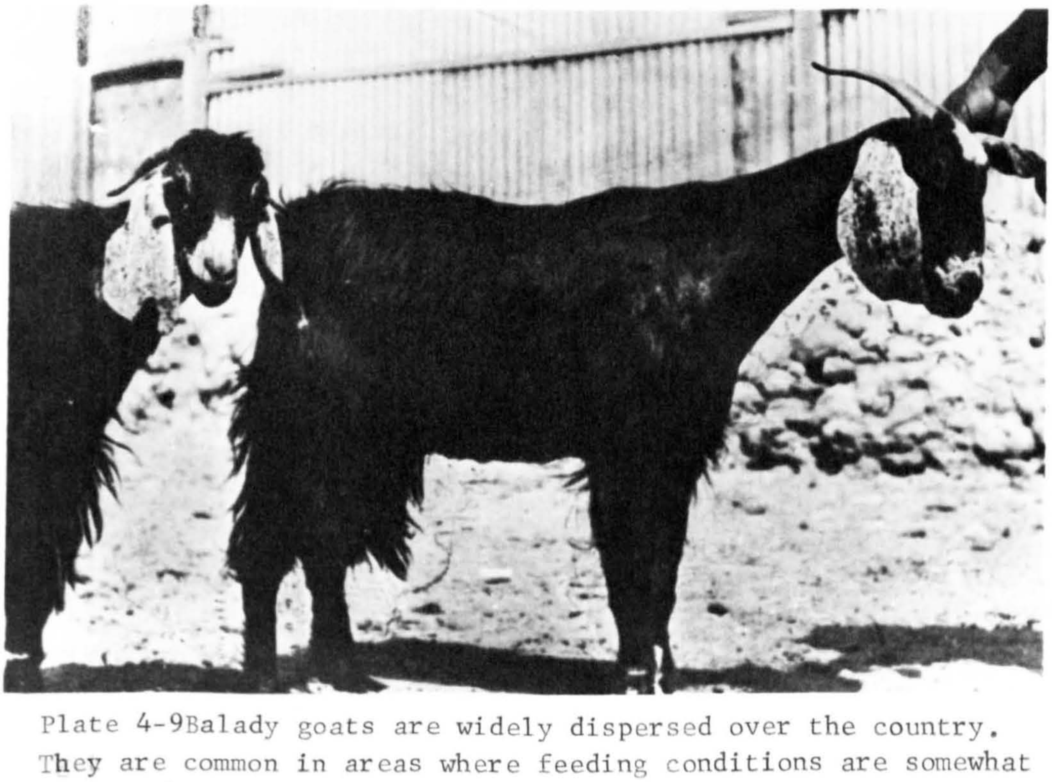

Plate 4-9Balady goats are widely dispersed over the country. They are common in areas where feeding conditions are somewhat better than in extremely arid environments.

arid areas.

4.3.3 The Abassi Breed

This breed (Plate 4-10) is also called Habsi or Ismiry and is referred to by outsiders as the Hijaz Dwarf goat.[26] It is typically an arid desert breed, which evolved under very poor conditions and is thought to be of African origin, an assumption strengthened by the fact that a strain of this breed is found in East Africa. It has a wide distribution around the country, and is found in large numbers in the north of Hijaz, and occurs as far afield as the Gulf of Aqaba.[27] The animal is small and weighs approximately 24-26 kg. This diminitive body size places it among the dwarf breeds, and is due to hereditary under-development affecting all parts and organs of the body alike which can be attributed to natural selection working through excessive in-breeding in a poor environment.[28] The breed is a low producer of milk and meat. Milk production is around 37 kg. per lactation. Meat yield is estimated to be between 9-14 kgs. It should be noted that the importance of this breed is not in its performance, but primarily in its high adaptability to very poor environments as in the northern areas where the temperature in the summer may reach 40°C. The animal exposes itself all day to this climate; sometimes the breed is watered only once every four days and hence approaches the camel in its efficiency in conserving water due to its low metabolic rate and economical water expenditure.

4.3.4 The Tihama Breed

This breed (Plate 4-11) is common throughout the coastal and high-land areas of the south-western part of the country. Its harmonious features recall those of a gazelle. The Tihama goat is mainly a meat animal weighing around an average of 29 kg. and meat yields are around

26. Epstein, H., "The Hijaz Dwarf Goat", J.Hered., Vol.37,(1943),p.345
27. Shkolnik, A., Borut, A., and Choshnick, J., "Water Economy of the Bedwin Goat" in Maloiy, G.M.O., op.cit.,p.231
28. Epstein, H., op.cit.,p.345

Plate 4-10 The Absi goat - Hijaz Dwarf Goat - is found in large numbers in the north of Hijaz, and as far as northern Aqaba.

Plate 4-11 The Tihama breed of goats is common throughout the coastal and high land areas of the south-western part of the country. It is mainly a meat animal.

15-16 kgs.

4.3.5 Goats in perspective

Goats have been criticised for being the least constructive animal on ranges and farms. Their distinctive and destructive behaviour on ranges has more than any other animal taken on an international perspective, to the point where they have become the world's most controversial farm animal[29], considered by many ecologists as "the most dangerous animal in the world" and the "desert maker".[30] There are many important reasons why goats attract such attention, and at least in the case of Saudi Arabia, the most important are the following:

(1) Over-Grazing: The effect of goats on range vegetation and plants has received a sizable amount of attention from range specialists. Specialists dealing with the effect of the goat on African ranges tend to have positive concepts of the goats as constructive grazers (if controlled). McKay, after a detailed experiment on range productivity in Botswana, concluded that:

> Goats in a suitable proportion kill smaller bushes and trees and provide an additional increment of meat to that derived from cattle.[31]

Staples et al. in a study of the comparative effects of goats and cattle on a mixed grass-bush pasture concluded that:

> After four years of heavy but controlled utilization great differences are apparent between the plots grazed exclusively by cattle and those fed on only by goats. The cattle plots have become open thickets, with poor grazing, bare ground that invites erosion...the goats plots are still grassland which though full of weeds, constitutes good grazing for any kind of stock, and there is little bare ground.[32]

In Tanganyika Territory, Hornby concluded that goats merely completed the destruction brought about by sheep, cattle, donkeys and man.[33]

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29. Tuohy, W., "F.A.O. defends the poor man's cow", The Guardian, Friday, July,14 1974 ,p.4
30. Ibid.
31. McKay, A.D., "Range land Productivity in Botswana", East African Agricultural and Forestry J.,(Oct. 1968),p.192
32. Staples, R.R., Hornby, H.E., and Hornby, R.M., "A Study of the comparative effects of goats and cattle on a mixed grass-bush pasture", East African Agricultural J.,(Oct. 1942),p.70
33. Hornby, H.E., "Over-stocking in Tanganyika Territory", E.Afri.Agric.J.,Vol. 1, 5, (1936),p.353

One conclusion from these opinions is that the goat's effect on ranges should be evaluated according to the type of ranges used, and because most African ranges are bushes and grasslands, rich with a variety of species, the goat, if controlled, does not do that much damage. However, in the case of the arid ranges of the Middle East the situation is different. As far back as 1930 complaints about the goat were voiced strongly. Major C.S. Jarvis, during fourteen years in Sinai, went as far as stating that:

> The goat is to a very considerable extent responsible for the desert, and in many places he has turned a more or less passable wilderness into a sandy and sterile waste. He bites the heart out of all living things and gnaws down to the roots of every tree or shrub seedling, immediately it appears above the surface.[34]

In 1963, F.A.O. recognized that goats were one of the four causes of the depletion of forest resources in Turkey.[35] Thus in areas of meagre ranges and grazing resources goats cause considerable and sometimes total destruction to these resources as a result of their feeding behaviour. It is commonly understood that goats are browsing animals but this has been rejected in favour of them being both browsing and grazing animals. Malecheck and Leinweber have concluded, in an experiment on forage selectivity by goats on lightly and heavily grazed ranges, that:

> during early spring, grass and herbs constituted the bulk of the diet on lightly grazed ranges while grass and browse were the most important dietary components on heavily grazed range ...results of this study indicate that goats could be classified as grazers during a greater part of the year than they could be classified as browsers.[36]

It is the ability of goats to adapt to the conditions of ranges that makes them destructive in areas of poor ranges like Saudi Arabia;

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34. Jarvis, C.S., "The goat standard", J. of the Royal Central Asian Soc., Vol.24, (1937), p.318
35. Kolars, J., "Locational Aspects of Cultural Ecology: The case of the goat in non-western agriculture", Geogr.Rev., (Oct.1966),p.577
36. Malecheck, J.C., and Leinweber, C.L., "Forage Selectivity by goats on lightly and heavily grazed ranges", J.Range Management, Vol.25, No.2, (March 1972),p.105

the worse the range the less selective they become and they do not limit themselves to small bushes or grasses but climb and jump from one tree to another (Plate 4-10). They have the ability to feed on plants that are not used by many other animals as a result of their bitter taste receptors which may not be readily stimulated to a threshold of rejection.[37]

Finally it could be concluded that goats with their grazing and browsing behaviour, do damage ranges if not controlled. The question of whether to leave them on the range or not, as in the case of camels, should be reviewed according to the extent of their socio-economic values to the society and as related to other animal types, as will be shown in the next points.

(2) Over-lapping: Another disadvantage is the locational function of goats as over-lapping animals. They are not restricted to where they should be (in households or mountainous areas) but they are found with camels and sheep in the desert ranges competing with them for the meagre resources available. Also they are found with cattle and sheep, feeding on farms and utilizing valuable feeding stuffs (Chapter 6). Therefore, goats are competing with these animals in their specialised land use producing milk and meat which are in any case produced either primarily or as a by-product by camels, cattle and sheep. This competition becomes more unfair in poor seasons when the number of animals is too large for the resources available.

(3) Preference for Goats: The author has not detected a national or a regional special taste preference for goat products in Saudi Arabia. Goat products are utilized and accepted by large numbers of people, but not to the point that they prefer them to lamb and mutton, or cows' milk, or camel milk and meat. The products of these animal types are pre-

37. Hafez, E.S.E., Cairns, R.B., Hulet, C.V., and Scott, J.P., "The behaviour of sheep and goats" in Hafez, E.S.E.,(ed.) The behaviour of domestic animals, (London; Balliere, Tinsdall & Cassel,1969),p.308

ferred in their areas over goat products. It is this lack of special preference that makes the previous disadvantages of the goats more valid and significant. The answers the author received to the question "Why do you keep goats?", which was put to a large number of pastoralists in the north and the south and to farmers in the central and Jizan areas, were amazingly similar. The majority say that they keep goats because they are easy to take care of and can endure harsh conditions. Pastoralists keep goats around the household to supply milk to the family specially when the season is poor, and the camels are far away grazing or the sheep are producing only enough milk to feed their lambs. It was observed by the author that it is usually the poor pastoralists who keep these animals. Usually small farms keep goats because they can feed on farm waste, and weeds and can clear land for crops.

Naturally the question of eliminating this animal from the livestock production scene in the country is out of the question because the efficiency of goats in producing milk under difficult environmental conditions is a great asset. Another advantage is their limited requirements for feed, housing and management as a whole, hence they are an ideal animal for <u>households</u>. Their contribution to the well-being of the country can be constructive as long as they are limited in numbers and are restricted to where they belong and contribute greatly and that is in urban, rural and pastoral households. Besides that, this animal should be discouraged from competing with more useful animals in areas where these animals are well adapted.

4.4. Cattle

In Saudi Arabia cattle are mainly farm animals and are unsuited to the arid ranges of the desert, where water sources are far apart and the ranges are too poor to support them. Therefore they are raised by farming communities and are identified with oasis agriculture. Cattle distribution in the country is associated mainly with the availability of fodder, either in oases or in flood-irrigated areas (Chapter 6). For the reasons mentioned above the Bedwins of Arabia never kept cattle and considered them a liability rather than an asset.

This concept of cultural specialization in animal use is so basic to Arabian society that it partially shapes the eco-cultural make-up of the two traditional cultures, those of the settled and al-Badiah communities. More than any other animals cattle and camels are identified respectively with the two communities. Consequently the largest concentration of cattle population is found in the region of the south-west which has the largest agricultural area.

4.4.1 Breeds

With the exception of a small percentage of imported European breeds, all the indigenous cattle of Saudi Arabia belong to the _Zebu_ breed _Bos indicus_, which is characterised by a fat hump and loose hide (Plate 4-12). The local types are horned, small-humped animals with cropping rumps and slightly swayed backs. Colours may vary from light grey to dark brown, dun, white and spotted. Grey colours predominate in the south-west coastal areas. In general terms the _Zebu_ cattle in the country are similar, in conformation and in their ability to adapt to local conditions, to the _Zebu_ cattle of the Indian Peninsula and Africa. However, it is probable that, over the centuries, strains of various origins have contributed to the formation of the present population. Considerable variations are clearly observed within the indigenous cattle population from area to area. Cattle in the south and south-west are on average superior in milk production and conformation to those found in oases, and in arid or semi-arid lands. Small black and brown native _Zebu_ cattle are used in oases in Nafud, Najd and on the fringes of the Empty Quarter. A taller and larger genotype, often reddish brown or

Plate 4-12 The local Zebu cattle. The variety shown above is from the south-west: Tihama. Cattle in the south-west are superior in milk production and conformation to those found in oases.

Plate 4-13 Zebu used for draft work in Jizan.

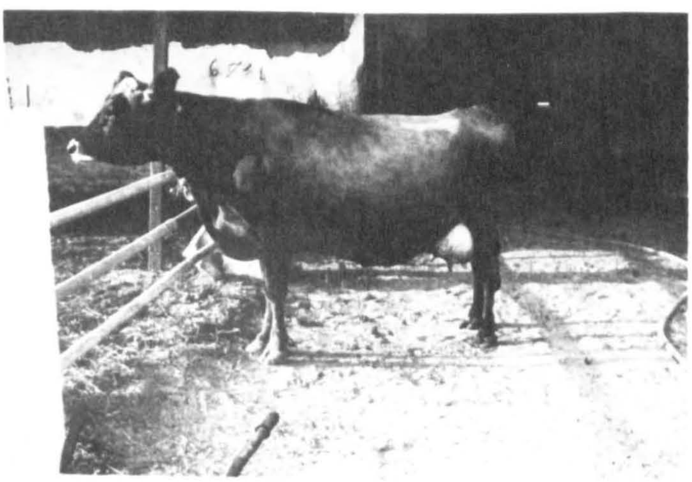

Plate 4-14 Local Danish Jersey in Hofuf Station.

spotted, is raised for dairy use in the large oases of Hofuf, Dammam and Qatif in the eastern region.

At birth, calves are moderate in weight, about 20 kg. The progress of weight gain, in so far as it has been observed, is very slow, due in part to the limited milk ration given to the young. In general the management of young and mature animals is lagging. Data collected show that the live weight of indigenous cattle varies between 150-400 kg.[38]

4.4.2 Performance

Cattle in the country are reared for milk production, then for draft work and for beef. Milk production ranges from 3-10 kg. per day. It is estimated that the average cow produces 364-545 kg. per lactation.[39] As shown in Table 4-5 the average milk yield for local animals on the Dirab station is very low producing an average of 401 kg. in a lactation period of 292 days. Milk is produced in farms or households to satisfy household needs. The surplus, in most cases, is either turned into clarified butter (ghee) or given to calves.

Although beef - mainly from dairy cattle - is eaten in the country, it rates fourth in importance after sheep and camel meat and has an almost equal standing with goats: beef constitutes almost 16% of the meat slaughtered in the main centres (Table 4-1). In most of the country and specially in the south-west meat is subsidiary to milk and draft work.

Even today oxen and bulls are raised for draft work (Plate 4-13), especially in the less developed areas of the south-west. They are mostly used for soil preparation and water lifting. However, as with camel transportation the use of modern technology is rapidly replacing the use of cattle draft animals.

4.4.3 Foreign Breeds

Brown Swiss, Holstein, and Jersey, as well as crosses of these

38 Mieheimied, M.A., Development of Animal Production in Saudi Arabia, Report prepared for MAW, (Riyadh; MAW, 1969), p.12

39. Swiss Technical Co-operation Service, Proposals for the Development of the Dairy-farming potential of Saudi Arabia, Prepared for MAW, (Riyadh; MAW, 1966), p.22

breeds have been used for the last 15 years. Although the performance of these cattle and their crosses has not been properly evaluated, all of the available data indicates that these breeds have shown, so far, an ability to perform efficiently under good management.

Virtually all the foreign breeds used in the country are dairy breeds. The Santa Gertrudis, the only foreign beef breed introduced, has been largely absorbed in ten years through cross-breeding on the al-Kharj farm. Zebu cattle of the Sudan Kenana breed are kept by some farmers in Madina, and are considered to be much better than the European breeds at a low level of nutrition.

The largest herds of a European breed consists of 450 head of Jerseys on two government farms at Dirab and Hofuf. Another 100 head of different foreign breeds are kept on the al-Kharj farm, 75 km. from Riyadh in the central region. So far the performance of the western breeds has been promising, specially the Jersey breed. The doubts which accompanied the first imports of Danish Jersey breed 12 years ago to the Hofuf station have evaporated. Two years of the author's work with Jersey cattle in the Hofuf station have shown nothing totally abnormal about these animals' performance. The recent joint research with the Univ.College of North Wales supports this opinion and the yearly report in 1973[40] concluded that the Jerseys tolerate hot and humid weather well; only on two occasions of high humidity was panting observed in a few animals. Furthermore, the Jerseys calve easily in open yards and only one cow has required assistance in the last eight months. Calf survival is good and all calves are very vigorous from birth. These conclusions are based on an evaluation of records kept for the Jerseys on the Hofuf station in the last few years.

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40. Univ. College of North Wales (Team), Research and Development of the Hofuf Agricultural Research Centre, Saudi Arabia, (Riyadh; MAW, 1971), pp.16-17

Table 4-4

Lactation records for the cows in Hofuf

Lactation No.		Station 1	2	3	4	5
Imported cows	Yield (kg)		3,129	2,917	2,578	3,635
	Length (days)		305	286	287	299
Local born cows	Yield (kg)	2,277	2,527	2,826		
	Length (days)	280	288	292		

Source: Univ. of North Wales and MAW, A Review of Research on Animals and Forage Production in Saudi Arabia, (1972)

Table 4-4 indicates that milk yields of imported cows in Hofuf station went first through a decline,then started increasing to reach 3,635 kg. per lactation which is higher than the second lactation. The first lactation period was slightly shorter than the second lactation period. The milk yield of the local offspring of imported cows was less than the first ones but the third and second lactation showed an improvement. The difference between the two could be attributed to certain amounts of in-breeding, however better management will overcome such a handicap. The standard of management is significant in these areas: for example, comparing the results in Table 4-4 with those in Table 4-5 for the Dirab station, which is less efficient than the Hofuf station, the difference is clear, the Jerseys in Dirab produced an average yield of 2,237.5 kg; which is much less than the performance of the worst lactation for the Jerseys in Hofuf.

Table 4-5

Milk yields and lactation of Jersey and local Zebu and crosses 1973 for Dirab Station

No. of Animals	Type	Ave. lactation days	Ave.milk lactation (kg)
39	Jersey	294	2,237.5
4	Crosses of Jersey and Balady	292	1,982
3	Balady	141	401

Source: Compiled from Dirab Station 1974.

4.4.4 Imported Breeds versus Local Breeds

The relative ability of the imported European breeds in the last 20 years to endure, produce and reproduce in arid Arabian environments has raised an important issue concerning the local cattle versus the imported ones. The significance of this issue has resulted from the following relevant points; (a) European cattle have been observed to be successful in acclimatizing and adapting to the arid environments of the country as has been shown earlier (Plate 4-14), (b) their production is substantial and greater than the local Zebu and (c) both the imported and the local cattle can only be raised within cultivated areas,hence there is competition for land use aggravated by the fact that cultivated areas are limited and inputs are costly. The question that arises is, should not the imported cattle be given priority so that they gradually replace the local ones? So far the MAW have not formed clear opinions on this question and the MAW policies concerning this issue seems to be contradictory. The MAW has been raising some local animals in their stations, in some areas they are crossing local breeds with imported ones, and the need to have breeding centres in some areas to breed with local animals and imported bulls has been suggested and even called for, but nothing so far has materialised except in Hofuf a few years ago. Considering the limited agricultural resources in the country it is imperative to have a clear policy and the author, as will be elaborated later (Chapter 10), suggests that imported cattle and their off-spring should be encouraged to be the main dairy breeds in cultivated areas. Attempts to up-grade the local ones should be limited to research stations until a clear answer can be arrived at. Local cattle should only be kept by house-holds and small farmers who do not have the resources for a larger breed.

CHAPTER FIVE

LIVESTOCK POPULATION AND STRUCTURE

5.1 Livestock Population

5.1.1 National Estimates

So far there has been no comprehensive national animal census for the country as a whole. Table 5-1 shows the five frequently quoted estimates. These estimates of the total national animal population expressed in animal units range from 10.7 to 8.4 million A.U. The earliest and the most commonly referred to are the estimates undertaken by Heady (F.A.O. Offices) in 1963 and based on personal counts and observation. His counts were the record of all animals observed during the course of 5,758 km.of car travel.[1] Heady's estimate was reduced by 20% to correct for low animal densities in the Empty Quarter, which was not visited. It is obvious from Table 5-1 that all F.A.O.'s estimates (a), (b) and (c) are larger than MAW's estimates of (d) and (e). It seems that the large estimate for camels in (a) and (c) and for sheep and goats in (b) are the main causes for this difference which can only be attributed to F.A.O. sources not allowing for the prolonged droughts in the 1960's. The similarity in cattle number in all of these estimates except in (b) and (c) is due to its being derived from an earlier cattle estimate in 1961 by M.A.Saleh (F.A.O. Officer).[2] On the whole all these estimates are crude and with the exception of (e) all stem in part or wholly from the Heady estimate.

5.1.2 MAW Estimates

The Ministry of Agriculture's estimate of the national animal population shown in Table 5-1 is basically derived from Heady's and other F.A.O. estimates. As yet the Ministry has neither up-dated this estimate

1. Heady, F.H., Grazing Resources and Problems, A report to the government of Saudi Arabia. Prepared by F.A.O; ETAP, Report No.1614, (Rome; F.A.O., 1963),p.5
2. Faulkner, D.E., Saudi Arabia: Animal Husbandary Production and Health A country study, unpublished report, (Cairo; F.A.O., 1965),p.1

Table 5-1

Various national estimates of total livestock population for Saudi Arabia (000 No.Heads and Units)*

Sources	Heady estimate (F.A.O.) 1963 (a)		F.A.O. Prod. Yearbook (b)		Near East Regional Study (F.A.O.) (c)		The official MAW estimate (d)		MAW Resource Survey 1967 (e)	
Units / Types	Heads	A.U.	Heads	A.U.	Heads	A.U.	Heads	A.U.	Heads	A.U.
Cattle	270	1,350	230	1,150	270	1,350	270	1,350	278	1,390
Camel	1,004	5,020	460	2,300	1,040	5,200	600	3,000	651	3,255
Sheep	4,158	4,158	5,288	5,288	2,730	2,730	2,800	2,800	2,331	2,331
Goats			1,400	1,400	1,390	1,390	1,400	1,400	1,998	1,998
Total		10,528		10,138		10,670		8,550		8,974

Sources:
(a) Heady, F.H., Report to the Government of Saudi Arabia on grazing resources and problems, ETAP Report No.1614, (F.A.O.,1963),p.5
(b) F.A.O., F.A.O., Production Yearbook, (Rome, 1971)
(c) F.A.O., Near East Regional study: Animal Husbandry, Production and health, fodder production and range management in the Near East and F.A.O.'s policies and plans for promoting the animal industry, (F.A.O., Rome-Cairo; 1972), p.238
(d) Allred, B.W., Range management training handbook for Saudi Arabia, (F.A.O., Rome; 1968),p.61
(e) Mackin,J.L., Evaluation and use of Area Resource Surveys for Agricultural Development in Saudi Arabia, Special Report No.1., prepared for Ministry of Agriculture and Water, Kingdom of Saudi Arabia, SRI Project ECH - 8680, (Stanford Research Institute, Menlo Park, Calif.,1971),p.92

* figures rounded to the nearest decimal.
With the exception of (a) and (e) all these estimates are earlier than the date of their references

nor carried out a comprehensive national census. There was a chance of taking a comprehensive animal census as part of the national population census that was being prepared early in 1972 by the Central Department of Statistics (the Ministry of Finance). Such an idea was suggested by the Ministry of Agriculture to the Ministry of Finance.[3] However, the latter understandably turned down the suggestion on the grounds that the inclusion of a section for animals owned by the respondents might have caused a negative reaction and hence impaired the whole census.

Field tests carried out in 1967-68 confirm that the Ministry's estimate is low. Two counts conducted in 1967 by Parsons-Basil, the consultant for the northern areas, using aerial counting supported by ground checking indicated that the Ministry's estimate was probably low.[4] A more comprehensive semi-national estimate of the animal population was also made as part of the Resources Survey which covered 1,273 thousand sq.km. out of a national total of about 2,193 thousand sq.km. It was based on field work, local samples and some aerial counting, and thus the methodology used was more convincing than personal observation alone. The Resources Survey estimate shown in Table 5-1 represents the animal situation in 1967, almost at the end of the prolonged drought of 1963-67, and hence takes into account the reduction of the animal population caused by the drought. These droughts had a devastating effect on the national livestock population, taking an estimated toll of around 55-60%.[5] In spite of the fact that the Resources Survey covered only part of the country and represented drought conditions, strangely enough its estimate surpassed the Ministry estimate by 8,000 cattle, 51,000 camels and 590,000 goats (Table 5-1). It is only in the case of sheep

3. Turkey, H., Personal correspondence, Ministry of Agriculture, (Riyadh; Dec.1974)
4. Allred, B.W., and Micheimied, M.A., Livestock Production and Related Problems in Saudi Arabia, Unpublished report by the Ministry of Agriculture (Riyadh; 1968), pp.2-3
5. Sprage, H.B., Improvement of Livestock Production by Bedwin Nomads on Semi-Desert Range Lands of Saudi Arabia, Prepared for the Ministry of Agriculture and Water by Stanford Research Institute, Special Report No.2, (Calif.: Menlo Park, SRI,1971),p.13

that the Ministry estimate has 70,000 more. This confirms that the Ministry estimate is too low.

5.1.3 Up-dating the National Estimate

To meet the urgent needs of subsidy allocations and national trade, the Ministry had to adjust its low estimate of the national animal population by an annual increase of 5%.[6] This annual increase is supposed to accommodate the animals' natural increase by reproduction, and also the sizable importation of live animals to the country. This annual rate of 5% is moderate compared to the average annual rates in other countries (e.g. the Sudan's rate of 10%),[7] and it is also more than the annual rate of around 4% used by F.A.O. in adjusting its 1964/65 estimates.[8]

The annual rate of increase in the population of animals varies greatly from one species to another, for in addition to the differences in the length of the reproduction cycles, the population is also related to consumption trends, feed availability and the number of imported breeding animals. The main disadvantage of up-dating the Ministry estimate by a flat annual average of 5% is that it conceals these facts. The field observations of the author indicate an active overall trend towards rebuilding the national animal population, especially in the case of cattle, sheep and camels. Moreover, present trends are expected to accelerate as a result of the newly introduced animal subsidy for 1974 (Chapter 3). The annual rate of 5% used by the Ministry to revise its low estimate will be adopted for this study, but only to represent the assumed annual rate of increase of the total animal population. However, this average annual rate should not be assumed to represent the individual annual rate of increase for each separate species of animal,

6. Micheimied, M.A. Personal correspondence, Ministry of Agriculture, Dec.1974
7. Arabic Organization of Agricultural Development, (Arabic), A Study for the technical and economical visability for meat production project in Sudan, (Khartoum; Khartoum Univ., 1974),p.37
8. F.A.O., Production Yearbook, (Rome; 1971)

since, as explained earlier, different species have different rates.

In the case of this study the individual rates will be derived from the agricultural surveys for cultivated areas of 1961/66 and 1970/71 undertaken by the Ministry of Agriculture and will be discussed later. The difference between the two surveys gives the increase in animal population over the period of 4 years (1966-1971). Table 5-2 indicates that the rate of increase was 3.7% for cattle, 7.2% for sheep, 3.9% for goats, with a negative rate of -0.3% for camels. The average national annual rate of increase for all animals thus amounts to 4.2%.

With no other alternatives, it is useful to assume most of these rates to be national ones and apply them to the country as a whole. The negative percentage of -0.3% (Table 5-2) for camels cannot, however, be assumed as representative of the national trends, since the survey covered agricultural areas, whereas camels are usually raised in desert areas. The author's observations indicated that camel herds have been building up over the last few years. The 5% annual increase assumed by the Ministry as the national rate will also be used here for camels after allowing for the decrease of -0.3% in the case of agricultural areas (5-0.3 = 4.7). To adjust 4.7% and the rates mentioned earlier to the national average of 5% (3.7 + 7.2 + 3.9 + 4.7 = 19.5 ÷ 4 years = 4.88 - 5 = 0.13), a fraction of 0.13% could be either divided proportionally among the rates for each different type of animal, or just added to the camel rate of 4.7%. Because it is a small fraction it will be added to the camel rate, making 4.8% the assumed annual rate of increase for the camel population.

Having arrived at the derived rates calculated above, there remains the important prerequisite of selecting a base year as a start for updating the Ministry's estimate. The Ministry estimate in Table 5-1 stems from estimates made for 1963, hence the selected base year must take into

Table 5-2

Annual Rate of increase for animal population in agricultural areas (1960/66 and 1970/71)

Stock/Year	Cattle	Camel	Sheep	Goat	Total A.U.
1960/66	211,712	102,189	961,557	725,258	3,256,320
1970/71	243,138	101,062	1,238,667	837,297	3,796,964
The difference	31,426	-1,127	277,110	112,039	540,644
Total per cent difference	14.84	-1.1	28.82	15.5	16.6
A.U. annual rate of increases	3.7	-0.3	7.2	3.9	4.2

Source: Constructed and calculated on the basis of Table 5-4 and 5-5

Table 5-3

The adjusted estimated MAW National Livestock Populations for 1968-1974 in thousand heads and A.U.*

Stock	Annual rates	Base year 1968	1969	1970	1971	1972	1973	1974	Animal Units 1974
Cattle	3.7	270.0	280.0	290.4	301.1	312.2	323.8	335.8	1,679.0
Camel	4.8	600.0	628.8	659.0	690.6	723.8	758.5	795.0	3,974.6
Sheep	7.2	2,800.0	3,002.0	3,218.0	3,450.0	3,698.4	3,965.0	4,250.5	4,250.5
Goats	3.9	1,400.0	1,455.0	1,512.0	1,571.0	1,632.3	1,696,0	1,762.1	1,762.1
Total A.U.									11,666.2

Source: Constructed from Table 5-1 and 5-2

* Figures rounded to the nearest decimal

account the reductions caused by the drought of 1963-1967, which the Ministry has never allowed for. As 1967 was the approximate end of the most recent prolonged drought, 1968 seems to present the ideal "base year".

Thus, as a result of these calculations,the total adjusted estimate of the animal population as shown in Table 5-3 for 1974 amounts to around 11.7 million A.U. and includes 335,800 cattle, 795,000 camels, 4,250,000 sheep and 1,762,100 goats.

5.1.4 Agricultural Census

A more reliable but partial attempt to estimate livestock population was the agricultural census of farming areas carried out by the MAW at two periods. The first was an accumulation of estimates made at intervals from 1960-1966 and published in the form of a summary in 1968. The second census was taken in 1970/71 and still has not been published (the author has obtained a summary of it). These two surveys were carried out on a regional basis and did not cover all pastoral animals. Methodologically they were more of a census than estimates, hence are more reliable than the national MAW estimates discussed earlier. They are valuable in giving an insight into the composition of the animal population and its regional distribution in the agricultural areas of the country. Thus any regional analysis of livestock composition and distribution must be based on these two surveys. Unless specified, results will apply to farming areas rather than the country as a whole. The population and regional distribution of animal species of these two surveys are shown in Tables 5-4 and 5-5, and both indicate that the total animal units in agricultural areas have increased since 1966 by as much as 540,644 or 16.6% (Table 5-2).

5.2 The Structure and Composition of Livestock Population

Table 5-6 estimates the national livestock population, its breakdown

Table 5-4

Estimated animal populations under farming conditions by provinces (1961-1966) in number of herds and A.U.

Region	Cattle	A.U.*	%**	Camel	A.U.	%	Sheep	%	Goat	%	Regional Total A.U.	%
Northern	2,270	11,350	1.07	13,280	66,400	13.00	54,240	5.64	49,620	6.84	181,610	5.6
Eastern	8,296	41,480	3.92	1,565	7,825	1.53	18,257	1.90	20,169	2.78	87,731	2.7
Western	12,200	61,000	5.76	10,880	54,400	10.65	116,480	12.11	84,290	11.62	316,170	9.7
Qassim	17,870	89,350	8.44	17,650	88,250	17.27	114,750	11.93	39,110	5.39	331,460	10.2
Central	24,980	124,900	11.80	5,830	29,150	5.71	81,230	8.45	62,140	8.57	297,420	9.1
Inner South	55,111	275,555	26.03	28,328	141,640	27.72	446,863	46.47	145,711	20.09	1,009,769	31.
Coastal South	90,985	454,925	42.98	24,656	123,280	24.13	129,737	13.49	324,218	44.70	1,032,160	31.7
Total	211,712	1,058,560	100	102,189	510,945	100	961,557	100	725,258	100	3,256,320	100

Source: Synthesised from the Agricultural Census for (1960-1964) and the summary of the skeleton statistical data of the agricultural surveys in various districts (1960-1965) and of the survey undertaken in the Southern Districts in the year 1965-1966, MAW, Department of Research and Development, Riyadh

Note: * - Animal unit equivalent
1 cow - 5 sheep
1 camel - 5 sheep
1 goat - 1 sheep

** - The percentage in the national total (for agricultural areas)

Table 5-5

Estimated Animal Population for Agricultural Areas by Provinces 1970/71 (Heads and A.U.)

Region	Cattle	Camel	Sheep	Goats	Regional total (A.U.)
Eastern	13,163	13,099	20,318	17,142	168,770
Riyadh-Afif-al-Khasra	18,243	1,909	102,334	68,439	271,533
Qassim	13,722	4,811	190,122	42,767	325,554
Hail	2,517	3,484	91,921	42,222	164,148
Jawf-al Guvayat-N.District	1,087	2,017	10,954	20,670	45,144
Madina	1,533	2,085	31,792	59,266	109,148
Mecca	49,801	24,740	217,351	197,077	787,133
Asir	43,456	17,409	312,988	202,193	819,506
al-Baha	24,345	4,001	74,798	55,336	271,864
Jizan	56,660	16,543	81,056	76,275	523,346
Najran	1,907	8,020	40,632	26,480	116,747
Bishah and Raniah	16,704	2,944	64,401	29,430	192,071
Total (Heads)	243,138	101,062	1,238,667	837,297	
Total (A.U.)	1,215,690	505,310	1,238,667	837,292	3,796,964

Source: Unpublished Summary the Agricultural Census for 1970/71, MAW, Riyadh according to species and its distribution between pastoral (range) and intensive (sedentary) conditions in 1966 and 1970/71. In 1970/71 almost 62% of the total national livestock population was supported by pastoralism and around 38% by the intensive system (settled communities), which is almost the same as the situation in 1968. This clearly emphasises the classical dominance of pastoralism as the main livestock-producing system in the country.

Table 5-6 shows that each of the two systems features a high degree of specialization in at least one animal type. The extensive system (pastoralism) supported around 85% of the national camel population. On the other hand around 80% of the cattle population was supported by the intensive system in 1971. This high degree of animal specialization is to be expected because of the different ecological environments of the two systems. Pastoralism evolved in an environment of highly erratic and scarce rainfall. The intensive system evolved around irrigated areas (the two systems will be discussed in detail in later chapters). Therefore pastoralism with its meagre fodder sources has always been suitable for camels. Agricultural areas with their irrigated fodder are the only suitable environment for cattle in Arabia.

The importance of pastoralism as the main breeder of sheep is illustrated in Table 5-6, which indicates that pastoralism sustained almost 64% of the national sheep population in 1970/71, while the intensive system supported around 36%. The pastoral share of sheep has declined slightly from about 66% in 1966 to 64% in 1970/71, while the share of the intensive system increased from around 34% to almost 36% in 1970/71. Such a shift, although small, confirms the present observed trend towards the integration of sheep in farms for fattening.

Though there are more goats under the intensive system, still goats are more evenly distributed between the two systems than are the other

Table 5-6

A reconstructed estimate of the national livestock inventory as distributed between range and sedentary for (1960/66-1970/71) in A.U. and %

Animal	1960/66					1970/71				
Type	Nat.Total	Range	%	Settled	%	Nat.Total	Range	%	Settled	%
Cattle	1,350,000	291,440	21.59	1,058,560	78.41	1,505,000	289,310	19.2	1,215,690	80.8
Camels	3,000,000	2,489,055	82.97	510,945	17.03	3,455,000	2,949,690	85.2	505,310	14.6
Sheep	2,800,000	1,838,443	65.66	961,557	34.34	3,450,000	2,211,333	64.1	1,238,667	35.9
Goats	1,400,000	674,742	48.20	725,258	51.80	1,571,000	733,703	46.7	837,247	53.3
Total	8,550,000	5,293,680	61.91	3,256,320	38.09	9,981,000	6,184,036	62.0	3,796,964	38.0

Source: Derived from Tables 5-3, 5-4 and 5-5 animals. This reflects the socio-economic status of goats as subsistence animals raised mainly to provide milk for household consumption. The concentration of population and hence households in and around agricultural areas is the main reason for having more goats under the intensive system.

The small proportion of camels sustained by the intensive system declined from around 17% in 1966 to almost 15% in 1970/71. This is only to be expected, since camels have no place in this system except as a means of transportation, and in this role they are being increasingly replaced by cars. On the other hand the large proportion of camels under the pastoral system, and its increase from about 83% in 1966 to almost 85% in 1970/71 is also a natural development, induced by the camel's ability to satisfy its needs under desert conditions.

Cattle rank far down in fourth position among animals raised under the pastoral system, retaining almost the same ratio of around 22% for 1966 and 19% in 1971. Although the ratio is small, it is still sizable in terms of animal numbers, amounting to over 66 thousand head of cattle. The author in his field work over the country neither observed nor heard of large-scale cattle herding in the non-agricultural areas. This high number may be explained first by the unreliability of the national estimates which provides the basis for Table 5-6. Secondly it may have resulted from the mistaken impression given by cattle seen grazing around villages and close by ranges, especially in the south-west. On the whole ranges in the country are desert ranges and cannot support cattle. The only exceptions are the few small rain-fed range enclosures in the south-west part of the country, which are usually either protected or when possible cultivated by owners. Cattle seen grazing are usually there for a few hours a day during a few months of the year. These cattle are housed in farms or houses and obtain their main supplement in their housing areas. It may thus reasonably be concluded that most if not all of the cattle population is supported by the intensive system and the contribution of the ranges is minimal.

5.2.1 Composition of Animal Population

Table 5-7

Composition of Animal Population (%)

	National Estimates			Agr.areas		Pastoralism	
Livestock type	1971	1968	1967	1968	1971	1968	1971
Cattle	15.1	15.8	15.5	32.5	32.0	5.4	4.7
Camel	34.6	35.1	36.3	15.7	13.3	47.0	47.7
Sheep	34.6	32.7	26.0	29.5	32.6	35.0	35.8
Goats	15.7	16.4	22.3	22.3	22.1	12.7	11.9

Source: Calculated from Table 5-1 and 5-6

The derived ratios in Table 5-7 above indicate that the national animal population is unevenly divided among the four main animals, with camels coming first and sheep, goats and cattle following in second, third and fourth places respectively. Nationally the difference between camels and sheep, and between goats and cattle is not very wide; however, the gap separating the two pairs has always been wide, which indicates that camels and sheep are the two nationally leading animals in total animal units. Camel and sheep ratios of 34.6 each constituted almost 69.2% of the national animal units estimated for 1971, while goats and cattle made up the remaining 30.8%.

The tendency towards closing ranks is strongly indicated by the 1971 estimate, where sheep caught up with camels. The shift in favour of sheep seems to be at the expense of goats, whose 1968 ratio of 16.4% declined to 15.7% in 1971, and also at the expense of camels, whose ratio declined slightly from 35.1 to 34.6. Such a trend is not surprising. The short reproduction cycle of sheep, the high national demand for lamb and mutton, and the continuous movement of sheep across the northern borders of the country are some of the main factors contributing to this trend, which is illustrated by the high annual rate of increase of 7.2% for sheep, a rate higher than that for any other animal (Table 5-3).

For the present time camels retain a slight lead, thus preserving the area's historical reputation as a camel country. In the case of pastoralism and as shown in Table 5-7 the camel faces no competition, for it is the dominant animal constituting 47.5% of the total pastoral animals in A.U. in 1970/71. On the other hand the camel's ratio has declined slightly in the agricultural areas from 15.7 in 1968 to 13.3% in 1970/71 for the reasons explained earlier.

Sheep rank with cattle as the leading animals in the agricultural areas, showing a sizable increase from 29.5% in 1966 to 32.6% in 1971. Sheep occupy a very strong second place under pastoralism with a ratio of 35.8% in 1971. This emphasises the importance of sheep in both systems (extensive and intensive). They are a common commercial investment, and a valuable source of income for both systems. It is the only species that is becoming increasingly stratified - herding generally taking place in the desert and fattening increasingly in farmed areas - and this explains why sheep have the same ratio in 1970/71 as in 1966 on the ranges and their increase in agricultural areas.

Cattle play a major role only in agricultural areas where they made up 32% of the total animal units in 1971. Comparison between the two surveys of agricultural areas indicates that sheep have already overtaken cattle, but with a slight margin in 1971.

All the estimates in Table 5-7 agree in ranking goats third and, with the exception of pastoralism, the goat ratios are similar in all these estimates. This emphasises the goat's role as a subsistence animal. Except in the south-west the author has not seen large herds of goats in non-agricultural areas. Goats are usually found in household farms, or mixed in small numbers with sheep herds. The relatively low ratio for goats in pastoralism may be explained by the smaller Bedwin population, and hence fewer households in the desert. The concentration of population in rural and urban areas accounts for the relatively large number of goats in agricultural areas.

Will camels lose their national lead to sheep? Will sheep take the first place from camels and cattle in the pastoral and intensive systems? Later chapters may provide some clues. The census available is too crude to make any major conclusion. However Table 5-7 indicates strongly that sheep (lamb and mutton) will become the leading animal in the nation (on A.U. basis) because it is popular in both systems (intensive and extensive) also it has an annual average increase of 7.2%, the largest among all the other animals. Moreover the intensification of fattening sheep in agricultural areas will certainly increase sheep numbers in farming areas but it may be off-set by the increase in dairy herds.

5.3 Regional Distribution of Livestock

5.3.1 The Data

The main statistical data used in this regional study have been drawn from the Agricultural Census of 1966 (Table 5-4). Although more recent, the 1970/71 census has not been used constantly because it has not been published and only the summary was available to the author. The 1966 census has served the critical purpose of providing semi-detailed comparable data for administrative and sub-administrative areas for the whole country. Thus it was possible to narrow down the 1966 census in Table 5-4 to smaller administrative areas as shown in Appendix 5-a.

The geographical area covered by the 1966 census includes most if not all of the irrigated areas in the country. However, the census has never been accompanied with a map showing the area boundaries for the data obtained. The one available official map with area boundaries contains only 18 administrative districts.* It should be stressed that the following regional analysis applies only to the agricultural areas and not to the country as a whole. With such a limited number of areas, the possible range of statistical and analytical work is much less than would have been the case had more districts been available. To overcome this limitation 8 more districts have been added and approximately delimited (Fig.5-1). It was felt that the 26 districts, although few and some of them large, could still help in the regional analysis of animal distribution. There are two main reasons for this. First, the country is not geographically diverse; desert is the main natural feature, cultivated and mountainous areas are limited and small in area. Consequently these 26 districts seem neither too few nor too large to provide a meaningful perspective. Secondly, as R.O. Buchanan stated, "Delimitation...implies that the criterion or criteria must be capable of being marked"[9] and this is the main reason for delimiting these 26 districts.

Before proceeding to identify and delimit actual livestock regions, it should be noted that the approach to the problems of recognising and explaining the regional variations in animal species may be essentially theoretical, as is the case with other types of geographical regionalization. However, the ultimate aim is to build up a general impression which can be used to identify regional livestock trends throughout the country. Since different animal species are always in competition for land use, the animal distribution in the country leads to a very strong sense of geographical regionalism, as will be shown later.

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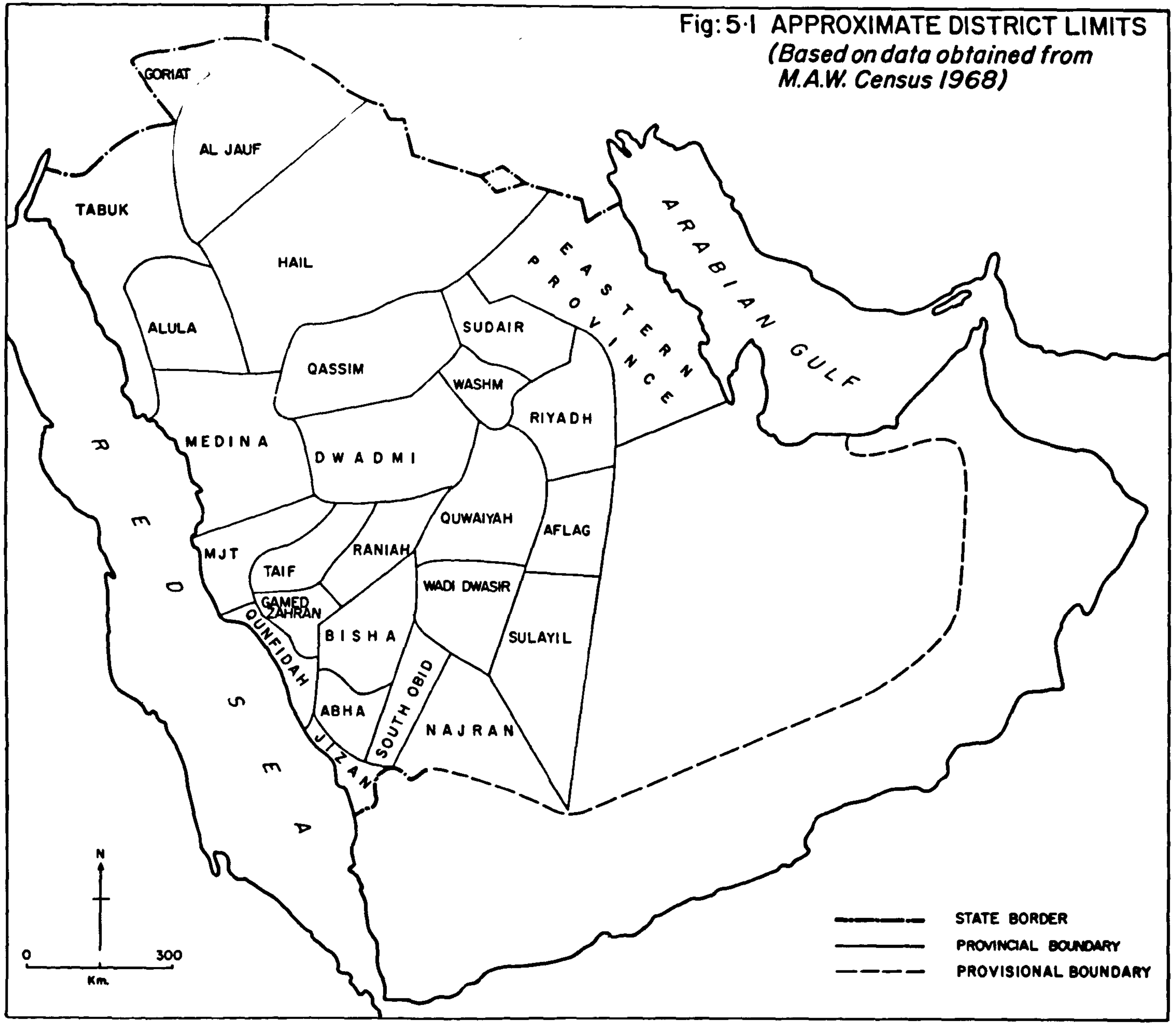
* The western province was delimited up to Qatar border, hence did not include most of the desert and the Empty Quarter because it was not included in the census.

9. Buchanan, R.O. "Some reflections on agricultural geography", <u>Geography</u>, Vol.44,(1955),p.5

Fig: 5·1 APPROXIMATE DISTRICT LIMITS
(Based on data obtained from M.A.W. Census 1968)



5.3.2 Regional Composition of Animal Types

A regional breakdown of the proportional animal composition is shown in Figure 5-2 and Table 5-4, for animal species raised under sedentary conditions in the seven main provinces in 1966. The coastal and inner southern provinces maintained almost 63% of the national animal population. They also held the largest proportion of the national farm stock of the four animal species, about 69% and 65% of cattle and goats, 52% and 60% of camels and sheep. Such a large regional proportion of animal types in these two provinces can be attributed to the fact that they have the largest agricultural areas in the country, while their close proximity to desert ranges makes them a suitable home for camels and sheep.

5.3.3 Ranking of Individual Livestock Types

The data on the regional distribution of livestock types are presented in Appendix 5-a as percentages of total animal units. It should be noted that ranking has been based on the smallest difference in percentages, hence it conceals a great many animal combinations; however, animal combinations will be discussed later.

Animal ranking is rudimentary, but nevertheless an enlightening preliminary method of acquiring a picture of the relative regional strength of each individual livestock type. Ranking was obtained for each type by one order of the percentage of each type in any district. This method was first used by J.C.Weaver in analysing the changing pattern of crop land in the Middle West of the U.S.A.[10] and also, with the help of associates, for livestock in the same area.[11]

The animal types ranking first, second, third and fourth have been mapped by districts for Saudi Arabia according to the 1966 census for

10. Weaver, J.C., "Changing patterns of crop use in the Middle West," Economic Geography, Vol.30,(1954),pp.1-47
11. Weaver, J.C., Hooge, L.P., and Fenton, B.C., "Livestock units and combination regions in the Middle West," Economic Geography, Vol.32, (1956), pp.237-259

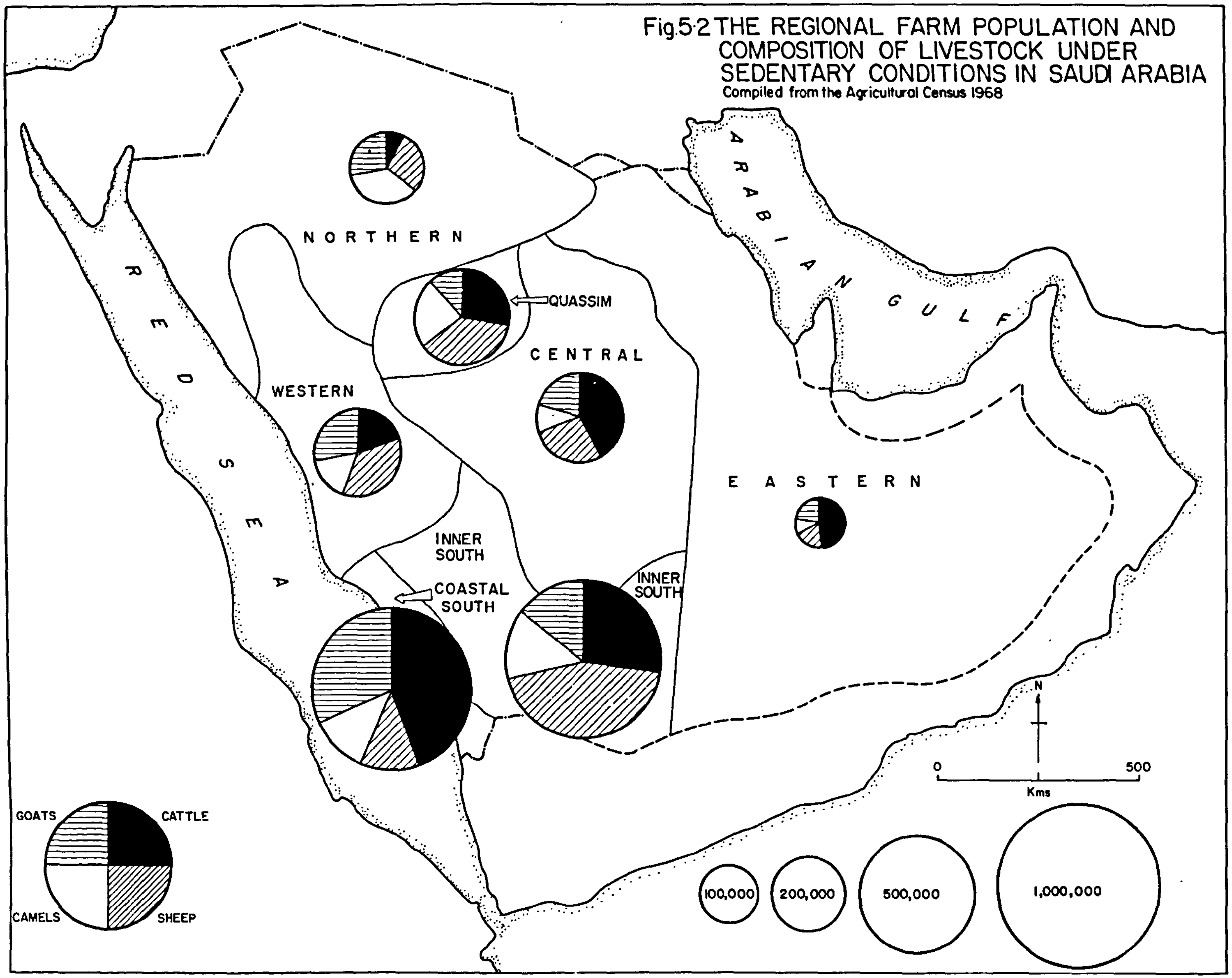


Fig.5·2 THE REGIONAL FARM POPULATION AND COMPOSITION OF LIVESTOCK UNDER SEDENTARY CONDITIONS IN SAUDI ARABIA
Compiled from the Agricultural Census 1968

the 26 districts shown in Figure 5-1. The pattern of first ranking found in Figure 5-3 is simple and shows the general tendency for sheep, cattle and camels to share the first ranking. Only in very limited areas did goats reach sufficient strength to challenge any of these three. Camels ranked first in the extreme north and north-east, and the two southern regions of Wadi al-Dwasir and al-Sulayyil, cattle came first in the eastern and east-central regions, and the extreme south-west tip of the country; and sheep ranked first in the main central part of the country separating the camel areas in the north from the cattle areas. The boundaries between these areas are very regular and fall approximately and from an ecological point of view where one would expect to find them. Camels ranked first in areas directly contiguous with the main desert areas, the northern desert and the Empty Quarter in the south, where camels have always been at home. In these areas agricultural land is limited and population is sparse. As camels are not farm animals, their prevalence in these areas is indicative of the strong influence of the desert. Cattle ranked first in areas where they could be expected. The eastern and east-central regions and the south-western tip of Saudi Arabia contain the main agricultural areas in the country and support a very large proportion of the country's inhabitants. The production of fodder and other crops is concentrated in these areas. The first ranking of cattle in the Najran district could be attributed to its proximity to Jizan and the availability of irrigated wadis. Sheep rank first in areas that are not in direct contact with the main deserts, or with the most populated areas. Sheep-dominated areas form a belt across the heart of the country, starting from its widest point in the north-east and gradually extending southwards to end at its narrowest point in the south-west, the sole interruption being Raniah (the prevalence of camels in Raniah may be attributed to its proximity

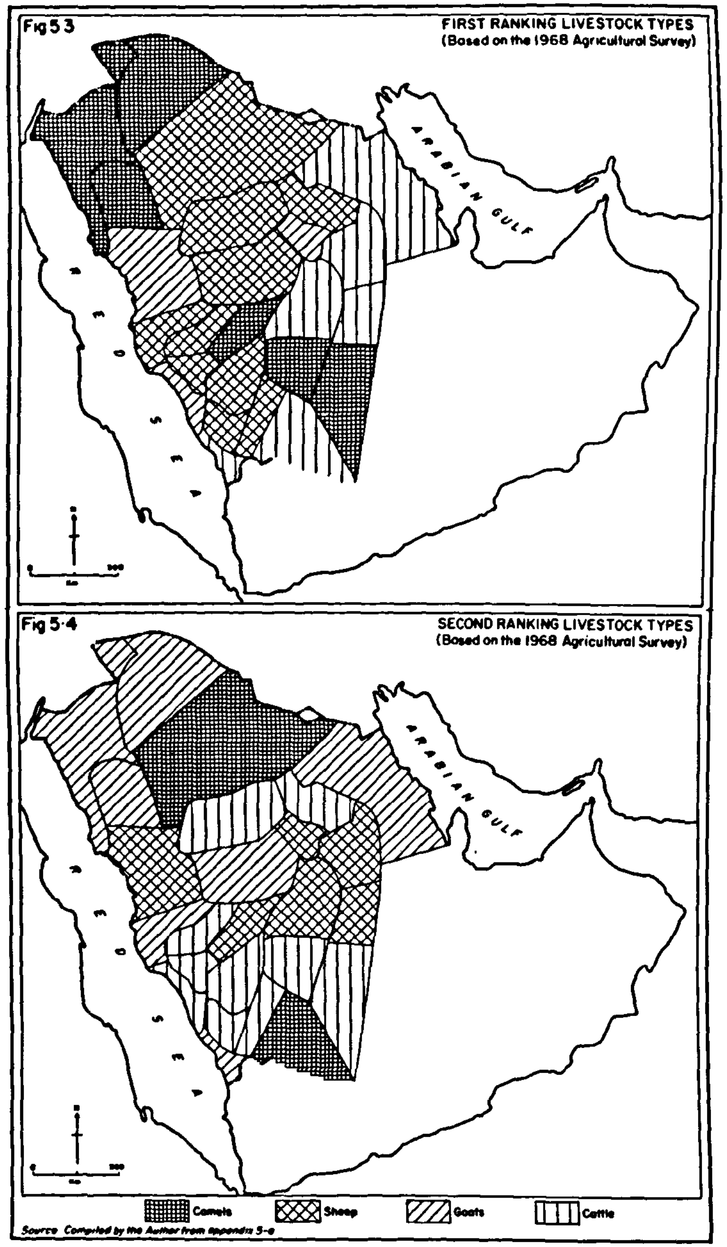


Fig 5.3
FIRST RANKING LIVESTOCK TYPES
(Based on the 1968 Agricultural Survey)
ARABIAN GULF
RED SEA
Fig 5·4
SECOND RANKING LIVESTOCK TYPES
(Based on the 1968 Agricultural Survey)
ARABIAN GULF
RED SEA
Camels
Sheep
Goats
Cattle
Source Compiled by the Author from Appendix 5-a

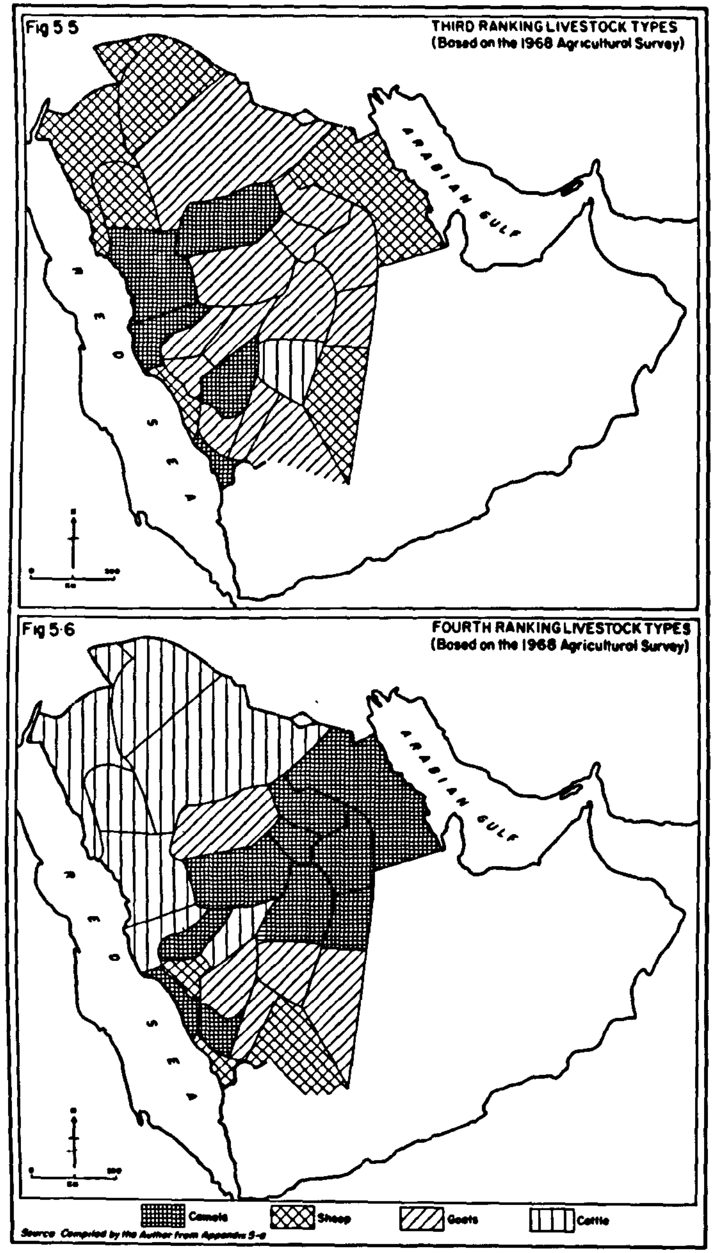


Fig 5.5
THIRD RANKING LIVESTOCK TYPES
(Based on the 1968 Agricultural Survey)
ARABIAN GULF
RED SEA
Fig 5·6
FOURTH RANKING LIVESTOCK TYPES
(Based on the 1968 Agricultural Survey)
ARABIAN GULF
RED SEA
Camels
Sheep
Goats
Cattle
Source Compiled by the Author from Appendix 5-a

to Wadi al-Dwasir and al-Sulayyil. This almost continuous belt separates the camel country in the north from the cattle areas; sheep do not have the camel's endurance and ability to penetrate deep into desert areas, nor are they preferred to cattle in irrigated areas. The sheep area is thus located between what could be termed the sown area and the desert. A rather important factor is that the sheep belt lies close to the main urban and rural markets.

The two islands where goats ranked first, at Madina and Gunfida, seem at first an anomaly. However, these areas are located far from the main deserts while they also lack rich agricultural resources. The fact that most of the population in these areas are either rural or Bedwin encourages the ownership of goats.

Understandably the second rank pattern in Figure 5-4 is more complex and fragmentation is much greater than in the first rank map. With the exception of goats all other animals occur in approximately equal proportions. The sudden emergence of goats indicates their importance as a secondary animal.

The third rank map (Fig.5-5) though fragmented, still displays a tendency to rather large blocks, with goats having the largest share. Cattle are insignificant and sheep occupy a strong position.

The lack of fragmentation on the fourth rank in Figure 5-6 is clear. Cattle occupy most of the northern half of the country, and camels most of the southern half. Sheep and goats occupy a few islands, with goats having a stronger position than sheep.

Sheep prominant in the first three ranks cover a sizable area over much of the country, and goats prominent in second and third ranks, indicate their common use throughout the country as a whole.

5.3.4 Livestock Combination Regions

The previous ranking method, as explained earlier, is an enlightening first step giving a general impression of the relative positions of strength of each livestock type. However, this method conceals livestock combinations, which are the rule rather than the exception. In a very real sense animal types, be it in the desert or in agricultural areas, are in a continuous state of competition, supplanting and complementing one another in the use of land. Characteristically animal types appear in combinations, hence any meaningful appraisal of animal land use and regional distribution must eventually seek to define and analyse the pattern and inter-relations of animal associations.

John Weaver was the first to attempt to outline animal and crop combination regions using a statistical approach[12] outlined in Appendix 5-b. The same approach has been suggested and used in industrial geography to identify "one industry" and "two industry" areas.[13]

There is a continuing conviction on the part of Weaver and others that this method is not completely satisfactory. Its principal weakness, as Hoag[14] has pointed out, is "the use of statistical procedure for purposes for which they were not intended". Another researcher, Johnson[15] has argued that the drawback of this method would not seem to nullify the utility of such a descriptive device. He supports his argument by saying that the classes produced by Weaver could only be dismissed if they were meaningless or misleading in the aggregate, and no evidence has been presented to indicate that this is so. The author supports Johnson's argument, because the results obtained by this method in the case of this study have proved logical and enlightening in defining the major animal core areas in Saudi Arabia. The limitations of this technique have been kept in mind when employing it and its results have been viewed

12. Ibid.
13. Smith, O., Industrial Britain: The North West, (Newton Abbot; David & Charles, 1969), p.257, and Haggett, P., Locational Analysis in Human Geography, (London; Edward Arnold, 1965), pp.220-221
14. Hoag, L.P., "The Weaver Method: An Evaluation", Prof.Geographer, Vol.21, No.4, (1969), pp.244-246
15. Johnson, L.J., "Further comments on Weaver Method", Ibid., pp.246-247

in the light of the author's personal knowledge of the subject and the country in question.

In the case of this study the animal combinations for each district in Saudi Arabia have been calculated by Weaver's method (Appendix 5-b) and are shown in Table 5-8. Figure 5-7 illustrates visually the spatial implication of Table 5-8, thus they both should be reviewed concurrently. The patterns M, C, G and S donate camels, cattle, goats and sheep respectively. At this point it becomes possible to draw boundaries around regions with the same combination. The percentage rank of animal types within any given group was not considered, and this will conceal the uneven strength of any animal type in any combination. For example, districts with combination groups MGS, SGM, GMS or any other possible variety of rank were consolidated into a common combination.

The pursuance of the statistical procedure (defined in Appendix 5-b) illustrated in Figure 5-7 produced 26 primary combinations. Figure 5-7 shows clearly that the concentration on a single type of livestock does not exist because it is more common for pastoralists or farmers to raise several types of livestock than it is for them to produce a single type.

The most common combination is the three animal group, which occupies 14 out of 26 districts, or more than 53% of the area. Among these the combination CGS (cattle, goats and sheep) is the most common, occupying 7 districts. The association among these three animals is due to the different needs and resources they both provide and utilize. Such combinations only apply to districts, but on a single farm basis such a combination could hardly exist, because cattle and goats are over-lapping and competitive animals: they produce the same commodities, primarily milk, hence a farmer who can afford a cow usually will not have a goat and vice versa. The raising or feeding of sheep in associa-

Table 5-8

Animal - Combination Regions in Saudi Arabia

TABUK	CAMELS	CAMELS	GOATS *	CAMELS	GOATS	SHEEP	CAMELS	GOATS	SHEEP	CATTLE
PERCENT	43.18	43.18	42.62	43.18	42.62	13.87	43.18	42.62	13.87	0.32
	3228.14	50.44		187.37			343.51			
GORIAT	CAMELS	CAMELS	GOATS *	CAMELS	GOATS	SHEEP	CAMELS	GOATS	SHEEP	CATTLE
PERCENT	46.79	46.79	40.03	46.79	40.03	12.31	46.79	40.03	12.31	0.87
	283[illegible].41	54.79		222.74			361.19			
JOUF	CAMELS	CAMELS	GOATS	CAMELS	GOATS	SHEEP *	CAMELS	GOATS	SHEEP	CATTLE
PERCENT	43.40	43.40	28.59	43.40	28.59	18.92	43.40	28.59	18.92	9.09
	3204.12	251.01		119.28			160.30			
HAIL	SHEEP	SHEEP	CAMELS	SHEEP	CAMELS	GOATS *	SHEEP	CAMELS	GOATS	CATTLE
PERCENT	42.19	42.19	30.80	42.19	30.80	18.91	42.19	30.80	18.91	8.91
	3342.56	214.89		101.32			160.77			
QASIM	SHEEP	SHEEP	CATTLE	SHEEP	CATTLE	CAMELS *	SHEEP	CATTLE	CAMELS	GOATS
PERCENT	34.61	34.61	26.98	34.61	26.98	26.62	34.61	26.98	26.62	11.80
	4275.56	383.43		28.78			68.30			
RIYAD	CATTLE	CATTLE	SHEEP	CATTLE	SHEEP	GOATS *	CATTLE	SHEEP	GOATS	CAMELS
PERCENT	52.85	52.85	26.79	52.85	26.79	18.12	52.85	26.79	18.12	2.24
	2222.86	273.35		218.38			336.14			
KHARJ	CATTLE	CATTLE	SHEEP	CATTLE	SHEEP	GOATS *	CATTLE	SHEEP	GOATS	CAMELS
PERCENT	56.28	56.28	20.27	56.28	20.27	16.24	56.28	20.27	16.24	7.21
	1911.[illegible]8	461.76		329.69			348.60			
SUDIR	SHEEP	SHEEP	CATTLE	SHEEP	CATTLE	GOATS *	SHEEP	CATTLE	GOATS	CAMELS
PERCENT	33.28	33.28	30.47	33.28	30.47	22.44	33.28	30.47	22.44	13.81
	4451.10	330.47		41.97			57.59			
ASHR	CATTLE	CATTLE	SHEEP	CATTLE	SHEEP	GOATS *	CATTLE	SHEEP	GOATS	CAMELS
PERCENT	54.95	54.95	25.90	54.95	25.90	15.62	54.95	25.90	15.62	3.53
	2[illegible]29.55	302.57		278.60			361.99			
DWADMI	SHEEP	SHEEP	GOATS	SHEEP	GOATS	CATTLE	SHEEP	GOATS	CATTLE	CAMELS *
PERCENT	29.87	29.87	26.07	29.87	26.07	25.82	29.87	26.07	25.82	18.25
	4518.75	489.07		40.02			17.77			
GWAIYAH	CATTLE	CATTLE	SHEEP	CATTLE	SHEEP	GOATS *	CATTLE	SHEEP	GOATS	CAMELS
PERCENT	32.15	32.15	28.56	32.15	28.56	27.69	32.15	28.56	27.69	11.59
	4603.55	389.11		18.39			62.69			
BISHAH	SHEEP	SHEEP	CATTLE	SHEEP	CATTLE	CAMELS	SHEEP	CATTLE	CAMELS	GOATS *
PERCENT	55.16	55.16	17.00	55.16	17.00	15.07	55.16	17.00	15.07	12.76
	2010.48	557.87		358.61			305.49			
RANIAH	CAMELS	CAMELS	SHEEP *	CAMELS	SHEEP	GOATS	CAMELS	SHEEP	GOATS	CATTLE
PERCENT	47.15	47.15	36.31	47.15	36.31	10.15	47.15	36.31	10.15	6.39
	2793.44	57.74		245.51			296.34			
G.Z.	SHEEP	SHEEP	CATTLE	SHEEP	CATTLE	GOATS *	SHEEP	CATTLE	GOATS	CAMELS
PERCENT	41.35	41.35	34.37	41.35	34.37	18.66	41.35	34.37	18.66	5.62
	3439.74	159.57		93.47			192.69			
AFLAG	CATTLE	CATTLE	SHEEP	CATTLE	SHEEP	GOATS *	CATTLE	SHEEP	GOATS	CAMELS
PERCENT	42.65	42.65	23.44	42.65	23.44	21.03	42.65	23.44	21.03	12.88
	3289.00	379.61		111.71			119.18			
SULAYIL	CAMELS	CAMELS	CATTLE	CAMELS	CATTLE	SHEEP *	CAMELS	CATTLE	SHEEP	GOATS
PERCENT	38.99	38.99	35.55	38.99	35.55	13.30	38.99	35.55	13.30	12.16
	3722.12	165.00		145.78			152.21			
W.DWASR	CAMELS	CAMELS	CATTLE	CAMELS	CATTLE	SHEEP *	CAMELS	CATTLE	SHEEP	GOATS
PERCENT	53.95	53.95	19.24	53.95	19.24	18.67	53.95	19.24	18.67	8.15
	2120.37	481.01		279.49			298.92			
NAJRAN	CATTLE	CATTLE	CAMELS	CATTLE	CAMELS	GOATS	CATTLE	CAMELS	GOATS	SHEEP *
PERCENT	31.24	31.24	24.63	31.24	24.63	22.78	31.24	24.63	22.78	21.35
	4728.25	497.75		63.37			14.32			
GUNFIDA	GOATS	GOATS	CATTLE *	GOATS	CATTLE	SHEEP	GOATS	CATTLE	SHEEP	CAMELS
PERCENT	40.71	40.71	35.64	40.71	35.64	13.36	40.71	35.64	13.36	10.29
	3515.76	146.25		132.61			177.56			
JIZAN	CATTLE	CATTLE	GOATS	CATTLE	GOATS	CAMELS	CATTLE	GOATS	CAMELS	SHEEP *
PERCENT	50.02	50.02	24.86	50.02	24.86	13.11	50.02	24.86	13.11	12.01
	2457.76	316.12		252.83			234.09			
ABHA	SHEEP	SHEEP	CATTLE *	SHEEP	CATTLE	GOATS	SHEEP	CATTLE	GOATS	CAMELS
PERCENT	44.13	44.13	38.91	44.13	38.91	12.94	44.13	38.91	12.94	4.01
	3121.20	78.67		187.73			286.38			
S.UBID	SHEEP	SHEEP	CATTLE	SHEEP	CATTLE	CAMELS	SHEEP	CATTLE	CAMELS	GOATS *
PERCENT	47.73	47.73	21.61	47.73	21.61	15.79	47.73	21.61	15.79	14.87
	2732.13	405.71		217.19			178.89			
TAIF	SHEEP	SHEEP	CATTLE *	SHEEP	CATTLE	GOATS	SHEEP	CATTLE	GOATS	CAMELS
PERCENT	49.39	49.39	30.87	49.39	30.87	12.26	49.39	30.87	12.26	7.47
	2561.07	193.15		239.81			274.73			
M.J.T	SHEEP	SHEEP	GOATS	SHEEP	GOATS	CAMELS *	SHEEP	GOATS	CAMELS	CATTLE
PERCENT	47.03	47.03	23.46	47.03	23.46	22.06	47.03	23.46	22.06	7.45
	2805.32	356.41		137.30			201.15			
ALULA	CAMELS	CAMELS	GOATS *	CAMELS	GOATS	SHEEP	CAMELS	GOATS	SHEEP	CATTLE
PERCENT	44.07	44.07	40.14	44.07	40.14	10.94	44.07	40.14	10.94	4.85
	3127.88	66.20		221.00			299.15			
MADINA	GOATS	GOATS	SHEEP	GOATS	SHEEP	CAMELS *	GOATS	SHEEP	CAMELS	CATTLE
PERCENT	46.83	46.83	22.90	46.83	22.90	20.35	46.83	22.90	20.35	9.92
	2827.41	372.31		192.94			182.43			
E.PVOV	CATTLE	CATTLE	GOATS	CATTLE	GOATS	SHEEP *	CATTLE	GOATS	SHEEP	CAMELS
PERCENT	47.28	47.28	22.99	47.28	22.99	20.81	47.28	22.99	20.81	8.92
	2779.31	368.48		192.59			194.16			

Source: Compiled from Appendix 5-a

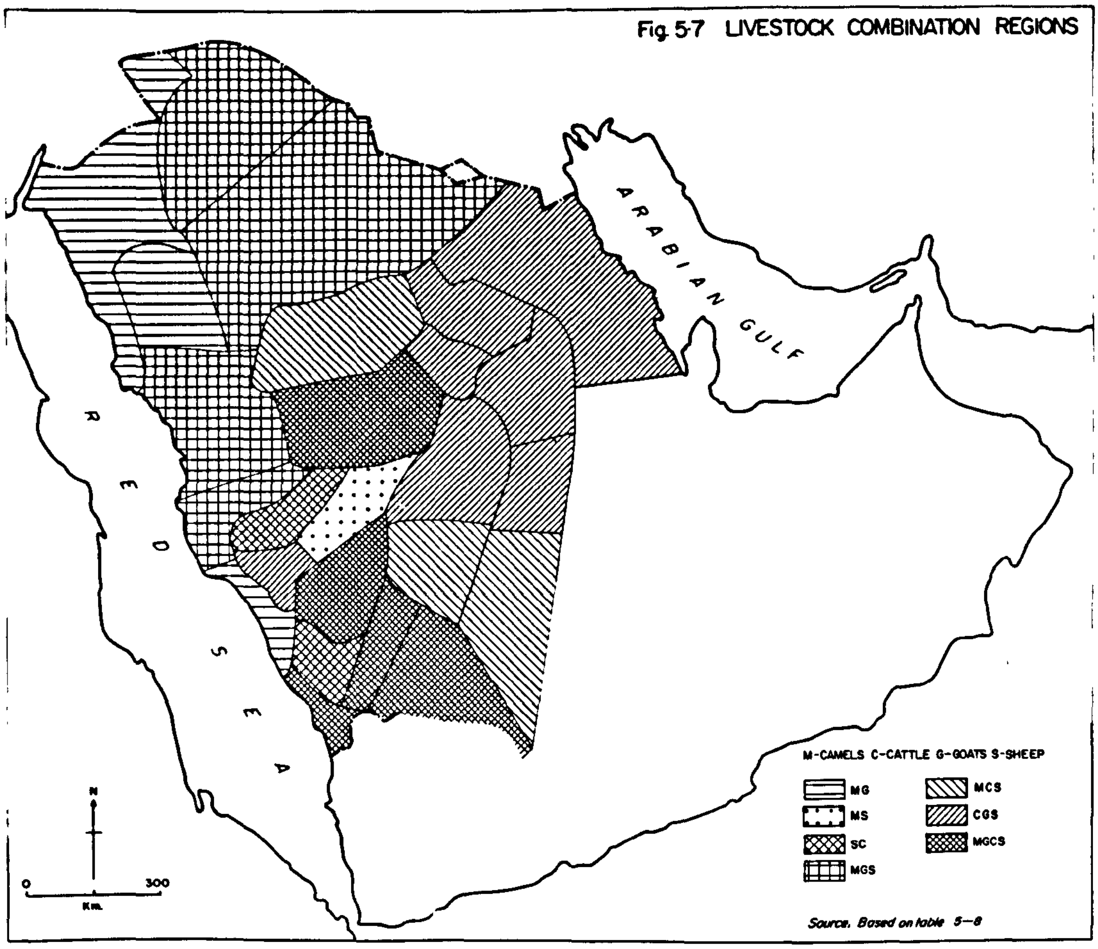


Fig. 5·7 LIVESTOCK COMBINATION REGIONS
ARABIAN GULF
RED SEA
M-CAMELS C-CATTLE G-GOATS S-SHEEP
MG
MS
SC
MGS
MCS
CGS
MGCS
N
0
300
Km.
Source. Based on table 5—8

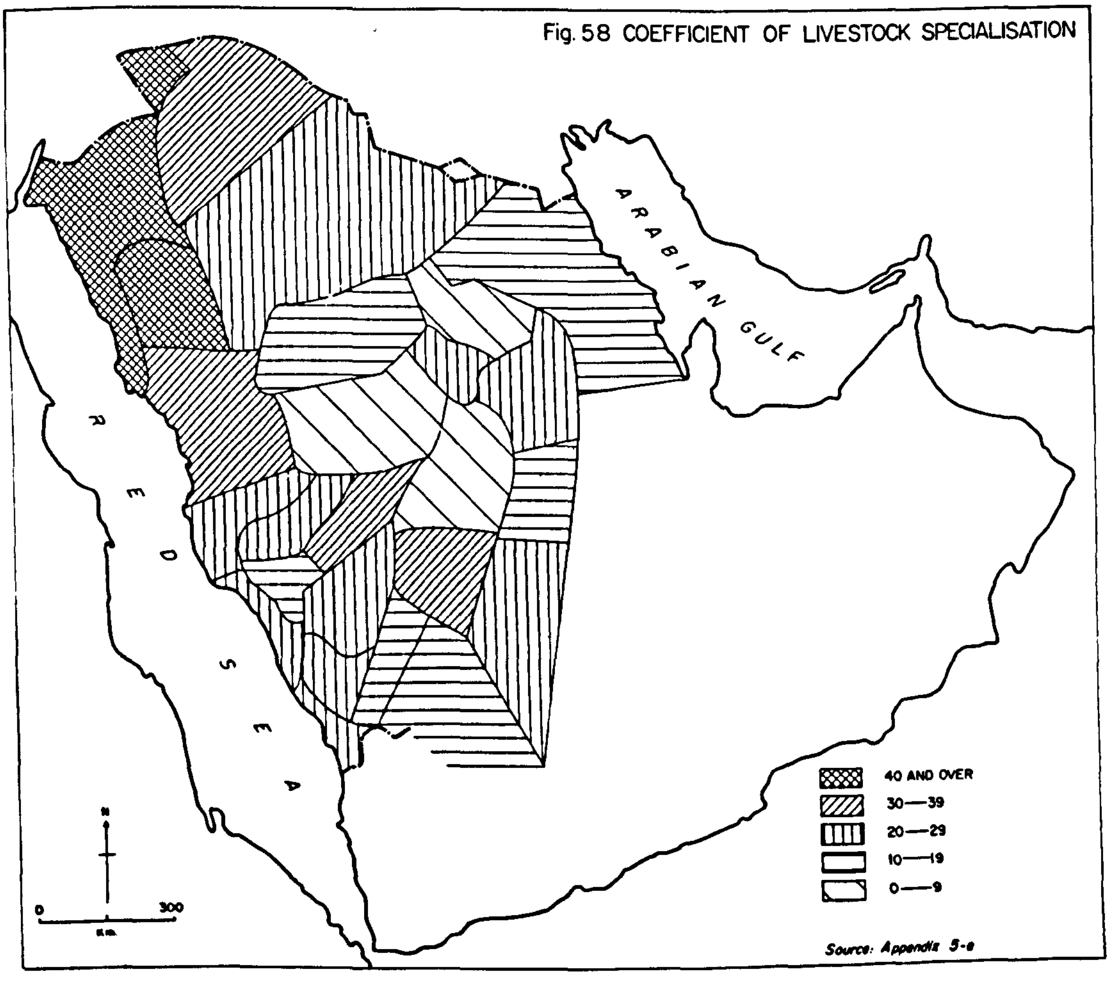


Fig. 58 COEFFICIENT OF LIVESTOCK SPECIALISATION
ARABIAN GULF
RED SEA
40 AND OVER
30—39
20—29
10—19
0—9
N
0
300
Km.
Source: Appendix 5-e

tion with cattle or goats is a regular phenomenon. The wide spread of 3 and 4 combination regions strongly indicates that intensive specialization in animal production as a main agricultural activity is not typical of agricultural areas in the country.

Another way of analysing Figure 5-7 is to rate the extent of individual animal types. Sheep were found in 22 combinations out of 26, goats in 20, cattle in 17 and camels in 12 combinations. This also confirms earlier findings that sheep and goats are widely spread throughout the country.

Fragmentation is great in Figure 5-7; the only large blocks are where MGS (camel, goats and sheep) occupy the north-east and central west and when CGS cover most of the east and east-central areas. With the exception of these two the rest are fragmented. The MGS and CGS also displays the importance of sheep and goats as strongly associated with camels and cattle in their areas. However, it should be noted that the roles they play (sheep versus goats) are socio-economically different. Sheep are integrated in these groups largely for the commercial production of meat, while goats are kept to satisfy the household need for milk. The former displays a pattern of stratification, while the latter plays the role of an over-lapping animal, which will be discussed in a later chapter.

5.4 Livestock Regional Concentration and Specialization

An awareness of the concentration of animal species in particular areas, and the establishing of the degree of reliance on particular animal types in different parts of the country, are matters of great importance. In other words, is there a regional preference for a certain type of animal? An attempt will be made to provide an answer for the 26 districts by using recent statistical approaches employed by some industrial geographers.[16] To the best of the author's knowledge such methods have

16. Smith, D., op.cit.,pp.60-61. Also Isard, W., Methods of Regional Analysis: An Introduction to Regional Science, (Cambridge; M.I.T. Press, 1963), pp.241-254

not been applied in the field of livestock studies.[17] These methods are enlightening and provide a means of analysing the available data.

5.4.1 Coefficient of Localization:
An Index of Animal Concentration (CL)

Table 5-9

The Coefficient of Localization for Animal Types in the Country

Livestock Types	Coefficient of Localization (CL)
Cattle	17.7
Camels	24.97
Sheep	23.59
Goats	14.33

Source: Derived from Appendix 5-c

In Table 5-9 the farm animal types are tested in order of their degree of geographical concentration. This is measured by the co-efficient of localization, which simply indicates how far the areal distribution of any animal type differs from the distribution of total livestock units. The coefficient varies between 0 and 100. A high coefficient indicates a high degree of concentration and a low one shows a rough correspondence with the distribution of all animals (for the method used see Appendix 5-c. As with industry, so in the case of livestock this method could provide a reasonable basis for a preliminary and tentative judgement about the livestock composition of each area, and about which type of livestock to encourage or at least to investigate further.

As Table 5-9 shows, there is no highly localized animal type. They all have low coefficients. The animal with the highest relative coefficient is the camel with almost 25%; sheep, goats and cattle have

17. These methods have been applied in agricultural geography by M. Chisholm for horticultural production in England and Wales in Rural Settlement and Land Use: An Essay in Location, (London; Hutchinson & Co., 1962), pp.93-95

coefficients of 24%, 19.3% and almost 18% respectively. This almost even distribution of animal types looks rather startling at first. However, it is not really so surprising. Deserts are the prevalent feature in most of the 26 administrative districts, but they are not the only feature, for agricultural areas, although small, are still found in almost every district. High altitudes constitute a small part of the country in the south-west, but do not make up the whole of a district. Therefore, almost every one of the 26 districts displays diversity within and a great similarity with other areas. In other words, one of the main disadvantages of basing the available data on these 26 delimited regions is the fact that their boundaries were defined by administrative and political considerations and hence they do not show uniform physical and geographical features. If the boundaries had been determined by physical considerations they would certainly have been different, a point which will be clarified in later discussion of animal land use. Some indication of the probable consequences is provided by the relatively high coefficient for camels of 25%, which must have resulted from the prevalence of deserts all over the southern and northern areas where the camel has its home. It is clear that different coefficients would have resulted if data on a national scale had been available, rather than the data based on agricultural areas that we are in fact obliged to use.

5.4.2 Location Quotients (LQ)

While the use of coefficients of localization has helped to indicate the degree of relative animal concentration, the LQ will permit a comparison between a region's share of the national stock of a particular species and its share of the overall national animal units. Where the location quotient is less than unity, the given district has less than its "fair" share of the animal type in question, where the LQ exceeds unity, the given area has more than a proportionate share of the animal type in question (method described in Appendix 5-d). However, as Isard warned, we should avoid the "temptation to read too much into the results of such an analysis".[18] The LQ is valuable in exploratory work and in conjunction with other methods used earlier. It should be interpreted on the basis of the knowledge of the subject and of the country in question.

Table 5-10 depicts the LQ for animal types over the 26 districts.. Taking the animal types one by one, the general following deductions can be made.

Cattle are widely dispersed in all but desert-dominated districts. but are very scarse in the main desert areas, e.g. Jawf, Hail and Madina in the north and north-west, and Raniah and Wadi al-Dwasir in the south. Cattle are almost totally absent in Tabuk and Jawf in the northern deserts. Cattle are also very scarce in urban areas like Mecca-Jeddah towns (M.J.T.), where households usually prefer to keep smaller animals like goats. They have a high LQ in agricultural areas, or districts surrounded by agricultural areas, like Riyadh, al-Kharj and Jizan etc.

Camels are obviously high in desert areas, their LQ exceeding 3 in Raniah and Wadi al-Dwasir on the edge of the Empty Quarter. One obvious conclusion is that areas with a high LQ for camels have a low LQ for cattle and vice versa.

Sheep are widely dispersed with neither the high nor the low LQ of camels and cattle. It is, as explained earlier, in part the stratification pattern of this animal that makes it common in association with both cattle and camels.

Goats show some higher LQ's than sheep, especially in Madina, Gunfedeu, Tabuk and Goriat, mainly desert areas where households require

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18. Izard, W., Methods of Agricultural Analysis: An Introduction to Regional Science, (Cambridge; M.I.T.Press,1961),p.124

Table 5-10

The Location Quotients for Livestock Types

	Cattle	Camel	Sheep	Goats
Tabuk	0.01	2.75	0.47	1.91
Goriat	0.03	2.98	0.42	1.80
al-Jawf	0.28	2.77	0.64	1.28
Hail	0.26	1.96	1.43	0.83
Qassim	0.83	1.70	1.17	0.53
Riyadh	1.63	0.14	0.91	0.81
al-Kharj	1.73	0.46	0.69	0.73
Sudir	0.94	0.88	1.13	1.01
Washm	1.69	0.23	0.88	0.70
Dwadmi	0.79	1.16	1.01	1.17
Gwaiyah	0.99	0.74	0.97	1.24
Bishah	0.52	0.96	1.87	0.57
Baniah	0.20	3.01	1.23	0.46
Ghamizahran	1.06	0.36	1.40	0.84
Aflaj	1.31	0.82	0.79	0.94
al-Sulayyil	1.09	2.49	0.45	0.55
W.al-Dwasir	0.59	3.44	0.63	0.37
Najran	0.96	1.57	0.72	1.02
Gunfida	1.10	0.66	0.45	1.83
Jizan	1.54	0.84	0.41	1.11
Abha	1.20	0.26	1.49	0.58
Janob Obid	0.66	1.01	1.62	0.67
Taif	0.95	0.48	1.67	0.55
M.J.T.	0.23	1.41	1.59	1.05
Alula	0.15	2.81	0.37	1.80
Madina	0.31	1.30	0.78	2.10
E.Province	1.46	0.57	0.70	1.03

Source: Calculated from Appendix 5-a

an animal like the goat to provide for their daily milk requirement.

Clearly the LQ confirms earlier results: all the findings point to the low concentration of animal types around the country as a whole, and whatever relative concentration takes place usually is due to ecological factors.

5.4.3 Coefficient of Specialization (CS)

The coefficient of specialization pertains to a given district and measures the degree of local specialization. Its main advantage over other indices used so far is that it compares the regional structure with the national one. It compares the percentage distribution of a livestock type unit among other types in any district with regional total animal units. (Method and Table used in Appendix 5-e.)

Like the coefficient of localization, this index varies between 0 and 100. If any one of the 26 districts has a proportional mix of animal units identical with the country as a whole the coefficient will be 0. In contrast if all the animal units of a district are concentrated in a single type, the coefficient will approach the unity of 100. This method is helpful in showing the approximate extent to which the distribution of animal units in a given district deviates from the distribution for the whole country.

The CS values mapped in Figure 5-8 confirm, to say the least, the results obtained earlier and indicate that animals are fairly dispersed in the country with very low regional specialization and animal concentrations. The only areas with a high departure from the national structure are the extreme north-eastern districts with CS values of over 40% but less than 50%. This relatively high value could be attributed to the relatively high LQ and CL for camels in this area.

PART THREE

LIVESTOCK PRODUCTION SYSTEMS

INTRODUCTION

As with agriculture as a whole, so with livestock, the classification into production systems is still a debatable issue beset with numerous methodological difficulties. Some of these difficulties are:

(a) A lack of universal criteria for the classification of agriculture. The criteria that apply to one region may not apply to another, and as Duckham and others have pointed out: "Each branch of the agricultural and geographical profession designs [classifications]to meet its needs".[1]

(b) Agriculture is an evolutionary and changing phenomenon, hence any classification will be a temporary one. The changes in agricultural practices in many parts of the world, including Saudi Arabia since the beginning of this century, have been too great to be ignored.

(c) There is a lack of detailed information about farming in most of the world and the information available is usually not standardized. Grigg suggested that: "there should be used as criteria of similarity, elements such as the crop grown, the animals reared, the implements used and the size of the farms...these criteria should be measurable, but this is rarely possible",[2] particularly in the case of an under-developed country like Saudi Arabia which has many organizational problems that prevent the production of reliable statistics.

In spite of these difficulties a classification of livestock systems for the country must be attempted in order to provide a framework for this part. Such a classification is temporary, and may be altered and improved upon to suit changing circumstances.

Part Three includes three chapters and deals mainly with livestock production systems in the country. The first chapter serves as an intro-

1. Duckham, A.N., and Masefield, G.B., Farming Systemsof the World, (London; Chatto and Windus, 1970),p.105
2. Grigg, D.B., The Agricultural Systems of the World, (London; Cambridge.Univ. Press, 1974),p.2

duction and provides a foundation on which to base the classification of livestock production systems in the country. It attempts to answer such questions as: what systems exist? how have they evolved? and what are the differences between them? Subsequent chapters, deal with the main livestock production systems in the country, with emphasis placed on the problems in each system.

CHAPTER SIX

THE CLASSIFICATION OF LIVESTOCK PRODUCTION

There are different ways of classifying livestock activities into systems. One way is to distinguish stages such as breeding, rearing and fattening as criteria for classification; this pre-supposes distinct specialization not only on separate farms but also in separate regions, with livestock being sold off by one farm and bought by another as each stage is completed. Another classification is on the basis of each animal type or animal product, each one representing a system of livestock production, i.e. dairying, beef, lamb and mutton or sheep, cattle, camel, and goats. In the case of Saudi Arabia these are not the ideal criteria for classifying livestock systems, because livestock production is traditional, hence specialization in animal type, products and processes has not evolved sufficiently to warrant their status as main criteria for classification.

6.1 Determinants

The classification of livestock production in the country is determined by the negative aspects of two major sets of factors. The first is the arid ecological factors, mainly climate and water resources (Chapter 1). The second is the traditional socio-economic nature of the farming and pastoral communities in the country, which are characterised by a low level of economic and technical development (Chapter 3). Ecological factors are detrimental because of: (a) the country's location in an arid zone, for the consequent high temperatures, high solar radiation and limited water resources, largely dictate the degree, intensity and the type of land use, and (b) the traditional socio-economic nature of the farming community in the country as a whole, for the lack of modern agricultural methods inhibits control over the environment. It is for this reason that agriculture in an under-developed and largely arid country like Saudi Arabia tends to be less resistant to ecological factors than that of a developed country of high technological power. As Duckham and associates have stated:

> Ecological influents...tend to be more important as locating and intensity factors in under-developed areas than they are in advanced economies. In the latter, high levels of industrial and scientific inputs...firstly, raise the level of input intensity which is practicable or profitable at a given ecological site; and, secondly, by extending man's control over his physical and ecological environment, increase the range of ecologically feasible enterprises on a farm.[1]

6.2 Criteria for Livestock Classification

Due to the determining significance of ecological and socio-economic factors, it is appropriate to classify livestock production on the basis of two criteria: (1) the principal types of land available in the country and (2) the animal adaptation to these land types.

6.2.1 Principal land use

Table 6-1

Land area by use in Saudi Arabia (000) ha.

Main use	Land use	000 ha	%
1. Arable	Arable land	525	0.24
2. Range land	Permanent grassland	1,700	0.77
	Forest	2,780	1.26
	Semi desert range land	140,000	63.6
	Desert (barren)	75,000	34.1
	Total	219,480	99.7
3. Non-agriculture	Settlements, roads etc	116	0.05
Total		219,969	100

Source: Derived from different MAW sources

As shown in Table 6-1 the country has approximately 219,969,000 hectares of land distributed unequally in three main categories: (1) small areas of arable land, (2) ranges varying from permanent grass lands, covering small areas of around 1,700,000 hectares, to largely barren

1. Duckham, A.N., and Masefield, C.B., op.cit., p.3

deserts, which together account for almost 99.7% of the country, and (3) non-agricultural land including settlements, roads etc., which occupy around 0.05%.

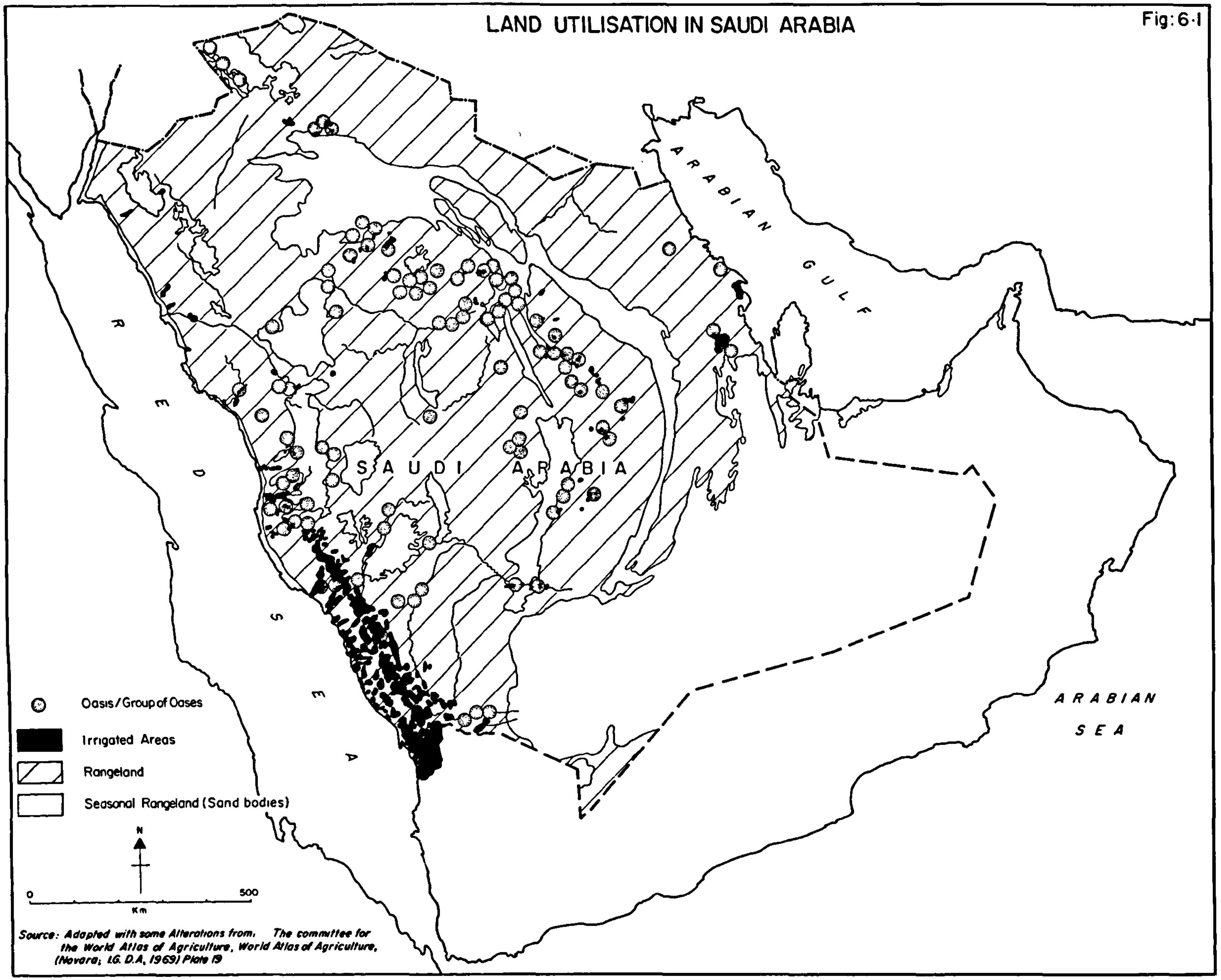
As shown in Figure 6-1, agricultural areas are limited to small scattered enclosures of cultivated land in either the rain-fed regions in the south-west or around irrigated oases dispersed all over the desert. In such a largely desert country, the location of the three main types of land in relation to each other takes the shape of concentric zones where all settlements are located in or near to cultivated areas. Both the settlements and the cultivated areas form an oasis surrounded by the desert. Figure 6-2a illustrates hypothetically this sequential order, where A, B, and C represent settlements, cultivated areas and desert respectively.

6.2.2 Animal Adaption to Land Uses

The main factors affecting animal life in arid environments are: sparse vegetation, considerable fluctuations in quantity and quality of grazing within and between years, poorly distributed water supplies, limited cultivated areas, high ambient temperatures, low humidity and intense solar radiation. The degree of animal adaption to these factors is a major criterion when considering the classification of livestock systems. Not all animals are "fit" to maintain their needs and reproduce in the desert ranges. It is only the adapted animals, like camels, sheep and goats who have the overall ability to satisfy their needs in some measure in arid ranges, while cattle cannot maintain themselves on ranges of that type, but can only thrive in a modified environment, i.e. arable areas (Part Two).

6.3 Animal Types and Land Uses

The clear and distinct pattern of animal adaptation to certain types of land has induced specialization in animal land use. The three



LAND UTILISATION IN SAUDI ARABIA

Fig: 6·1

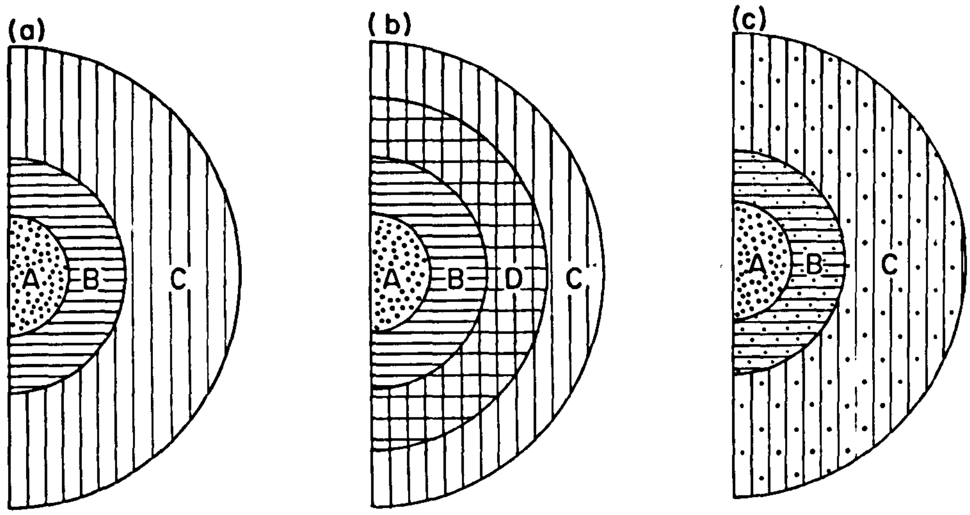
Source: Adapted with some Alterations from, The committee for the World Atlas of Agriculture, World Atlas of Agriculture, (Novara; I.G. D.A, 1969) Plate 19 types of land estimated in Table 6-1 and illustrated hypothetically in Figure 6-2a are utilized to different degrees by different types of animal. This specialization is mainly ecological in nature; where one land use is more suitable for the production of certain animal types than others. Thus the spatial ordering of specialization in animal production for each animal type is different for the three land uses as illustrated in Figure 6-2a. This pattern of animal and land use specialization has induced a spatial ordering of livestock production in the country resembling that of the classical "isolated state" of Von Thünen, at least in the sense that as one goes away from the centre zone, production becomes less intensive, fewer inputs are added and returns per area fall. If we take Von Thünen ideas at their face value, that is they "do not constitute a theory of location...but amount to a method of analysis which may be applied to any situation in any time or place",[2.] then in the light of this method a classification of livestock systems can be derived from the intensity of animal and land use specialization. Focusing on Figure 6-2a it can be seen that Zone A represents urban areas, and the households in this zone raise mainly goats. The popularity of goats in this area can be attributed to the advantages of this animal, for it is small enough to be kept in houses, has limited feed requirements, and needs minimum care to maintain. Zone A therefore has a kind of subsistence economy, producing milk within households for individual consumption despite the fact that it is the market centre; this is a common phenomenon all over the urban areas in the country and has resulted from the lack of reliable commercial sources of milk.

Cattle can only be maintained in Zone B - the arable areas - because desert ranges (Zone C) are too poor to support these animals. The fattening and finishing aspect of sheep production, with its reliance on

2. Chisholm, M., Rural Settlement and Land Use, (London; Hutchinson Univ., Library, 1973), p.20

Fig: 6·2

Ideal Concentric Pattern of Land Use
and their Specialized Animal Types



(a) land types and their specialized animal use

(b) hypothetical location of stratification

(c) A state of overlapping

Goats = A = Settlements

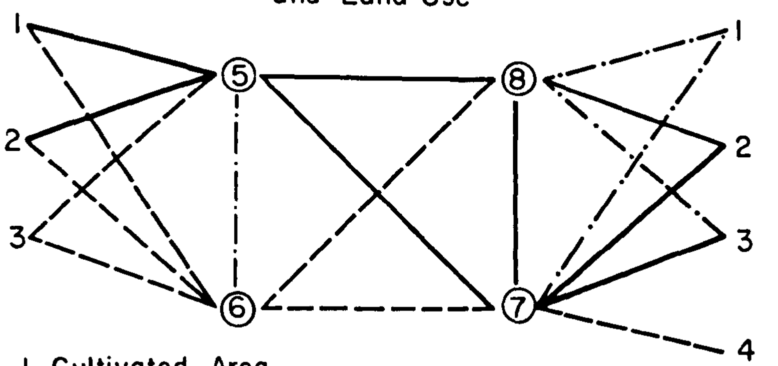
Cattle = B = Irrigated areas

Camels = C = Desert Ranges

Sheep = D = Arable Range Fringe

Fig: 6:3

Rank Correlation of Animal Types
and Land Use



1 Cultivated Area
2 Fodder Area
3 Irrigated Area
4 Permanent Crops Area
5 Cattle
6 Camel
7 Sheep
8 Goats

Positive Correlations

>80
70 - 79
50 - 69
<50

Source based on table 6-2

intensive feeding, is also practised in this zone. Intensive production of meat and milk in this zone is very much a matter of economic choice, based mainly on the joint function of inherent production costs, transportation costs, demand, and livestock response to inputs, which are costly.

Zone C represents desert ranges which are largely utilized by camels and, to a lesser extent, by sheep and goats. The poor state of most of the ranges and the large distances that have to be covered by animals in order to find food makes the camel the ideal animal for this zone. Camels when found in Zones A and B are usually for transportation or have been brought to market for sale.

This specialization in animal land use is due mainly to the kind of resources or opportunities provided by each particular type of animal and land. The three land types or zones provide comparative advantages in the form of vegetation, fodder or housing for some particular type or types of animal and these have the complementary advantage of being able to adapt to a particular zone and to utilize it more efficiently. Thus each of these zones tends to specialize in the animal type for which it has the greatest advantage (Fig.6-2a).

The validity of the existing relationships between animals and land use, and the theoretical delimitation of the three zones shown in Figure 6-2a have been supported by the discussion in Chapter Five. It should be recalled that in Chapter Five, the different geographical techniques used to analyse the animal regional specialization and concentration (LQ, CL, CS, Animal Ranking and Combination regions) all indicated indirectly the existence of a pattern of <u>animal land use specialization</u> in the country. It is necessary to illustrate this specialized land use using all the available facts. Thus this chapter will use a statistical approach to see to what extent this pattern of specialization does exist.

Although statistical relationship is only part of the picture, it is of great value as an aid to analysis in that it illustrates the problems in precise terms. The coefficient of correlation is a very useful measure for our purpose and will be the main tool used in the following section.

6.3.1 Correlation between Animal Types and Land Uses

The degree of correlation throughout the country between the regional population of each type of animal and the regional variations in the size of areas that are found under cultivation support the earlier pattern of animal land use specialization. The Spearman Rank Correlation Coefficient (rs) is used in this study,[3] to detect the relationships between the four animal types (cattle, camels, sheep and goats) and the four types of land uses (arable areas, fodder areas, irrigated areas and areas of permanent crops). The data was derived from the 1970/71 MAW census as shown in Appendix 6-a. The matrix shown in Table 6-2 shows the degree of correlation and the significant relationships between these animals and land uses. The significant positive correlations are illustrated in Figure 6-3 which shows that cattle, sheep and goats correlate with cultivated and forage areas at the 0.01 level,[4] and this means a strong association between these variables, indicating highly specialized animal land use. This significant relationship in the case of cattle is expected because, as has been stressed earlier, cattle can only be raised

3. The coefficient of rank correlation was introduced by Spearman, who showed that:

$$P = \frac{6\Sigma D^2}{n(n^2 - 1)}$$

where D is the rank difference and n is the number of pairs. Theakstone, W.H., and Harrison, C., The Analysis of Geographical Data, (London; Heinemann Educational Books, 1971), pp.80-81

4. The significance of Spearman's rank correlation is tested for a sample of any size having not less than 10 paired values by the use of the "t" table available in statistical references and based on the formula:

$$t = rs\sqrt{\frac{n-2}{1-r^2}}$$

Moreover the 0.01 and 0.05 levels simply mean that there are only 1 and 5 chances in 100 that a coefficient as high as these would occur from randomly paired data. Hammon, R., and McCullugh, P.S., Quantitative Techniques in Geography, (Oxford; Clarendon Press, 1974), pp.196-213 and p.301

Table 6-2.

Correlation Matrix of Animal Types and Land Use Types

Variables	1	2	3	4	5	6	7	8
1. Arable areas	1.000000							
2. Alfalfa areas	0.909091*	1.000000						
3. Irrigated areas	0.636364+	0.706294+	1.000000					
4. Permanent crops	0.272727	0.027972	0.426573	1.000000				
5. Cattle	0.804196*	0.867133*	0.468531	-0.132867	1.000000			
6. Camels	0.356643	0.391608	0.104895	-0.321678	0.587413+	1.000000		
7. Sheep	0.664336+	0.804196*	0.846154*	0.013986	0.699301+	0.440559	1.000000	
8. Goats	0.545455+	0.762238*	0.510490+	-0.258740	0.734266*	0.363636	0.776224*	1.000000

Notes * correlation at the 0.01 level of significance

\+ correlation at the 0.05 level of significance

Source: Based on Appendix 6-a, see also footnotes (3) and (4) in cultivated areas, thus the (rs) coefficients for cattle in cultivated and forage areas are higher than those for other animals, amounting to almost 0.80 and 0.87 respectively.

In the case of sheep and goats this significant relationship is attributed to two factors: (a) the sheep more than any other animal is well integrated into both pastoralism and farming, the former concentrating on breeding and the second on fattening and finishing sheep for market, and (b) goats are usually maintained in urban and rural households, and because these are located within or close to arable areas, a high correlation of over 0.50 and in the case of fodder areas over 0.70 is natural.

Moreover, the high degree of correlation that these three animals (cattle, sheep, goats) have with arable areas is reflected in the degree of association these animals have with each other, for goats and cattle correlate at the 0.01 level and the correlation between sheep and goats is at the 0.05 level (Table 6-2).

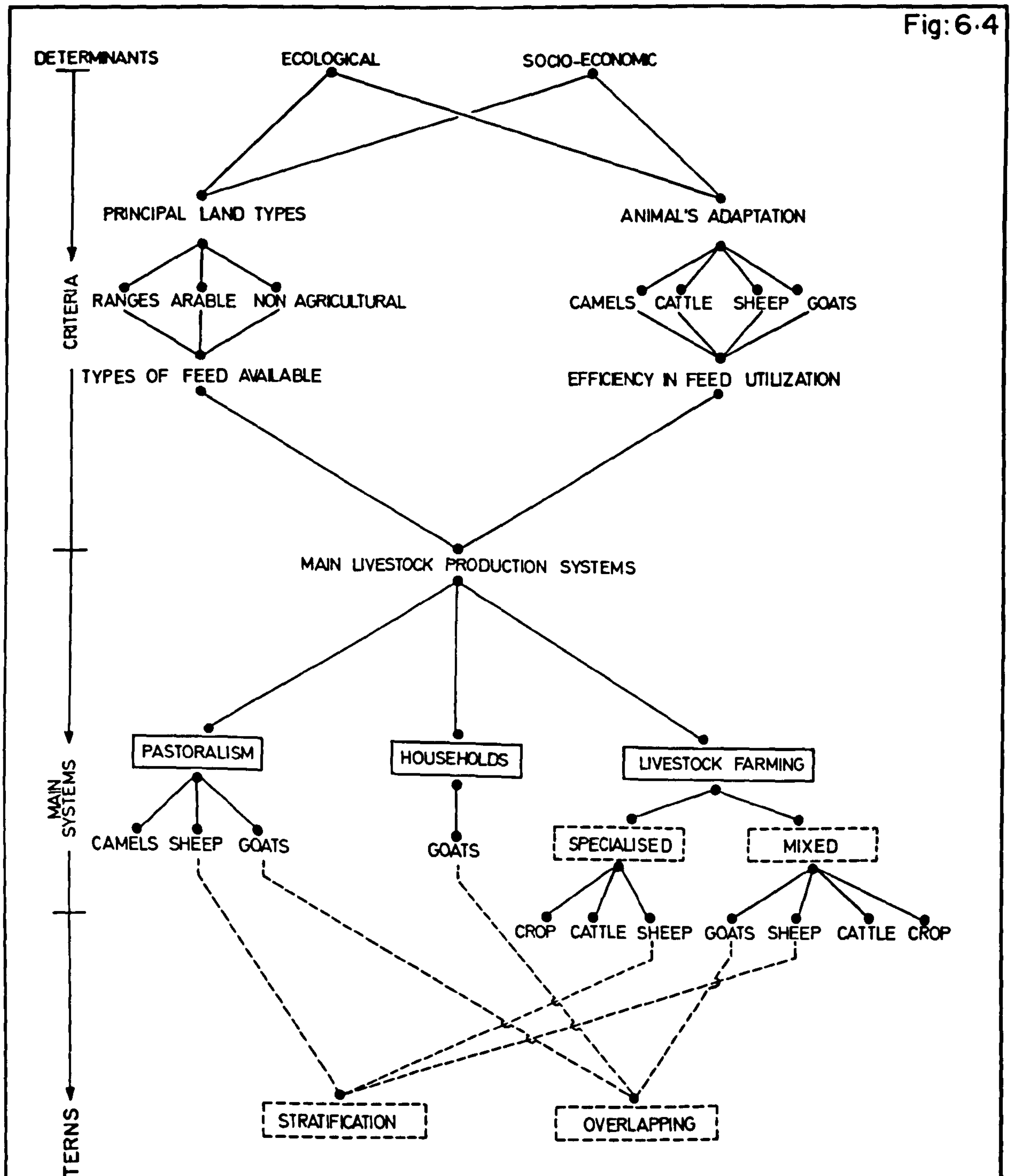
The correlation of the camel with the other seven variables cannot be taken as a direct indication of the degree of association this animal has with these variables because (a) the information in Appendix 6-a is derived only for the agricultural areas (Chapter 5) and camel estimates for these areas represent only a small fraction of the national camel population, which is largely found in desert areas, and (b) there is no regional animal census for the country as a whole. However, the degree of association the camel has with the main three land types or zones (Fig.6-2a) can be deduced indirectly and partially from the low correlation values camels have with arable areas indicating a low degree of association between camels and these areas. Furthermore, the pastoral system accounts for almost 83% of the camel population in the country (Chapter 5) and this supports the fact that camels are largely associated with and specialized in the utilization of Zone C or the desert area.

Finally, two important observations must be made concerning Table 6-2: the first is that the rs for permanent crops and animals indicates low values for sheep and is negative for the others, and such results are in opposition to the common observation that animals kept in rural areas are confined to farms with trees, mainly date palms, which can provide them with shade as they graze. It is inadvisable to take the results of Table 6-2 too far, but such low correlation values can be attributed mainly to the large agricultural areas in the south-western part of the country, and especially to Jizan, for these have few trees or permanent crops, as shown in Appendix 6-a, and at the same time they have more areas of temporary crops; this must exert an influence on the picture as a whole.

6.4 Livestock Production Systems

As shown in Figure 6-4, on the basis of the two criteria elaborated above, there are three main systems; pastoralism, livestock farming and household animal raising. As shown in Figure 6-4, each system is specialized in maintaining certain animal types and each system is specialized in utilizing certain types of land.

Pastoralism specializes in maintaining camels, sheep and, to a lesser extent, goats, and involves the use of range lands. Livestock farming is of two types: specialized and mixed. The first is a recent development aimed at the commercial production of milk and meat by the intensive feeding of cattle and sheep. Mixed farming is the traditional form of livestock farming; animals are raised as a secondary activity to that of crop production and also to provide milk and meat for the farmer himself, the surplus sometimes being sold. Livestock farming is an arable activity based on the utilization of irrigated fodder crops. Household animal raising is an ancient tradition aimed at the production



THE DETERMINANTS AND THE CRITERIA FOR THE CLASSIFICATION OF LIVESTOCK PRODUCTION SYSTEMS IN SAUDI ARABIA of milk for household needs, and goats are the main animal maintained.

Camels and cattle are the only animals that are specialized, that is each type is largely maintained under one system and not substantially raised under other systems. Camels are mainly maintained by pastoralism and cattle are raised only under livestock farming conditions.

6.4.1 Stratification and Over-lapping

Sheep and goats are common animals in all three systems. It is for this reason that the production of these two animals displays two prominent characteristics. The first could be identified as a stratified pattern, the second as an over-lapping pattern.

Stratification indicates a situation where a larger part of the sheep raising is being done on ranges, and the finishing is done in irrigated areas. The market preference throughout the country for mutton and lamb and the traditional integration of sheep in arable areas has encouraged the stratification of sheep rather than cattle (for which ranges are unsuitable) or goats (whose meat is not generally prized). Stratification in the case of sheep takes place between ranges and arable areas, hence it is theoretically assumed to be located in a buffer Zone D between Zones B and C on what can be identified as the Arable Range Fringe (Fig.6-2b).

Goats are the speciality of households, and since households are dispersed and found in ranges and arable areas, goats are thus also dispersed. It is for this reason that the dispersal of goats, grazing or feeding with other animals on all land types over the entire country, creates an over-lapping land use situation. Such a situation is not considered a stratification feature for the following reasons: (a) goats are found on all types of land competing with specialized animals (camels, cattle and sheep) (b) the goats' use of ranges has been rightly considered in certain cases a misuse that encourages over-grazing of vegetation and plants (c) although goats compete with specialized animals on ranges and farms, they produce meat and milk, as do other animals, with no obvious advantages. In any case milk is produced by sheep as a by-product to meat and by cattle and camels as a main product. The goat is only ideal for households (in settlements or deserts); this animal has a clear advantage in its small size and consequent lower food consumption and limited demands for housing and care.

Over-lapping is different from stratification, not only because of the commercial significance of the product produced, but also because it cannot be delimited to a certain zone. It is not located in a specific area or delimited by a theoretical boundary. Goats are found in households within the three main zones, and as an over-lapping animal with cattle, camels and sheep on ranges and farms (Fig.6-2c).

6.4.2 Essential differences among Livestock Systems

The three livestock production systems (pastoralism, livestock farming and households) display major differences. These main differences are outlined in Table 6-3. Although the household system is ancient it is unlikely to survive because, as reliable sources of milk become available, (i.e. dairies and reconstituted milk) this system will gradually vanish, especially in urban areas. This system will be discussed as a part of livestock farming (Chapter 7), because as a household activity it is located in or around arable areas and derives its fodder from these areas. Therefore, the most important systems to elaborate in this part are pastoralism and livestock farming. The traditional separation of these systems from each other has accentuated the inherent differences between the two systems and maintained their isolation.

Among the most outstanding differences shown in Table 6-3 are three. The first is the cultural background behind each one of them: Pastoralism is practised by al-Badiah, while livestock farming relies on sedentary farmers. The second is the difference in their spatial location: one is an outer and the other an inner form of livestock agriculture. Pastoralism is the outer system, traditionally permitting the use of areas located beyond the cropped areas. It is a mobile type of animal herding with no permanent means of confinement, and requires considerable space per animal unit. On the other hand livestock farming is an inner form of livestock raising, practised within cropped land and based on animal confinement by some type of housing.

The last major difference is economic, and involves the kinds of resource used. Pastoralism constitutes the sole economic means of those who practise it and is based mainly on the utilization of natural range land for animal feeding. On the other hand traditional livestock farming constitutes a partial source of income for the majority of farmers, and on the whole relies on irrigated crops, by-products and supplementary industrial products.

The following two chapters are an analysis of the nature of these two main livestock production systems and their basic problems in Saudi Arabia.

Table 6-3

Essential differences among the Three Systems

Factors	Pastoralism	Livestock Farming	Households
Fodder	Range vegetation	Irrigated fodder and supplements	Purchased fodder
Feeding systems	Grazing	Zero grazing	Zero grazing
Protection	None	Housing	Housing
People involved	al-Badiah	Farmers	Members of household
Main animal types	Camels	Cattle	Goats
Land use	Ranges	Irrigated areas	Houses
Economic aspects			
Milk	Subsistence	Subsistence and commercial	Subsistence
Meat	Commercial	Commercial	Subsistence

CHAPTER SEVEN

PASTORALISM

Man in an arid region, constrained by a low rate of rainfall, persistent droughts, and by a location remote from accessible water resources, can neither cultivate crops nor profitably find activities other than the utilization of desert vegetation. Therefore the Bedwins learnt to rely almost entirely upon animals and their products. The animals in turn are dependent on the natural vegetation of the desert. On this basis pastoralism came to be the dominant traditional economy of the greater part of Arabia, for it is the only form of agriculture that the ecology in such an arid area can maintain; Sauer stated, it is a "derived form of farming culture in which livestock was an original element".[1]

At present pastoralism is not the dominant economy, but certainly it is the major livestock system in Saudi Arabia. Pastoralism still provides the nation with most of the internally produced animal products. In 1971 ranges raised over 60% of the total national animal population (A.U.) while livestock farming raised the rest, and over 85%, 64% and 46% of the nation's camels, sheep and goats respectively were supported by pastoralism (Chapter 5).

Pastoralism today is in a state of decline and there are strong indications to support this trend. The first indication has been elaborated in Chapter Three and concerns al-Badiah institution, the main source of man-power for pastoralism. This institution has been disintegrating as a result of the massive and unorganized migration to urban areas. The second is that Saudi Arabia has changed over the past thirty years from a livestock exporting and self-supporting to an importing nation. Third, there is a disequilibrium within pastoralism as a result of the misuse of pastoral resources, mainly range resources which are the central

1. Sauer, C.O., Agricultural origins and dispersals, (New York; The American Geographical Society, 1952),p.97

element of pastoral activities and it is to this cause that pastoral decline is largely attributed. Range resources have been going through serious stages of deterioration caused by perplexing problems. An overall understanding of pastoralism and its present changing state in Saudi Arabia can only be arrived at through the evaluation of the present state and condition of range resources and the causes of their deterioration; and this is the main subject of this chapter.

7.1 Range Resources

The nature of ranges in an arid country like Saudi Arabia has aroused either low or high expectations. Both of these two extremes fail to grasp their true potential. Low expectations arise either from a global comparison of arid ranges with ranges in areas of high rainfall, or from a mistaken impression based on the meagre plant cover of the summer season. On the other hand a high expectation is usually derived from the sheer size of the desert range lands, and from the amazing response of desert vegetation to seasonal rains and conservation when provided (Plates 7-1 and 7-2).

However, efforts towards a better understanding of the national range lands have been made by Saudi Arabia within the last few years through the utilization of international expertise. The most important and recent venture in this direction was the Agricultural and Water Resources Survey of 1966-1970, sponsored by the MAW, supervised by F.A.O., and carried out by different international consultant groups for the areas shown in Figure 7-1. These surveys, F.A.O. studies, and other individual investigations have been based on reconnaissance, rather than on systematic inquiry. Thus they are of value in so far as they provide urgently needed, first-hand information for planning purposes.

Grazing lands in the country are of two types; arid range lands and pasture lands. Range lands are lands where the natural plant community

Plate 7-1 Natural range in sound condition with a good vegetation cover, spared from over-grazing as a result of its isolation. (30 km. to the south of Khamsin in W.Dwasir on the edge of the Empty Quarter.)

Plate 7-2 An excellent range condition achieved by conservation and effective water management of an experimental area located in the north of Wadi Arar (Northern Deserts).

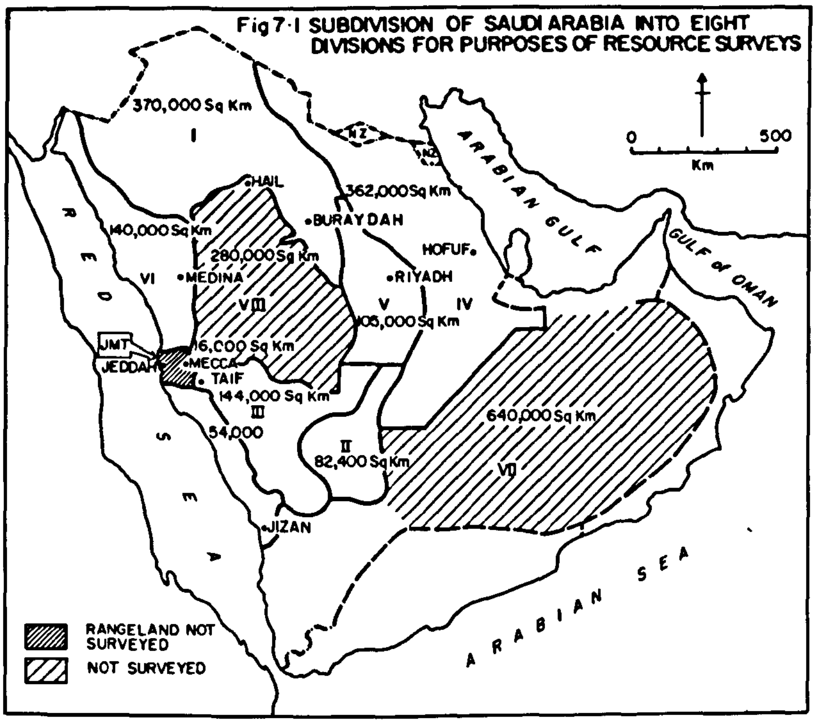


Fig 7·1 SUBDIVISION OF SAUDI ARABIA INTO EIGHT DIVISIONS FOR PURPOSES OF RESOURCE SURVEYS

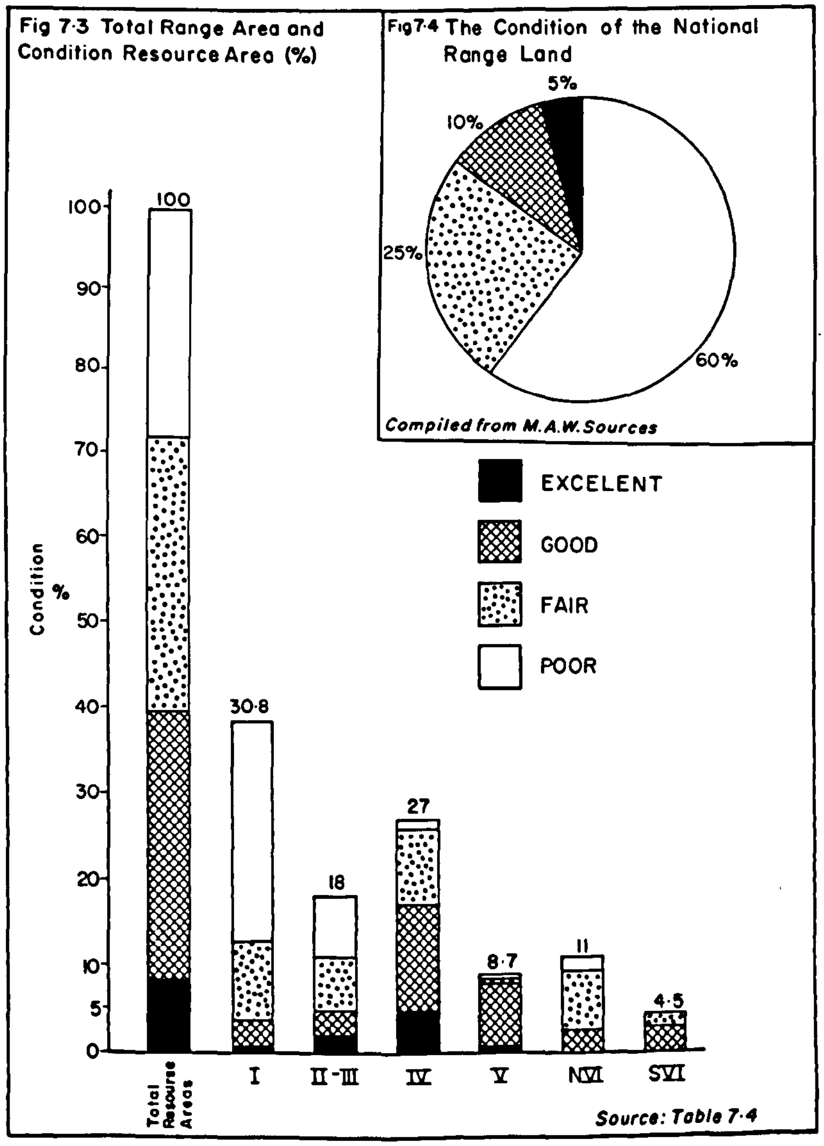


Fig 7·3 Total Range Area and Condition Resource Area (%)

Fig 7·4 The Condition of the National Range Land is composed mainly of vegetation suitable for grazing, and where there is sufficient plant life to justify use at least during those periods when adequate moisture is available. These ranges make up most of the country and for the most part they cannot be cultivated due to erratic scarce rainfall, rough topography, soil adversities or other restricting factors. On the other hand pasture lands are lands where vegetation is produced for year-round grazing. This type of land is limited to around 1.7 million hectares and located in the rain-fed areas in the south-west.

The total area of Saudi Arabia is around 220 million hectares, of that area there are around 215 million hectares classified as grazing areas. Only around 0.24% of the national land is cultivated arable land, rain fed,and forest areas, and the rest, around 98%, is range lands (Chapter 6); 34% of this range land is classified as barren areas of very limited grazing value, the rest is of potential grazing value only on a seasonal basis. Environmental variables decide the availability of grazing in these ranges. Not all ranges receive rain every season, and the amount of rain in any one season may be insufficient to generate vegetation. Variations of this nature are the result of the low rate and uneven distribution of rainfall. Over 90% of the country is estimated to have less than 100 m.of rain. This small amount of rain is, moreover, unevenly distributed within the period of the rainy season and in location.

7.1.1 Vegetation and Range Sites

All of the Kingdom of Saudi Arabia, except the Asir Mountains, lies within the great belt of desert which extends from the west coast of North Africa 6,000 miles eastwards to the Indus Valley, and constitutes a natural geographical unit with a single range of terrain and climatic conditions. The types of vegetation in this area are also similar and most of the area supports at least some vegetation during certain seasons of the year. The south-western highlands of the country are classed as part of the East African Highlands floristic region and not as part of the desert. True forests of Juniper (Juniperus procera) and wild olive (Olea chrysophylla) cover parts of the higher slopes of Asir.

The vegetation consists of small annual herbs or small shrubs, true trees are rare, and with the exception of Asir there are no forests. A great part of the vegetation is xerophytic and will grow in places where the water supply is scanty, or where there is physiological drought. Some are tolerant of drought, while others are drought-evading. Vegetation is frequently sparse and widely spaced, with areas of bare soil between the patches of plant cover. Most of the species seem not to have originated in the area but to have migrated from adjacent regions.[2]

The number of vegetational species is small. The Eastern Province of the country does not have more than 370 native plants as compared to the smaller Lebanon-Palestine area which has approximately 3,500 species.[3] However, the total national number of plants is large and they comprise a vast resource in the country. Over six hundred plants have been named and listed in the MAW Range Management Handbook.[4] It is believed that several hundred plants were not found in 1965-66 when the Resource Survey was conducted. Most of these plants were not found because some plants were missed as a result of the reconnaissance character of the survey, and others were over-grazed. Table 7-1 lists the most important forage plants in Saudi Arabia, including the adopted foreign grasses, native grass-like plants and the palatable native shrubs.

Vegetation species in the country vary greatly from one geographical area to another according to the variation in soil, topography and climate. Any major geographical area in the country, for example, the coastal plains, the Asir mountains, the Hammad deserts in the north or the Nufud,

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2. Aramco, Aramco Handbook, (Dhahran; 1968), p.198
3. Ibid., p.198
4. Allred, B.W., Range Management Handbook for Saudi Arabia, (Rome; F.A.O., 1968), pp.115-155

Table 7-1

Most important forage plants in Saudi Arabia

1. Aeluropus lagopoides
2. Aristida plumosa
3. Cenchrus ciliaris
4. Cymbopogon schoenanthus
5. Cynodon dactylon
6. Hyparrhenia hirta
7. Lasiurus hirsutus
8. Panicum turgidum
9. Paspalum distichum
10. Pennisetum divisum
11. Phragmites communis
12. Poa sinaica
13. Saccharum spontaneum
14. Sporobolus marginatus
15. Themeda triandra
16. Medicago sativa

Adapted Foreign Grasses

17. Panicum antidotale
18. Panicum maximum
19. Agropyron elongatum
20. Sorghum Sudanense

Native Grasslike Plants

21. Cyperus conglomeratus
22. Juncus acutis
23. Juncus maritimus

Palatable Native Shrubs

24. Achillea fragrantissima
25. Anabasis setifera
26. Artemisia herba-alba
27. Artemisia monosperma
28. Atriplex bracteata
29. Atriplex leucoclada
30. Calligonum comosum
31. Capparis decidua
32. Commiphora myrrha
33. Ephedra alata
34. Haloxylon persicum
35. Haloxylon salicornicum
36. Indigofera spinosa
37. Lycium persicum
38. Leptadenia pyrotechnica
39. Maerua crassifolia
40. Ochradenus baccatus
41. Rhanterium eppaposum
42. Salsola baryisma
43. Salsola foetida
44. Salsola forshalii
45. Salsola tetandra

Source: MAW Range Section 1974

has different ranges that exhibit a uniform plant community and display significant differences from other areas. The spatial variation in range resources from one area to another in the country is distinguished on the basis of range sites. A range site is a specific area where characteristics can be recognised and described by the uniformity of the vegetation available. The vegetation of one range site is different from that of another, and the degree of the variation between one site and another depends mainly on the geographical location of the sites. The vegetation of range sites that are located in different geographical areas is clearly recognizable, hence every site unit shows different types of vegetation. On the other hand it is very difficult to distinguish between range sites located within one area and exhibiting similar soils, relatively uniform topography, and gradual changes in climate, because changes in composition and types are also gradual. Therefore range sites are so intermingled that their separate delimitation is not practical or meaningful. The preliminary map shown in Figure 7-2 (back cover) shows the location of the major range site units in the country, the type of soil, vegetation and the climatic character of each site unit and indicates that the major range sites are (a) rock land and mountainous sites (b) sand and dune sites (c) Red Sea coastal plains and (d) wadi bottoms.

(a) Rock land and mountainous sites are concentrated along the western coast of Arabia extending southward from al-Agabah in the north-west to the border with Yemen in the south-west. The site is separated from the Red Sea by a thin coastal area. Also this site is found in a scattered pattern in the south-west and north-east of the country. Most of this site is of granitic and metamorphic rocks. In the lower slopes there are some colluvial deposits that support vegetation. Mountains of high altitude south of Taif are of a very rugged relief-granitic lithosolic soil - of rock debris mixed with fine sandy and loamy weathered products. In Asir area the soils are sandy or gravelly and the mountains blend into rolling plains. Annual rainfall varies greatly from as low as 30 mm.in the north-west to an average annual rainfall of 300-500 mm. in the sub-humid areas of an elevation of 1,800 to 3,000 m.in the highest parts of the mountains located south of Taif. The vegetation of the major part of the site varies greatly. Areas in the north-west have a vegetation which is largely limited to cracks and low places of a low range land value. In the north central parts of this site some annual plants grow during favourable rainfall. On the whole, vegetation is scattered and discontinuous. The most common plants are Rhanterium epappesum, Rhazya stricta, Gymnocarpos decandrum, Acacia tortilis, Indigofera spinosa, Lycium persicum and Acacia ethaica. Mountains of high altitude over 1,800 m.south of Taif formthe major part of the forest area in the country and the most common species are: Juniperus procera, Olea chrysophylla, Cynodon doctylon and Tricholaene teneriffae.

(b) Dune and sands sites are the most common in the southern, northern and central areas of the country. This site is characterised by poor scattered vegetation. Vegetation is sparse and seasonal in character. The most common plants are: Cyperus conglomeratus, Moltkia ciliata, Salsola tetragona, Calligonum comosum, Scrophularia hypericifolia, and Panicum turgidum. Annual rainfall is usually around 50 mm.and less than 100 mm.

(c) Red Sea coastal plains. This site is located in varying widths along the Red Sea. Coastal plains are at their widest in the southern part of the Red Sea coast at Tihana. The soil is generally sandy, loamy, gravelly or pebbly alluvia in the central parts of the plains, relief generally is negligible, and soils are mostly sandy wind blown materials layered over pebbly silt, loam or gravelly substratum. Vegetation is quite variable. The most common plants are Panicum turgidum, Acacia tortilis, Aristida mutabilis, Dactyloctenium sindicum. Rainfall varies from as low as 30 mm in the north to 200-500 mm. in Tihama area.

(d) Wadi bottoms. This site is scattered all over the country with larger concentrations in the south-west and north-east. Soils are extremely variable, pebbles, gravel, sand, silt and clay. Most of the wadis have heavy vegetation after rain. Vegetation types are relatively numerous and the most common are: Ziziphus, Leptadenia, Tamarix, Panicum turgidum, Artemisia herba-alba, and many others.

7.2 The State of Ranges

On the whole the Kingdom's ranges are deteriorating rapidly. This situation has been strongly emphasised by range experts of F.A.O. and others. All the Agricultural and Water Resource Surveys (1967-1970) of the six areas expressed the same opinion. Allred, an F.A.O. range expert, went so far as to declare that:

> Saudi Arabia's immemorial grazing lands, which have supported a hardy race of pastoralists for hundreds of years, face certain extinction unless immediate steps are taken to halt the destruction of the perennial range plants before they are destroyed by over-grazing, fuel gathering and farming.[5]

There are three main range aspects that can be examined to illustrate the extent of the depletion of the ranges in Saudi Arabia. They are: range condition, the ranges' carrying or grazing capacity, and the comparison between the animal population grazing at present with what could be carried if ranges were improved.

7.2.1 Range condition

Range condition is the state of health or productivity of both the soil and forage of a given range, in terms of what it could or should be under normal climatic conditions and the best practicable management. In the case of Saudi Arabia there are four classifications that are used

5. Allred, B.W., op.cit., p.1

by range experts to evaluate range conditions, and these are based on the degree to which the composition of the present plant community has departed from that of the climax plant community. They are: excellent, good, fair and poor as shown in the following Table 7-2;

Table 7-2

Range Condition Classes

Condition class	% of present plant composition to that of the climax for the site
Excellent	76-100
Good	51-75
Fair	26-50
Poor	0-25

Source: MAW

On the basis of this classification, the Resource Survey (1967-1970) attempted a general classification of the condition of ranges in the six areas (Fig.7-1). The consultants contracted for the survey were three different western firms, and the areas surveyed varied greatly in their geographical characteristics from largely desert areas, as in areas I, V and IV, to largely mountainous semi-desert areas as in area VI and the western parts of areas II and III. Therefore the parameters used for classification of the range condition classes were not standardised for all the areas, hence the variation in the consultants' evaluations was considerable.

As shown in Table 7-3 below, the survey covered an area of about 126.2 million hectares. The range land was estimated to be about 120.2 million hectares or about 95.2% of the total area.

As shown in Table 7-4 and illustrated in Figure 7-3 the total range areas that are considered to be in an excellent condition - that is having 75-100% of the better and original kinds of vegetation - are estimated to be about 8.4% of the total ranges in the Resource areas.

Table 7-3

Ranges in the Resource Area (000 and Ha.)

Area	Total	Range area	%
I	37,500	37,000	98.7
II,III	22,600	21,587	95.5
IV	36,200	32,421	89.6
V	10,500	10,498	99.9
N.VI)) VI S.VI)	19,400	18,645	96.1
Total & Ave.	126,200	120,151	97.3

Source: Different MAW sources

Table 7-4

Range condition classes for the Resource Area (%)

Area	% of the total ranges*	Excellent	Good	Fair	Poor
I	30.8	0.5	3.4	8.9	18.0
II,III	18	1.9	2.9	6.1	7
IV	27	4.9	12.5	8.7	0.9
V	8.7	1.1	6.7	0.55	0.44
N.VI	11	-	2.6	6.9	1.4
S.VI	4.5	-	3.1	1.4	-
Total	100	8.4	31.2	32.6	27.8

Source: Synthesized from Appendix 7-a

The concentration of most of the excellent ranges (5% out of the total of 8.4%) in area IV is attributed largely to the consultant's relative system of classification, ranges being classified according to the local conditions and maximum productivity of this area, with no regard to the other areas. This weakness has developed as a result of the lack of continuous supervision to enforce a common method of compiling agro-economic data, and this has resulted in each consultant applying its own approach and method. This weakness has been clearly noted by the Stanford Research Institute (SRI):

* Total ranges in each area as compared to that of the total area of the Resource Survey.

> The lack of a consistent set of standard definitions was one of the most disappointing features of the Survey Reports This lack led inevitably to considerable difficulty in rationalizing and comparing the results of one survey with another.[6]

Areas I, II, III and V have very few range sites in an excellent condition. The lack of ranges in excellent condition in area VI, is also to be attributed to the consultant's rigid classification. However, if compared to other areas, the southern part of area VI would have better ranges as a result of its higher altitude and higher rainfall.

The Resource Area has around 31% of its ranges classified as "good". With the exception of area IV, whose results were exceptional for the reasons explained earlier, all areas have very small percentages of their ranges in that condition. The rest of the ranges, almost 60% of the total range area, are in a fair or poor condition, having only 0-50% of their original plants. Areas I, II and III have most of their ranges in this condition. Only the southern mountainous part of area VI does not have ranges in a poor condition, and that is because of their higher altitude, which allows a higher rainfall and prevents lowland pastoralists from bringing their animals to the area.

On a national basis the MAW estimate of the condition of the national ranges seems to be more pessimistic than that of the Resource Survey classification. As illustrated in Figure 7-4 about 5% of the country's ranges are in excellent condition, 10% in good condition, 25% are classified as fair and 60% are in poor condition. Such a state was attributed to the fact that many ranges had lost most of their good perennial plants and only in wet years did they acquire some short lived annuals that soon withered and blew away. There is a very strong indication that many shrubs have disappeared completely and the MAW specialists neither confirm nor rule out such a suggestion because a complete vege-

6. Macking, L.J., Evaluation and use of Area Resources Surveys for Agricultural Development in Saudi Arabia, Special Report No.1., (Menlo Park, California; SRI, 1971),p.7

tation survey has never been carried out. However, an MAW Report[7] has stated that Salsola panicifolia, known locally as Rothah, a very desirable grazing shrub usually found mainly in a wadi in Arar named after the shrub and called Rowithiah, will soon disappear. It was estimated that only 1% of the original shrub population is now left in the wadi.

7.2.2 Grazing capacities

A precise estimate of the grazing capacities must take into account the rating of a complex number of factors. The most important are the soils, topography, trees and palatable shrubs, condition (resulting from erosion or a growth of undesirable plants) and rainfall. Unfortunately an accurate rating of this kind is not available for the country's ranges. Therefore the potentialities of the ranges are largely unknown. However the limited knowledge available indicates that the national range land's grazing capacity is very low, as indicated by the sizable number of hectares devoted to an animal unit. This situation can be illustrated by the evaluation and comparison of a range's stocking rate, grazing capacity and potential grazing capacity. The stocking rate is the number of hectares devoted to an animal unit grazing at the time of the survey. The grazing capacity is the present ability of a range unit, exclusive of years of severe drought, to give adequate support to a constant number of animal units for a stated period each year without deteriorating, and it is expressed in numbers of hectares per animal unit. The potential grazing capacity is the grazing capacity at its best vegetation state or climax, and can only be attained if ranges are conserved, rested and maintained.

The comparison between the stocking rate with that of the grazing capacity for the Resource Area's ranges at the time of the survey (around 1967-68) as shown in Table 7-5 and illustrated in Figure 7-5 indicates

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7. MAW Range condition in the Eastern, Northern and Central Area, (Arabic), (Riyadh; MAW, 1962),p.16

Fig.7·5 THE STOCKING RATE, CARRYING CAPACITY AND POTENTIAL CARRYING CAPACITY FOR THE RESOURCE AREAS HA/AUY

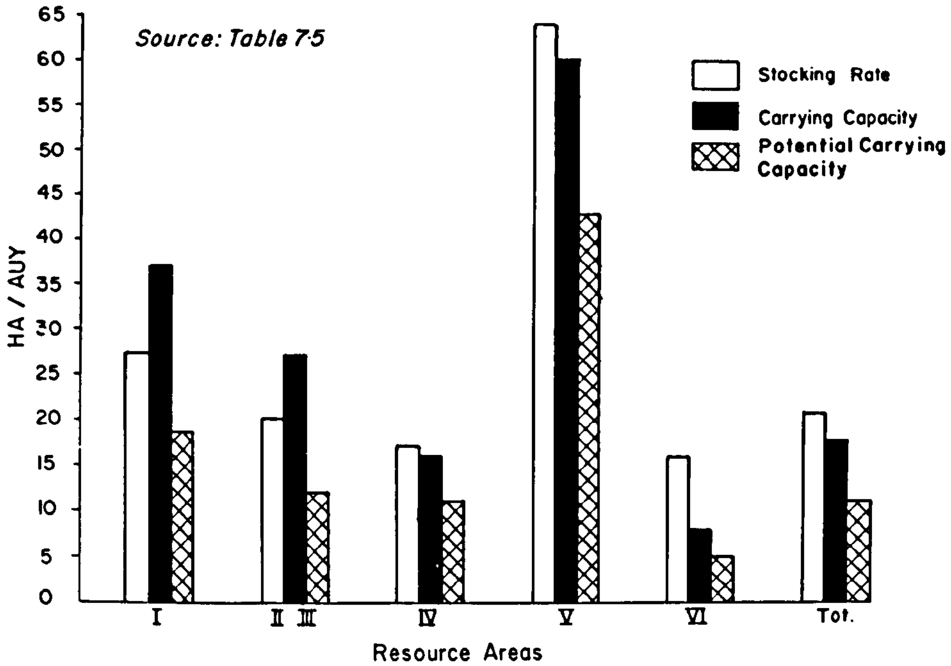
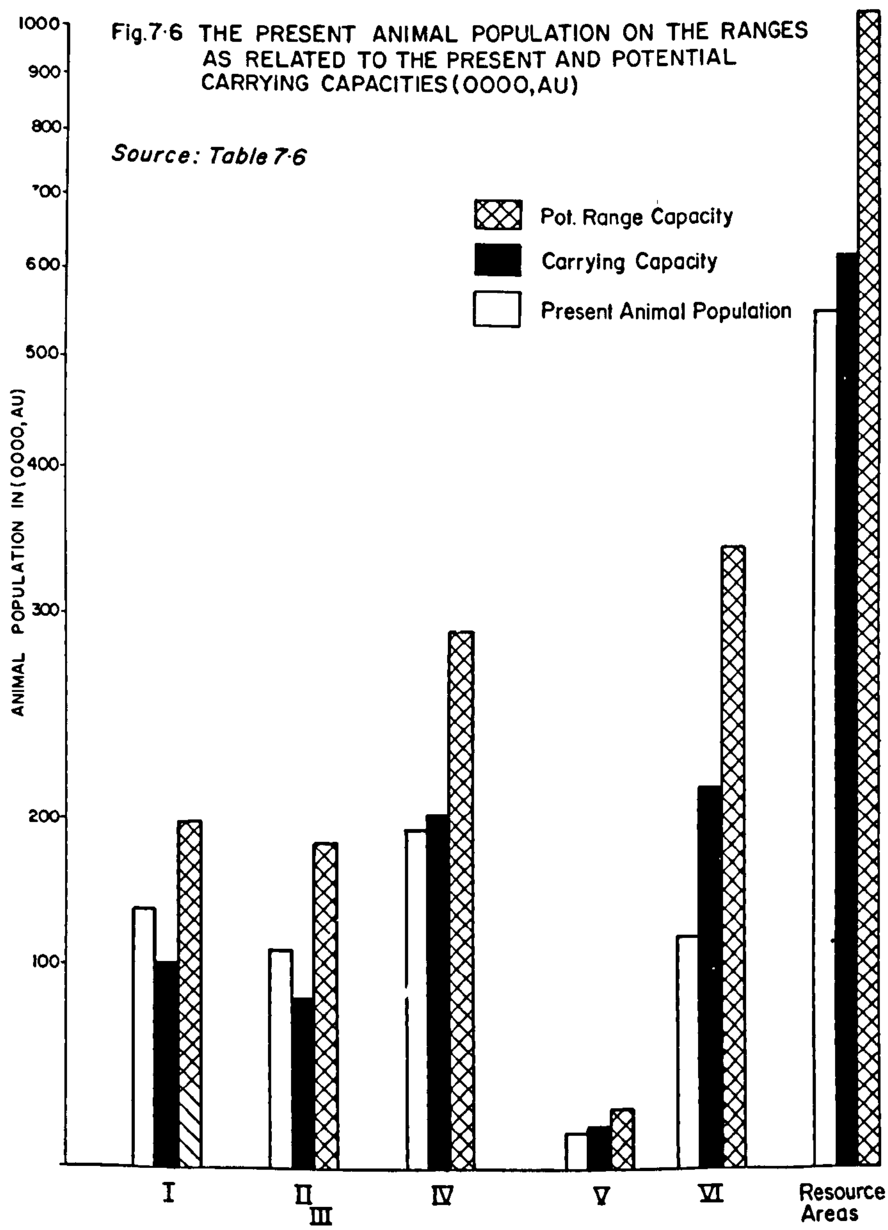


Fig.7·6 THE PRESENT ANIMAL POPULATION ON THE RANGES AS RELATED TO THE PRESENT AND POTENTIAL CARRYING CAPACITIES (OOOO,AU)



clearly that areas I, II and III are carrying more animals than the grazing capacity allows. For example, area I is at the time of the survey devoting 27.4 hectares per animal unit, while the grazing capacity is so low that it allows no less than 37 hectares per animal unit, and the case is similar for areas II and III. Thus in the case of areas I and II and of area III a state of over-stocking is obvious, with a net deficit of 9.6 and 7 hectares respectively. What seems to be a slight case of under-stocking in areas V and IV is attributed mainly to the fewer animals in that area as a result of the decline in al-Badiah and the expansion of the urban areas. Only area VI seems to be clearly out of danger of being over-stocked, with a positive net difference of as much as 7.6 Ha/AUY; this is a result of the higher altitude of most of the area, which permits higher rainfall and prevents desert pastoralists from migrating to the area.

These estimates are average and highly general, and they conceal a great deal of regional variation. For example in area VI, ranges may have anything from a high grazing capacity of almost seven Ha/AUY in range sites of moderately deep sand veneers located in the southern region, to as high as 2,000 Ha/AUY for range sites of gently rolling terraces located in the northern region of area VI.[8]

The comparison of the present grazing capacity with the potential grazing capacity as illustrated in Figure 7-5, indicates that the potential grazing capacity in all of these areas, (if it could ever be attained) could feed more animal units/hectare than that of the grazing capacity, and this also illustrates the very low present grazing capacity of these ranges. As shown in Table 7-5, if the ranges in areas I-VI were allowed to attain their potential grazing capacities their carrying capacity would be improved by as much as 49, 56, 30, 28, 35.7

8. Kingery, C.E., op.cit.,p.35

Table 7-5

The present stocking rate, grazing capacity and the potential total carrying capacity of the Research Area Ranges - in Ha/AUY %

	1	2	1-2	3	2-3	(2-3)x 100 / 2
Resource Area	P.S.R. (a)	P.G.C. (b)	Net.Diff.	Pot.G.C. (c)	Net.Diff.	Possible % P.G.C improvement
I	27.4	37	-9.6	18.8	18.2	49.2
II,III	20	27	-7	12	15	56
IV	17	16	1	11.2	4.8	30
V	64	60	4	43.2	16.8	28
VI	16	8.4	7.6	5.4	3.0	35.7
Ave.	21.2	19.3	1.9	11.6	7.7	40

(a) present stocking rate, (b) present grazing capacity
(c) potential grazing capacity.

Table 7-6

Animal population on the range and the present range carrying capacity in A.U. for 1967

Area	A.U. on ranges	Range capacity	Net.diff.	%
I	1,350,365	1,000,000	-350,365	-35.00
II,III	1,079,350	799,519	-279,831	-35.00
IV	1,907,130	2,026,327	119,197	6.0
V	164,039	174,975	10,936	6.3
VI	1,165,319	2,219,655	1,054,336	47.5
Total	5,666,203	6,220,476	554,273	9.0

Source: Synthesized from Appendix 7-a

and 40% respectively. This situation indicates vividly the obviously deteriorating state of ranges in all of these areas, so that more hectares are at present being devoted per AUY to overcome the low production.

Another illustration of the extent of the depletion of the national ranges is the contrast between the present animal population on a range and what the range can safely carry if conserved. As shown in Table 7-6 and as illustrated in Figure 7-6, areas I, II and III at the time of the survey were maintaining almost 35% more animal units than the ranges can carry, while areas IV and V were barely within the limits of the range carrying capacity. Area VI is the only area which is substantially under-stocked, by as much as 47.5, and as explained earlier, that is because of its high altitude. Therefore, with the exception of area VI, all these areas are over-stocked because they have more animals than they should or because they are close to the limit of their ranges' carrying capacity, which is anyway very low compared to the potential carrying capacity.

Table 7-7

Animal population on the range and potential carrying capacity

Areas	Present A.U. on ranges	Potential capacity	Net.Diff.	%
I	1,000,000	1,968,085	968,085	96.8
II,III	799,519	1,798,915	999,398	125
IV	2,026,327	2,894,752	868,425	43
V	174,975	243,021	68,046	39
VI	2,219,655	3,452,796	1,233,141	55.6
Total	6,220,476	10,357,571	4,137,095	66.5

Source: Synthesised from Appendix 7-a

As shown in Table 7-7 if the ranges were allowed to regain their vegetation climax, a substantial increase in the safe stocking rate would allow the whole resource area to carry more than 10.3 million animal units rather than the six million animal units that are now carried, and this amounts to a national improvement of almost 67% over the carrying capacity at the time of the survey. Moreover all the areas would gain substantially with an improvement of as much as 97% for area I, 125% for areas II, III and over 55% for area VI.

Finally, the previous evaluation of the state of ranges, their conditions, capacities and stocking rates indicates that the state of ranges is static in a few areas but largely deteriorating all over the country and the states of over-grazing and over-stocking are the rule rather than the exception. The most pressing question is, can this state of over-stocking be defined numerically? In other words what percentage of the present population of range animals is over or above the range carrying capacity? The answer to this question is vital because it will indicate the degree of over-stocking in definite terms. Unfortunately the answer on a national basis is impossible even to estimate, because as already shown in Chapter Five there are no comprehensive national estimates for animal population. There are no complete and comprehensive national surveys for desert vegetation, their nutritive value, quality and above all their production/hectare. Therefore an answer to the previous questionsis beyond the available knowledge at present. However on a regional basis an answer might be attempted from the results of the resource surveys and subsequent follow-ups carried out by the Central Planning Organization for some areas, specially for area I, the northern area (Fig.7-1) which has been emphasized - in this study - as a case study. Parsons Basil's consultant assessed the state of the northern ranges in 1966-67 by both ground and air surveys and estimated that over-stocking averaged 90%.[9] In 1974 the same area has been surveyed by the Economist Intelligence Unit (EIU) on behalf of the CPO and they found that within the whole region there are some smaller

9. EIU, Socio-economic Development Plan: Northern Region of Saudi Arabia, Technical Report, Annex 111; Productive Resources (Riyadh; CPO,1974), pp.16-17

areas where range conditions vary significantly from the average for the region as a whole. However most of the range sites are poor, or very poor, and only the very few are fair and none is good or excellent. For the whole northern region the EIU assessment for the condition of ranges in 1974 was more severe than that of Parsons Basil in 1967. As shown in Table 7-8 below over-stocking averaged 110%. In numerical terms the ranges in that area can only carry 174,000 A.U. but they have over 364,000 A.U. with a surplus of around 191,000 A.U. or over 50% of the animal units which should leave the range. The author in his field work in that area (1974) found that the trends reinforce this sad situation because (a) there is no unexploited range resource remaining in the region (b) ranges show the results of uninterrupted uncontrolled grazing, (c) many important plant species have declined in quantity and (d) migration radii have widened. These trends will be elaborated later in discussing the causes of range deterioration.

Table 7-8

Estimated range conditions of the northern region

1974 (in A.U.)[10]

Area in sq.km.	426,000
Est.max. carrying capacity	174,000
Present stock carried	364,870
Over-stocked animal units	190,870
Percentage over-stocked (%)	110

7.3 Major causes of Range Deterioration

Environmental factors have often been blamed for the deteriorating state of the Arabian range lands. Certainly climatic variations, low erratic rainfall and droughts contribute to this situation. However, they are not the whole reason, as Drabbs noted:

> Saudi Arabia is a desert country and according to known history has been desert for centuries. It is safe to assume that the country has been subject to periodic droughts over the years.

10. Ibid.

> It also follows that if droughts were the main factor in the deterioration of the range land, they would have been reduced to bare sand a long time ago.[11]

Allred agrees, stating that:

> In areas far removed from water, where grazing is less severe, our studies show that no large amount of perennial vegetation dies out even during droughts such as the recent seven years dry period in northern and eastern Saudi Arabia.[12]

Butzer is of the opinion that climate in this area has not undergone any drastic change. He believes that, "The bleakness and desolation is mostly due to deterioration and a catastrophic soil erosion". Butzer adds also that the "so called archaeological evidence does not support a hypothesis of climatic deterioration in the Near East in historical times" and he concludes that "there is simply no foundation, in fact, for progressive desiccation in the dry zone of the old world".[13]

The poor state of ranges in the country has resulted from the action of a chain of factors, constituting a complicated ecological vicious circle where climate, man and animals and their seasonal movement have acted as the destructive agents.

What has been taking place all over the Kingdom's range land is that when rain falls, after a period of a few weeks, usually before the plants mature to the grazing state, pastoralists start migrating to the area. If the area is easily accessible or has more rain, then a larger migration of pastoralists will follow. This situation usually leads to the migration of more animals than the range can carry. In the same range site more than one animal type (camel, sheep, goats) overlaps to graze the palatable then less palatable shrubs. The consequences are the removal of a great part of the vegetation cover; when the vegetation is removed, top soil is exposed to the erosive effect of the wind and flood rains. The result is an increase in the erosion of the soil that

11. Drabbs, J.R., Improving Range Management, Report to the Government of Saudi Arabia, (Rome; F.A.O., 1967), p.3
12. Allred, B.W., op.cit., p.44
13. Butzer, W.K., "Climatic change in Arid Regions since the Pliocene" in Stamp, D.L., (ed.) A History of Land Use in Arid Regions, (Paris; UNESCO, 1961),p.45

had been started by the excessive removal of the vegetation. This in turn destroys even more vegetation, and so on, creating a vicious circle. This cycle has been in operation for a long time, but has been accelerating in the last 30 years with the advent of the roads, trucks and water wells. The scale of destruction has been so severe lately that the lack of immediate remedy might lead to disaster, with some ranges becoming unproductive for ever.

This worsening situation has evolved as a result of numerous causes that could be sub-grouped under six main factors: (1) scale of the seasonal migration (2) political measures, (3) changes in land use (4) over-grazing, (5) poor water-point distribution, (6) man's misuse of ranges.

7.3.1 Seasonal Migration

Pastoral mobility is so basic that the whole cultural make-up of pastoralists is based on being on the move, with no permanent attachment to one location. The causes of this mobility are two interdependent factors; one is alimental and the other is climatic. The alimental reason for this mobility is the search for vegetation. In turn the availability of vegetation is controlled by climatic variables. Because climatic changes are seasonal in nature, migration has come to be seasonal too. Also because ranges are large in scale, have light vegetation cover and are far apart, the move to other ranges within or beyond a particular area is a daily and seasonal activity which necessitates the concept of the pastoral move. This seasonal grazing move is a sporadic phenomenon, and involves a round trip of annual occurrence. In Saudi Arabia the seasonal migration takes two forms, one horizontal and the other vertical. The first is the most common, while the second is limited to the mountainous south-western part of the country. This discussion will focus on the present character of seasonal migration as a cause of range deterioration.

<u>The schedule of the seasonal migration</u>: The migration commences at the end of the summer season. Usually by the middle of October, pastoralists leave the summer camps and start their annual move. The traditional signal for this is the appearance of the star <u>Suhil</u> or Canopus which to pastoralists signals the end of the summer season and the beginning of <u>wasm</u> - the rainy season. As the season continues, pastoralists move their animals from one grazing ground to another, staying long enough for their animals to graze the available vegetation. The time spent on a grazing ground does not usually last more than ten days, because its carrying capacity starts to decline after this period. The timing of the migration follows closely the seasonal change shown in Table 7-9, which indicates that the timing of migration seems to correlate closely with the isothermal advance of the average mean temperature for the Arabian desert, and the rain that does come usually at the period of the migration from October to May.

Constant camping and moving is spread over the period from the end of October to May. In May the temperature starts increasing and vegetation dries. During May pastoralists end their seasonal migration and start their gradual trip back to their summer camps. By early June at the latest pastoralists have concentrated their camps around the water holes, and there they remain for the whole period from June to the first half of October. They stay with their animals and move only locally.

At present the pastoral density involved in migration is substantially lower than in the late 1930's, when it was reported by Dickson that vast herds, sometimes amounting to 100,000[14] at a time, followed the grazing from one area to another. Figure 7-7 is an areal survey of area (I) made by the MAW consultant in 1966 and indicates three main points; first, in the summer months of July and August animal concentrations around water wells are at their highest around the main summer camps of

14. Dickson, H., <u>The Arab of the Desert</u>, (London; Allen & Unwin, 1951), p.251

Table 7-9

The schedule of the seasonal grazing migration with a reference to the isothermal advance of the average mean temperature (AMTC°) and the monthly rainfall (MRF) for Qassim* area in 1972

Seasons		Duration Days	Months	Schedule of the travel	AMT	MRF mm
Arabic	English					
			Mid Feb.	Seasonal move is at	12.5	T+
Rabi	Spring	90	March	its maximum and range is	18.8	5.1
			April	at its maximum growth	22.5	103.2
			Mid May	The end of migration	27.7	10.2
Saif	Summer	90	June	at camp	-	T
			July	at camp	32.9	-
			Aug	at camp	34.0	-
Kharif	Autumn	90	Sept.	at camp	31.5	-
			Oct.	The beginning of migration	26.6	-
			Mid Nov.	Seasonal migration	17.9	-
Shita	Winter	90	Dec.	Seasonal migration	10.2	47.5
			Jan.	Seasonal migration	10.9	-

Source: Based on field work in the northern area of Saudi Arabia, (November 1974) Average mean temperature and rainfall were derived from Ministry of Finance Statistical Yearbook, 1973

*Qassim area was chosen because it is a prototype of a desert range area

+ T - Trace

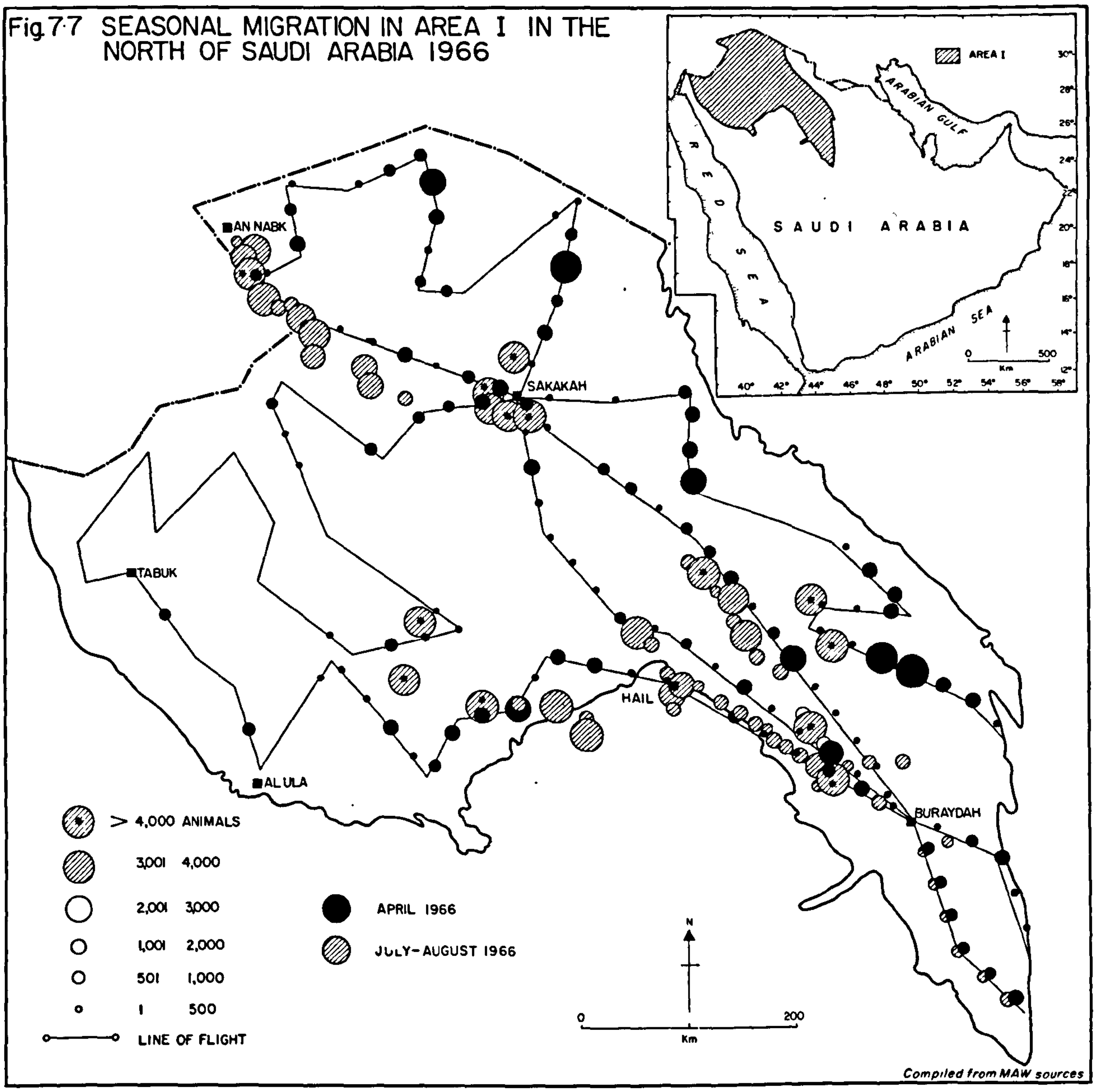


Fig. 7·7 SEASONAL MIGRATION IN AREA I IN THE NORTH OF SAUDI ARABIA 1966

Sakakah, Annebk, and Hail, while in April of the same year animals are scattered all around the area for grazing. Second, it is this area that used to be the centre of a great migration of over a hundred thousand animals as reported by Dickson,[15] but now the number of animals involved is less as a result of the decline in animal numbers and the decline in al-Badiah and both are caused by the decline in range potentials. The third point is that migration becomes more dispersed and scattered all around the area as a result of the drilling of numerous water wells and the introduction of modern transportation which induced the dispersal of pastoralists around ranges rather than grouping them in one tribe or sub-tribe.

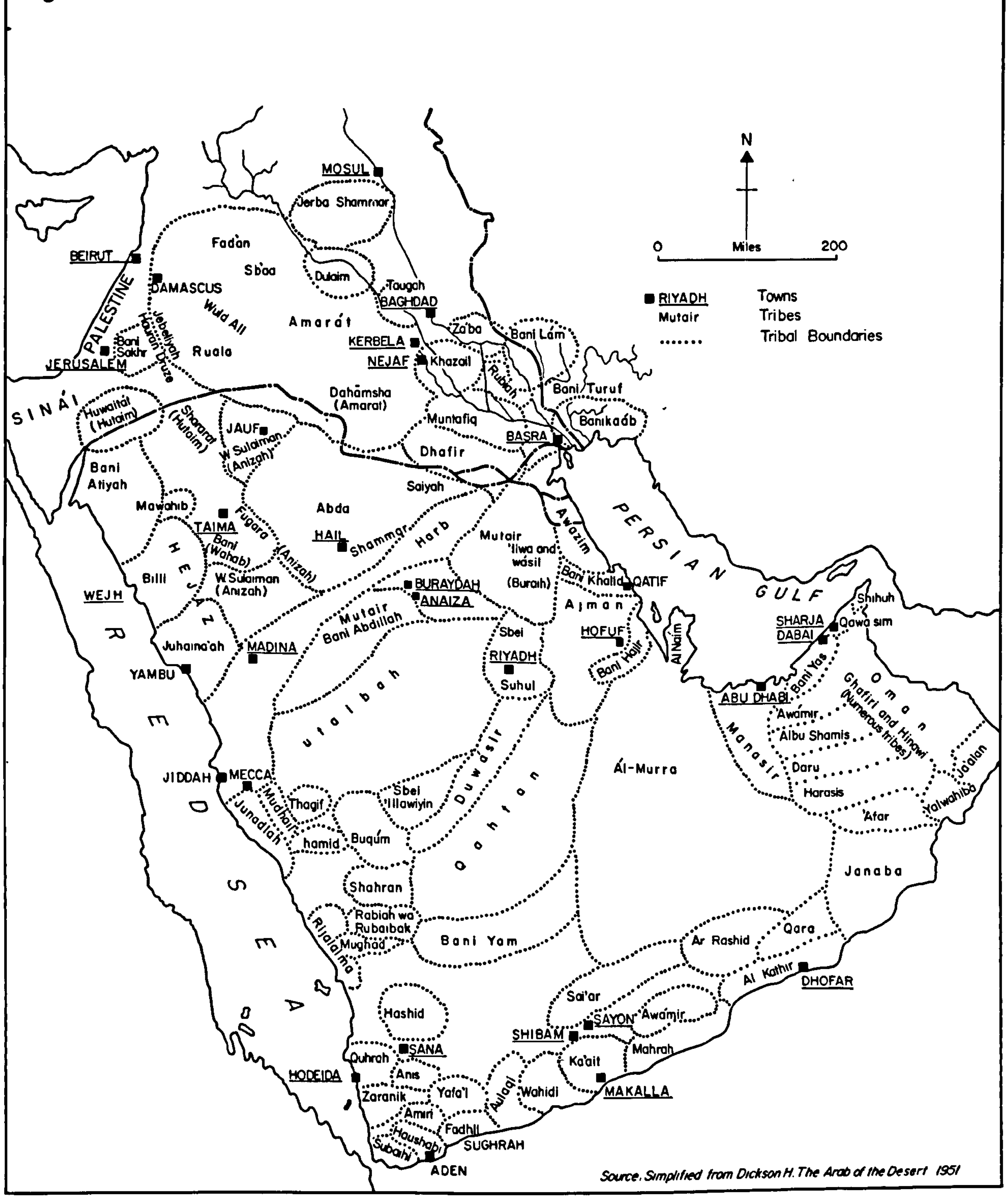
Recent changes affecting seasonal migration: The concept of seasonal migration is based on four main elements; the dirah or tribal territory, environmental factors, animal types, and the spatial extent of migration. To evaluate the present state of seasonal migration, it is therefore essential to analyse some of the changes that have taken place within these four elements. The seasonal migration of the Ruala tribes in the northern areas, and the effect of these changes on the extent of their present seasonal migration routes will serve as an example.

Tribal territory: The individual ownership of land as a property does not form part of Bedwin tradition. Territoriality is their concept of space utilization. A territory is shared and held by the tribe. Moreover, it is a sphere of influence rather than legally owned land. Before the recent emergence of the Kingdom, Arabian Society was divided into tribal territories which were virtually independent political units as shown in Figure 7-8.

Traditionally seasonal migration takes place within the tribal territory. A territory is usually extensive enough to include water

15. Ibid.

Fig. 7·8 ROUGH TRIBAL MAP OF ARABIA



Source. Simplified from Dickson H. The Arab of the Desert 1951 points and pastoral areas. However, the extent of grazing within or outside territories is of an amoebic character, changing shape continuously. It is seldom well defined, since in years of poor rainfall, the Bedwins range further afield than in good years. It was in such times that a tribe might in the past range by agreement or force in territories other than its traditional ones. As the British foreign office complained "there is a wide difference between the extreme limits of the tribe's wandering [seasonal move] and the territory within which it may be predominant".[16]

The unification of the country into a Kingdom has induced the disintegration of tribal territories by encouraging the concept of common land for all. Such an attitude has been emphasised by the 1953 Royal Decree which recognized the common use of grazing areas and water points. This has meant that no tribe can use its traditional rights to prevent others from grazing on their Dirah: similarly, they can graze on others' territories. Such a major change made the areal scale of migration theoretically unrestricted; any tribe can range as far as it sees fit.

Climatic factors: Pastoral activities are affected by climatic variations. More rain means a smaller scale migration because nearby ranges will provide enough grazing and hence a further migration is not needed. Less or no rain in an area necessitates a further migration to areas with good grazing grounds. The recent successive droughts and their aggravating effects upon ranges have necessitated further migration, hence larger scale migration has become common all over the country, consequently causing poorer ranges.

Animal types: The scale of migration is largely influenced by the animal type. Migration generally affects sheep and camel herds, but only affects goats to a less extent, for goats are kept mainly around tents. Camels

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16. A memo to H.M.King Abdulaziz Ibn-Soud, June 17, 1949, in Kelly, J.B., Eastern Arabia Frontier, (New York; Praeger, 1964),p.143

and sheep have different rates of movement, a different environmental tolerance, and different pasture preferences. When vegetation is relatively abundant both sheep and camels can obtain some of their moisture needs from vegetation. Thus they can be further away from water sources looking for pasture. In winter and spring camels penetrate deep into the desert for almost nine months, far away from inhabited areas. Therefore it is only with camels that the Arabian Bedwin can penetrate the long bodies of sands in the interior. On the other hand, sheep are limited in their movements by their frequent needs for markets and water, especially in the summer when their watering frequency increases to every other day. Therefore the grazing grounds for sheep are much more narrowly defined than those wandered over by camel herds. As a result, (lately) the emphasis on the traditional animal land use specializations in the herding of one type of animal, either sheep or camels is gradually becoming evident. Areas close to market and water sources are usually used by sheep herders. Areas that are further away in the deep deserts support camel herds as indicated in Chapters Five and Six. Thus the largest camel populations are found in the northern and southern areas (Chapter 4).

Spatial Extent of Migration: The extent has been greatly increased notably as a result of the opening of tribal territories, but also as a result of (a) the recent introduction of the automobile, (b) the drilling of deep water wells all around the country and (c) the new international borders.

The automobile, now widely used, has overcome distance and physical limitations. Pastoralists can now bring water to their animals or even transport their animals where they want (Plate 7-3). This has given pastoralists more and better ranges and a larger grazing radius.

The drilling of hundreds of wells all over the desert has released

Plate 7-3 Transporting animals in cars is becoming a common sight in the desert (Summan desert).

Plate 7-4 Traditional shallow water hole: Moured where pastoralists obtain water for their animals. (Khamsin, Wadi Dwasir).

Plate 7-5 Modern deep water holes used by al-Badiah. Wells may be left discharging water for no use. When visited in 1974 Dec. no operator was at hand at this well to control the flow.

the pastoralists from the restriction to one area or to a traditional water point and has also decreased the pressure on water holes. Now the Bedwin has more water points with a greater production rate than hand dug traditional water holes; the latter used to water around 75 camels a day, while the recently drilled wells water as many as 5,000 camels a day.[17]

During the last three decades the independence of the states in the Arabian Peninsula and the discovery of petroleum have introduced a more aggresive international aspect of land control. Claims to valuable territories are now much more important than before. Boundary definitions are based on geographical, ethnographic and historical considerations, with very little regard to pastoral migration, as Toynbee pointed out:

> The new international frontiers which had been roughed out at Paris, London and San Remo were for the most part arbitrary lines; and they ignored such facts of economic geography as the distribution and seasonal migration of the nomadic tribes.[18]

The border divided many traditional territories into two parts; one part stayed with one country, while the other part went to another country. In some cases (as in the case of the Ruala tribe, which will be discussed later) one part of a divided territory had the winter grazing, while the other included the summer camping area. For a tribe intentionally or unintentionally to ignore these new lines and to return to their traditional grazing habits meant trespassing in another country and thus committing an international violation. Each country discourages other 'foreign' tribes from grazing within its borders, and in so doing tries to give its own tribes the monopoly of range resources, and simultaneously to prevent these resources from being over-grazed by outside tribes. These international restrictions on pastoral movements and the consequent loss of substantial grazing areas lead to the intensification of internal

17. Abercrombie, J.T., "The Sword and the Sermon", Nat.Geog.Mag,(1966),p.5
18. Toynbee, J.A., Survey of International Affairs, (London; Oxford University Press, 1927),p.326

migration within the Kingdom's borders. More tribal competition for ranges and hence poorer ranges necessitate more and further migrations.

The modification of Tribal Migration Routes: As a result of these changes, the migration routes were modified, partially altered and enlarged in scale. Migration routes in the northern part of Saudi Arabia, specially in the case of Ruala, present a clear example of the extent of such modifications.

The Ruala tribes are the largest and most important section of the Anaza tribe (Fig.7-8). They used to occupy the eastern part of the Anaza territory and extend from the tributary villages south-east of Damascus at the north-western end of the Wadi Sirhan depression to the borders of the Nafud and the northern most oases of central Arabia.

As with any other tribe, the Ruala traditional territory has lost its political significance, hence they do not prevent other tribes from grazing in their areas. The author has seen Shararat, Shammar and other tribes in the Ruala area. The Ruala population accepts this situation as a natural development accompanying the recent unification of the country, and they also take advantage of this situation to extend their migrations to other tribal areas.

A major change that has modified the Ruala migration lines is the recent demarcation of the boundaries between the country and its northern neighbours, which has resulted in the division of Ruala territory among Saudi Arabia, Jordan, Iraq, and Syria as shown in Figure 7-9. Consequently the summer and sizable parts of the spring and winter areas of the traditional Ruala territory have become parts of those countries. These borders have not become completely impassable, however the Saudi Ruala have been greatly discouraged for three main reasons. The first is that the neighbouring countries do not offer the needed security. Secondly, these countries have lately adopted measures to protect their

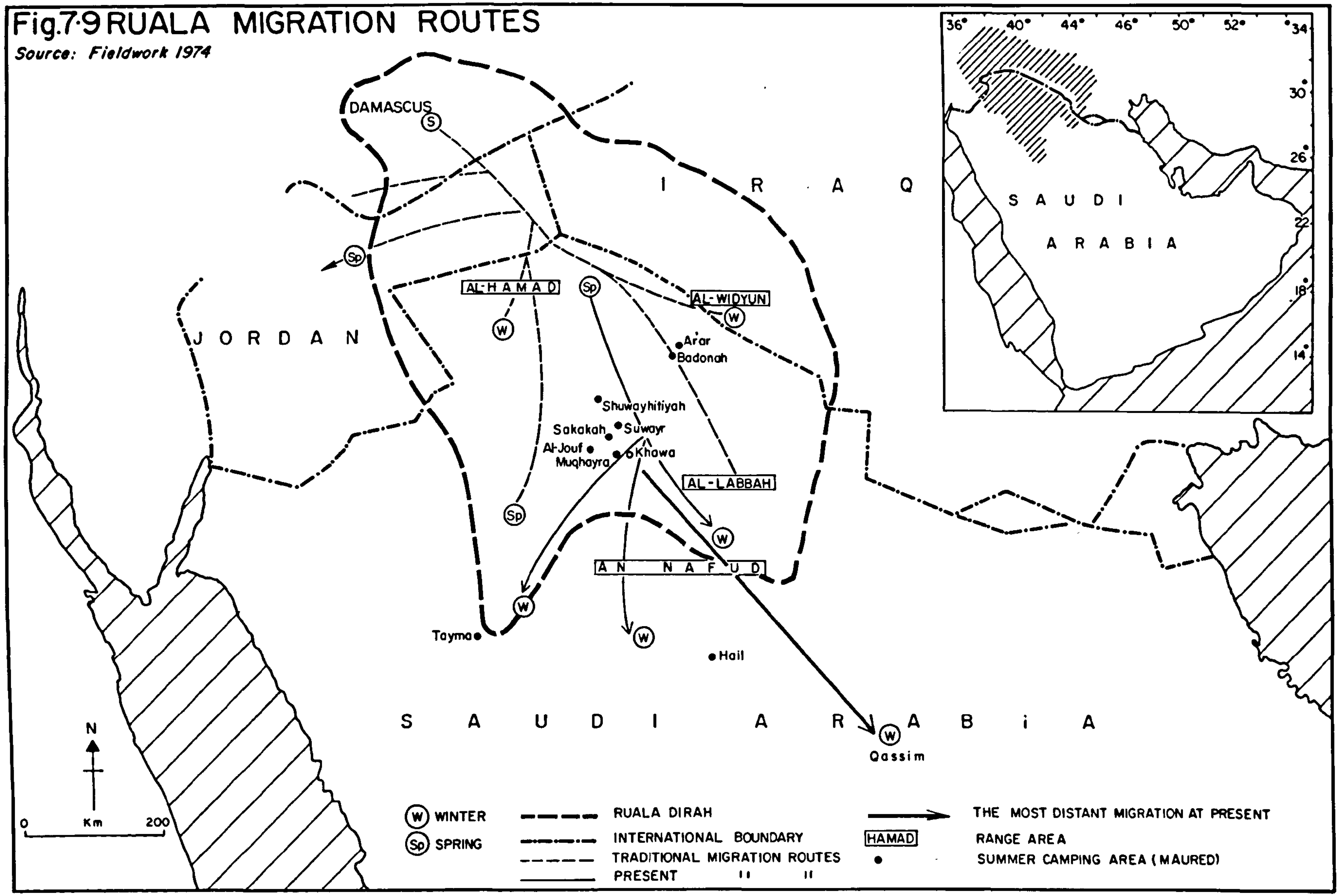

Fig.7·9 RUALA MIGRATION ROUTES
Source: Fieldwork 1974

ranges from over-grazing, and the discouraging of outside tribes has been one of the measures. Thirdly, and especially in the case of Jordan, their ranges are already over-grazed and have little to offer. In spite of these difficulties and when they have to find good ranges the Saudi Ruala take risks and cross the borders.

These recent changes have induced the Ruala to alter their migration lines so as to keep within the northern Saudi territory. As shown in Figure 7-9 their main Mouard (Sing.Maured) or summer camps have become concentrated mainly around Sakakah and Arar instead of the Damascus area. At present, winter migration usually takes place in Nafud desert and its principal outlying area, al-Lebbeh. Spring is spent in al-Hammad and al-Wydian. On the whole the lines of migration are not strict but can be extended especially when rain falls over some areas more than others. Usually if the traditional ranges are good further migration is not attempted. If the season is poor Rualas go as far south as the Qassim area.

The recent socio-economic changes have provided the Ruala with the means and the incentives to expand their scale of migration to reach further ranges that never used to be in their domain. Cars have provided sheep herders and to a less extent camel herders with the means to go as far south as the Qassim area, and eastern and western areas. Cars have shortened the time needed to reach further ranges from one or two months to only a few days. On the whole the distances to and from ranges and water holes do not now play the restricting role they used to play in the past.

The effect of the present scale of seasonal migration on range resources:

The enlargement of the scale of seasonal migration as a result of, (1) the opening of tribal territories to all, (2) worsening environmental conditions, (3) the drilling of large numbers of deep water wells all over the desert, (4) the introduction of the automobile and (5) the new international boundaries have collectively so intensified the use of ranges that almost all ranges are within reach. The poorer the ranges, the further pastoralists have to travel, hence the present scale of migration is a main cause for the present state of range deterioration. Thus seasonal migration in its present state has contributed greatly to the state of disequilibrium within pastoralism.

7.3.2 Political measures

The opening of the tribal territories, the demarcation of international borders and the abolition of the al-hema system are political measures that have altered the traditional pastoral land use and contributed a great deal towards the over-use of ranges. The first two have been discussed, earlier (within the context of migration), hence this discussion will focus only on their impact on range use. The abolition of both the tribal territories and Ahmia (Sing.hema) was effected in the early years of the Kingdom as a political means of undermining the stiff tribal territoriality and preventing the conflicts resulting from it. The unification of the country in the late twenties also led to a situation where the concept of public land changed from implying common low status "tribal land" to the strict interpretation of the Koran status of public lands. Thus the range lands have become available to all, almost without restriction, and the previous grazing rights have been abrogated without installing subsitute systems. This has created the feeling among pastoralists that no one stands to gain any longer by the careful use of the range. Any outsider may move in and graze all the plants if the local tribe does not.

The relaxation of al-hema: al-hema (Pl.Ahmia) is a range conservation system that has existed in some parts of Arabia, and the word also applies to the actual range itself, a tribally managed range that has been correctly grazed since early periods. No one seems to know when this practice was first started, but it definitely dates from pre-Islamic times, more than 1,400 years ago. Draz stated that this system "maybe the world's oldest effective range conservation programme".[19] Allred, an F.A.O. specialist, noted that Ahmia "constitute the most ancient examples of wise grazing management known in world history".[20]

The system aimed at attaining some kind of equilibrium between the range's capacity and the grazing by animals or other uses to which the range was put. The purpose of these Ahmia was classified according to the kind of use. In some, animal grazing was prohibited, but cutting grass was, however, permitted during specified periods. In other areas grazing and/or cutting was permitted, but restricted to certain seasons. The number of Ahmia in Taif alone was over 30 hema; others were found elsewhere, as in the mountainous south-western districts of the country. The central desert plain also had large Ahmia, which were abandoned a long time ago. One of them was al-Rabza near Dariyah in central Saudi Arabia; the length of this hema was about 260.7 km.

This system has been disintegrating as a result of the lack of care and more recently it has been abandoned, after the Royal 1953 Decree which prohibited any controlling monopoly of public land and more precisely stated by the order of His Majesty that "No hema should be kept in Riyadh or any other place" and it was based on the Prophet's saying, "Muslims are partners in water, fire and ephemeral ranges".[21] It is the common conclusion of specialists that the Prophet's saying and in turn the Decree have both been misinterpreted. In any case the result has been the withdrawal of restrictions on most of Ahmia. Attitudes of protection towards Ahmia have been replaced in most of the traditional

19. Draz, O., The Hema System of Range Reserve in the Arabian Peninsula, (Rome; F.A.O., unpublished report, 1969), p.1
20. Allred, B.W., op.cit., p.1
21. Royal Decree by H.M.King Saud al-Saud No.2461, dated 5/4/1373 (1953), (His Majesty Diwan, Riyadh; Saudi Arabia)

areas by indifferent exploitation. The destructive consequences of the Decree have recently been recognised. Hence a slow change of policy is taking place at present. One hema, Saisad, east of Taif in the western mountains, was put under protection in 1965.

International Boundaries: The international boundaries established in the 1930's between Saudi Arabia and its northern neighbours have encouraged the deterioration of ranges in two ways. First, because Saudi tribes were discouraged from migrating across the northern borders, they had consequently to intensify their grazing of local ranges and to migrate further inside the country to areas that used to be outside their traditional migration routes, i.e. the southern parts of Nafud desert and areas around Qassim (Fig.7-9), thus causing over-grazing as a result of their competition with pastoralists in that area. Secondly, for the lack of governmental preventive measures, the borders did not prevent non-Saudi tribes from migrating to the Saudi ranges. The scale of this migration and its destructive impact on the Saudi northern ranges was so severe as to warrant the formation of an enquiry committee to study this problem. In 1965 the committee concluded that:

> Iraqi herders in large numbers migrated with an estimated two million head of sheep into the northern areas covering about 300,000 sq.km...Their grazing period continued for about seven months, starting from the beginning of the rainy season and continuing to its end, causing over-grazing and range destruction...The Iraqi herds were estimated to have consumed around 300,000 tons of herbage Ave. two kilograms herbage per animal per day in these seven months.[22]

There is a general agreement among the Saudi tribes, governmental officials, and MAW specialists that this situation must be terminated. As a temporary solution the committee suggested that the Iraqi tribes or any other northern tribe should not be allowed to migrate further and deeper into the northern areas of the country. This solution has not

22. Unpublished memorandum on the migration of non-Saudi tribes to the Saudi ranges as requested by His Excellency, The Minister of MAW, No.828 at 10/11/1385 A.H.,p.3

been enforced until now, because; (a) as the northern borders are around 1,800 km. long, manning them is an almost impossible task, especially as Bedwins usually roam the desert moving from one range to another without passing by government points, (b) the country does not have an efficient specialized body to supervise and control such large migrations.

7.3.3 Changes in Land Use

The two most important are the reclamation of more land for settlements, and the emergence of crop cultivation and dry farming as a competing mode of land use in areas that used to be predominantly desert ranges and pasture lands. This trend has led to the reclamation of sizable areas of land, either within traditional ranges or close to them, for the establishment of settlements. Although settlements by themselves do not consume much land, they tend to destroy adjacent ranges either through their animals, which graze for several months each year, or through the human inhabitants, who travel many miles to grub up desert shrubs for fuel.

The other change is that the concept of land use is no longer as stationary as it was thought to be in the past. It was earlier believed that "stock raising itself permits the use of surfaces which were never or are no longer economical for farming. Such areas may be located just beyond the cropped or farmed areas and at some distance from the farmyard".[23] This is disputable because in the case of Saudi Arabia some of these areas are now no longer considered uncultivable as a result of the recent discovery of large water reserves under the sedementary part of the country which have lately been exploited for crop farming. This competitive land use is consequently transforming ranges into irrigated areas in many parts of the country. For example, the Qassim area, which

23. Tietze, W., "A Matter of Terminology, A Critical look at Migratory Stock-breeding", Geoform, B/73,p.74

used to be famous for its neighbouring ranges, has lost many of its rich nearer ranges to farming. The data indicate that the increase of cropped land has been in the region of 7.5% annually throughout the period 1949-1963. On a hectare basis cropped land increased in this area from 95,944 hectares for the period 1944-1950 to 242,829 hectares in 1960-1963, an increase of over 250%.[24] On a national basis the total cultivated area in 1968 was estimated at 396,467 hectares.[25] This estimate jumped in 1971-1972 to 524,726 hectares.[26] A large part of this increase is the result of further intensification of land use by expanding the areas under cultivation. When ranges are turned into cultivated areas either by irrigated or dry farming, all the native range vegetation is killed off. If these lands are abandoned for some reason or other they become barren and dusty because their native vegetation has been denuded, and even under good climatic conditions they will not recover unless artificially re-seeded, a new development that has not been tried yet in the country on a large scale.

Pastoralism is no longer <u>the only land use</u> for areas characterized traditionally as ranges. Now it is the law of comparative advantage that decides the type of land use. As long as pastoralism retains its present low rate of efficiency, it is very hard to see how it can compete with crop agriculture, hence the economic reason for protecting ranges from reclamation for cropping is not convincing. In such a situation, and if pastoralism does not improve, it could be envisaged as becoming in the future a form of land use only for areas of very poor vegetation in the very arid parts of the country.

7.3.4 Over-grazing

Over-grazing results from pastoral indifference to the limitation of the range's grazing capacity, and as has been shown earlier most of

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24. al-Jarash, M.A., Soils and Agricultural Development in the Region of al-Qassim, Saudi Arabia, (Univ. of Durham, M.A., 1968), pp.14 and 164
25. MAW Basic Agricultural Statistics, 1968
26. MAW Unpublished survey of 1971-1972 Statistics

the country's ranges are over-stocked. Pastoralists abuse ranges to feed their animals and in bad seasons to keep them alive. As long as there is vegetation, pastoralists increase the number of their animals to the maximum regardless of the range's carrying capacity. Without governmental interference such practices are unlikely to end. The emphasis on number rather than quality is a traditional trait and is becoming a menace to ranges, especially in bad seasons when a desperate hand-to-mouth existence forces pastoralists to sacrifice their long term needs for short term ends. The worse the ranges are, the greater the need for more animals in the hope that some of them will survive the droughts. These traditional practices are rooted in tribal pastoral behaviour, and changing them will not be an easy task, mainly because the pastoral concept of cause and effect was what the philosopher John Ladd terms, "temporarily remote":

> that is, current situations are not the result of something that is presently occurring, but rather of something that has already occurred.[27]

The combined collective grazing of camels, sheep and goats in a range site creates a state that could be called over-lapped-grazing, a situation where all animal types (camels, sheep, goats) with their different inherent selective grazing behaviour graze different plants and even different parts of the plants at different heights leading to a partial or total destruction of the plant (Plate 4-2, and 4-10). Camels, sheep and goats select and prefer different vegetation species, various parts of individual plants and different stages of plant maturity. The sheep's grazing preference is for grass and succulent herbage, while goats prefer twigs, leaves and more feed variety than sheep.[28] Camels have sensitive upper lips that pick up small vegetation,

and hard tissues are present around the mouth which are impervious to the

27. Fonaroff, L.S., "Conservation and stock reduction on the Navajo tribal range", The Geographic Review, Vol.41,(April 1963), p.122
28. Hafez, E.S.E., (ed.), The Behaviour of Domestic Animals, (London; Baillive, Tinsdal & Cassel, 1969), p.341

xerophilous vegetation that provides a main portion of their diet.[29] The poorer the ranges, the less selective the animals become. Goats and camels on poorer ranges can feed on almost any plant, and they become more thorough range destroyers in their attempt to survive. It is in these cases that plant leaves are consumed in such a large quantity that many plants lose their leaves altogether and thus they cannot regenerate because the loss of their leaves almost stops the vital process of food intake. Selectivity in grazing is directly proportional to the amount of vegetation available, thus the shorter the supply of feed as a result of drought, a bad season or over-grazing, the less discriminating animals become, and by then whole plants and ranges are devastated to the roots.

7.3.5 Poor water point distribution

The location of water points and range sites are the main spatial factors in pastoral activities. Water holes are the points of concentration for surrounding pastoralists and their animals. Thus ranges located near water points are usually the first to be over-grazed because they are continuously grazed by animals as a result of the pastoral daily or weekly move to water points. Therefore, the location of water points in relation to ranges is of immense importance and can make all the difference to having or not having over-grazing.

In the past a reasonable spatial balance between the number of water points and ranges was always in operation as a result of two main factors:

(1) Traditional water holes were manual (Plate 7-4) and were found in shallow aquifers in wadi beds, hence they are usually distant from range sites (2) summer and seasonal droughts force large numbers of these wells to dry up, thus forcing pastoralists to look for another area, and giving surrounding ranges the chance to rest and regenerate.

29. Hafez, E.S.E., (ed.), Adaptation of Domestic Animals, (Philadelphia; Lea & Febiger, 1969), p.63

At present the relationship between ranges and water points is in disequilibrium as a result of the drilling of a large number of powerful wells (Plate 7-5) even in areas that used to have none at all. Most of these wells are in operation all the year round. In 1962 the number of deep artesian wells in the nation (excluding the Eastern and south coastal areas) was more than 4,674 (artesian) and 56,925 (ordinary).[30] The greater part of these wells is distributed as shown in Table 7-10.

Table 7-10

Number of wells in Saudi Arabia

District	Artesian	Ordinary
Northern	46	7,385
Inner South		30,877
Western	121	10,918
Qassim	3,985	958
Central	522	6,787
Total	4,674	56,925

Source: MAW sources

The Qassim district has by far the largest number of artesian wells as a result of the early expansion of agricultural development and land reclamation there. The total number of wells drilled by MAW is over 1,000, largely medium to deep ones, and 250 wells[31] are either under drilling, tender or planned for. It is not the number of wells that causes alarm, but more important the location of these wells. The wells that are located inside settlements for urban and rural drinking are not usually harmful to ranges. It is the wells that have been drilled for Bedwins or small settlements in or around grazing areas that cause the destructive effects on ranges. Most of these wells are located close together making a cluster shape and a large number of them especially in the north and the south are used by pastoralists and in any case there are no regulations or laws that prevent pastoralists and their animals

30. MAW Basic Statistics, 1968
31. MAW Programme and projects for development, (Arabic), (Riyadh; MAW, 1974),p.15

from using these wells. This unbalanced distribution of water wells everywhere and close together has encouraged over-grazing, the area between one well and another usually being denuded. As observed by the author the areas around water points are usually over-grazed up to a radius of 20-30 kms.,and some affected areas have a radius of 50-100 kms. Parsons Basil has reported that the ranges around al-Jawf and Sakakah are now depleted and of limited grazing value for a distance of 100 kms.or more. It was their main finding that drilling more wells for stock watering purposes merely expands the radius of range destruction and hastens the elimination of all economically useful plants.[32] A study of drought damage to perennial vegetation varied from 25 to 100% depending on how close to water the observations were made.[33] Interviews with tribal leaders, officials and MAW specialists have indicated that at present there are no ranges that are considered inaccessible to pastoralists (except in the Empty Quarter), because almost every range site can be reached by lorry from one or more water points. At present these wells are dotted around the country and are managed in a laisser faire manner, thus contributing to range destruction.

The location of wells is a valuable regulating instrument to rest ranges, direct migrations, rotate grazing and protect the nation's ranges, and this instrument should be applied by the MAW as early as possible in any programme for range conservation.

7.3.6 Man's Misuse of Ranges

The misuse of ranges by man is common and takes many forms; the most important is the grubbing and cutting of trees and shrubs for fuel. Desert trees and large shrubs are used as a source of fuel by al-Badiah and settlers. Most of the large cities in the country, i.e. Riyadh, Mecca, Madina and Hail etc., have a large wood market supplied mainly from

32. Parsons Basil, op.cit., p.V.23
33. Allred, B.W., op.cit., p.2

the desert (Plate 7-6). The demand for desert wood is escalating annually especially in the winter. Bedwins and for that matter some settlers prefer it to other sources of heat, i.e. petrol products, not only for its fuel value, but above all for its scent, its slow-burning quality and for the heat it generates in winter, and it is for this reason that they call desert wood "the winter fruit of the desert"(Plate 7-7). The number of plants used for fuel is large and Table 7-11 lists the most important local shrubs and trees that are used for fuel. It is not only large shrubs but also small shrubs that are used in great quantities to ignite the fire and keep it burning brightly to produce light around the camping area. The fear that popular fuel trees and shrubs might become extinct is becoming more justified than ever before. The devastating extent of this misuse by man of ranges can be illustrated by the following quotation concerning area I:

> From the air it is noted that except in protected areas, there are no longer bushes or shrubby plants in the vicinity of cities or communities. These circular perimeters, void of large growth, are expanding as trucks push further into the sand areas to obtain fuel wood...when the wood haulers grub out the larger plants to obtain the roots, grazing animals must then obtain all their food from small plants remaining in the area. These small plants are soon eaten to the base and they die. Thus the combination of range abuse continues to decrease forage by killing out the primary plants that range livestock must depend on.[34]

The MAW have estimated that an average truck load would contain the roots from 400 plants and on this basis it was estimated that annually 1,552,000 trees are grubbed and over 10,300 acres are destroyed each year in and around the Qassim region.[35] This promiscuous range use is not new, but has recently taken the frightening form of mass destruction. In area I it has been estimated that over 40,000 hectares of range land are being destroyed each year. On a national basis it was estimated that over 120,000 hectares of shrubby ranges are being destroyed by the

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34. A letter to the MAW from Parsons Basil from MAW Dept. of Public Lands dated 1967
35. Ibid.

Plate 7-6 Wood Market in Riyadh. All wood has been brought - grubbed - from the desert as far as 100-600 km. from Riyadh.

Plate 7-7 A fire fuelled by desert shrubs is a strong traditional Bedwin custom and consume large quantity of desert woods.

Plate 7-8 The transportation of wood and its marketing in urban and rural areas is big business. (Nafud area.)

same method.[36]

To some Bedwins wood gathering is a main source of income, to many it is a substantial side activity. Individual Bedwins load their camels with grubbed wood, transport it to the nearest highway, and then transport it by car to markets all around the country. To avoid taking their trucks empty when fetching water or gas from the markets, Bedwins usually earn income by loading their cars with wood. The cost of a truck load (Plate 7-8) has been escalating from an average of SR 440 in spring and summer to as much as SR 600 in the winter. Interviewed drivers reported that they go as far as 200 km. to get wood and all of them confirmed that the distance to wood areas has doubled in the last few years. This scale of misuse is making the desert encroach at a rapid rate each year and justifying Whyte's words:

> The nomads are spoken of as sons of the desert but in view of the desert they created it would be more fitting to speak of them as fathers of the desert.[37]

Ironically such misguided practices are taking place in a country that has a greater oil reserve than any other nation in the world, mainly because marketing of petrol products in the desert areas still faces major problems. The prohibiting of the use of desert shrubs for fuel cannot be attempted until this marketing problem is solved. It was as early as 1958 that the MAW obtained a royal decree forbidding the grubbing, sale and truck-loading of desert shrubs. However, the punishments were lenient, the maximum being a fine of SR 100 and 15 days imprisonment. Moreover nobody enforced and supervised the implementation of the decree, and therefore its implementation was left to the Ministry of Interior offices around the country. When interviewed, some officials in different parts of the country did not know about it and many acknowledged such

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36. Ibid.
37. Whyte, R.O., "Mediterranean land, Near and the Middle East", in Imperial Agriculture Bureau, (ed.) The Use and Misuse of Shrubs and Trees as Fodder, (1947), p.124

an order but stated that the order had not been enforced on a large scale mainly through lack of staff to man such a large area of land.

Table 7-11

Native range shrubs and trees* used for fuel

1	Acacia spp.
2	Achillea fragrantissima
3	Anabasis setifera
4	Artemisia herba-alba
5	Artemisia monosperma
6	Atriplex bracteata
7	Calligonum comosum
8	Capparis decidua
9	Capparis spinosa
10	Commiphora myrrha
11	Dodonea viscosa
12	Ficus salicifolia
13	Ficus sycomorus
14	Ephedra alata
15	Haloxylon persicum
16	Haloxylon salicornicum
17	Indigofera spinosa
18	Lycium arabicum
19	Lycium persicum
20	Maerua crassifolia
21	Nitraria retusa
22	Ochradenus baccatus
23	Pistacia palestina*
24	Olea chrysophylla*
25	Juniperus procera*
26	Prosopis stephaniana
27	Rhanterium eppaposum
28	Retama raetam
29	Salsola baryisma
30	Salsola foetida
31	Salsola forshalii
32	Salsola tetandra
33	Seidlitzia rosemarinus
34	Salvadora persica
35	Zizyphus nummuularia
36	Zizyphus spini-christi

Native poisonous plants used for fuel

37	Calatropis procera
38	Datura stominium
39	Rhazya stricta

* - Trees used in small construction

Source: MAW sources

CHAPTER EIGHT

LIVESTOCK FARMING

Livestock farming is the second system of livestock production in Saudi Arabia, yet very little attention has been given to it. Early writers directed their attention to pastoralism as though it was the only livestock production system in the country. The bulk of contemporary writing, too, fails to recognize this system and instead gives greater attention to crop farming. This lack of recognition can be attributed to the obscuring of this system as a result of the unequal relationship and association between crops and livestock on farms. Traditionally, crop farming has always been - and still is - the dominant activity in cultivated areas, because irrigated areas are limited and hence are used intensively to produce crops. Therefore, livestock has always played a secondary role as a side activity. This unequal relationship between crop and livestock activities on farms has obscured the latter's importance and potential.

8.1 Livestock farming and land use

The agricultural census (1968)[1] estimated that, out of a total of 188,053 agricultural holdings in the country, there were 47,102 livestock holdings, a proportion of 25%. This census did not elaborate on the size, nature, method or the system of these holdings. However, this sizable number of holdings indicates clearly that livestock rearing in farming areas is a common practice and substantial in extent. Such a conclusion can be supported by the results of the 1971/72 census which, (Chapter 5), indicates that livestock farming supports around 38% of the estimated national animal population in A.U.: 78% of the total population of cattle, 35.9% of the sheep, 53.82% of the goats and 14.6% of the camels. It is obvious that livestock farming is the major method of raising cattle, a

1. MAW, Basic Statistics for 1963-68, (Riyadh; MAW, 1968)

feature that distinguishes this system from pastoralism, which cannot support cattle.

8.1.1 Limitations of Land Use

The scarcity of water, and hence the scarcity of cultivable land (Chapter 1) has always been the major limiting factor in the expansion of livestock farming. In 1971/72 the total arable area of the nation (land in use, or potentially cultivable), was estimated to be around 13,912,737 donums* (Table 8-1). Of this area only 37.7% was cultivated and the rest, around 62.3%, was uncultivated at the time of the survey. Environmental factors together with inefficient farming methods are responsible for the high percentage of uncultivated land.

Table 8-1

Cultivated and cultivable areas in Saudi Arabia (1971/72) in (Donums)

Type	Donums	%
Total arable area	13,912,737	100
Cultivated area	5,247,258	37.7
Uncultivated area	8,665,479	62.3

Source: MAW Unpublished Census for 1971/72

The areas that can be cultivated may vary from one year to another as a result of variations in rainfall and the common drought cycles. For example, in the case of the six areas surveyed by the Resource Survey in 1967, it was estimated that cultivated areas in an average year might amount to 290,000 hectares while in a favourable year they amount to around 360,000 hectares.[2]

Because of the scarcity of cultivable land, farms have been small, averaging 2.98 hectares. Forty per cent consist of less than 0.5 hectares, 25% between 0.5-1.0 hectares, 25% from 1.0-5.0 hectares and only 4% are more than 5.0 hectares.[3] The small size of these farms does not make

*1 Hectares = 10 donums

2. SRI, Evaluation and use of Area Resource Surveys for Agricultural Development in Saudi Arabia, (Menlo Park; Calif., 1971), p.68

3. Saadi, M., Report of the Research and Development Dept., (MAW; 1970), p.4

integrated mixed farming (crops and animals) a feasible proposition.

8.1.2 The intensification of land use

The response of farming as a whole to the scarcity of cultivable areas was the intensification of land use, both a horizontal and a vertical expansion of cultivated areas. Considering the physical limitations, horizontal intensification of land use has been marked over the last twenty years, especially after the discovery of rich groundwater resources in the sedimentary parts of the country, and the widespread use of water pumps. As shown in Table 8-2, the area cultivated in 1971/72 was 416% of the 1950 area, more than a four-fold increase. The expansion was most pronounced in the period between 1963 and 1971/72 because this was the time when water drilling and the emerging demand for vegetables and fruit was at its greatest as a result of the expansion of urban areas, the building of new roads and the initiation of government subsidies for some agricultural commodities.

Table 8-2

Areas under cultivation in Saudi Arabia

(1950 - 1971/72)

Year	Cultivated area (donums)	%
1950	953,160	100
1957	2,074,600	217.6
1968	2,428,290	254.8
1971/72	3,964,674	416

Source: For 1950 and 1957, derived from Medawer, Report to MAW, 1965 and Turki, M., Accelerating Agricultural Production of Saudi Arabia, Colorado State University, Ph.D., 1971, p.22. For 1963 and 1971/72, derived from MAW Census for 1968 and the unpublished summary for 1971/72.

Vertical expansion has taken the form of an increased production per hectare, achieved through the use of fertilizers in most of the central areas, and double cropping in the sub-tropical environment of the south-west. As shown in Table 8-3, on a national level the cropped area in 1968 was 114% of the cultivated area and in 1971/72 it was 150% of the cultivated area. Vegetables, sorghum and millet accounted for most of the double cropping in the country.

Table 8-3

Actual cultivated area and cropped area in Saudi Arabia

(Donums)

Year	Cultivated area	Cropped area	%
1968	3,964,674	4,513,111	114
1971/72	5,247,258	7,886,414	150

Source: Appendix 8-d

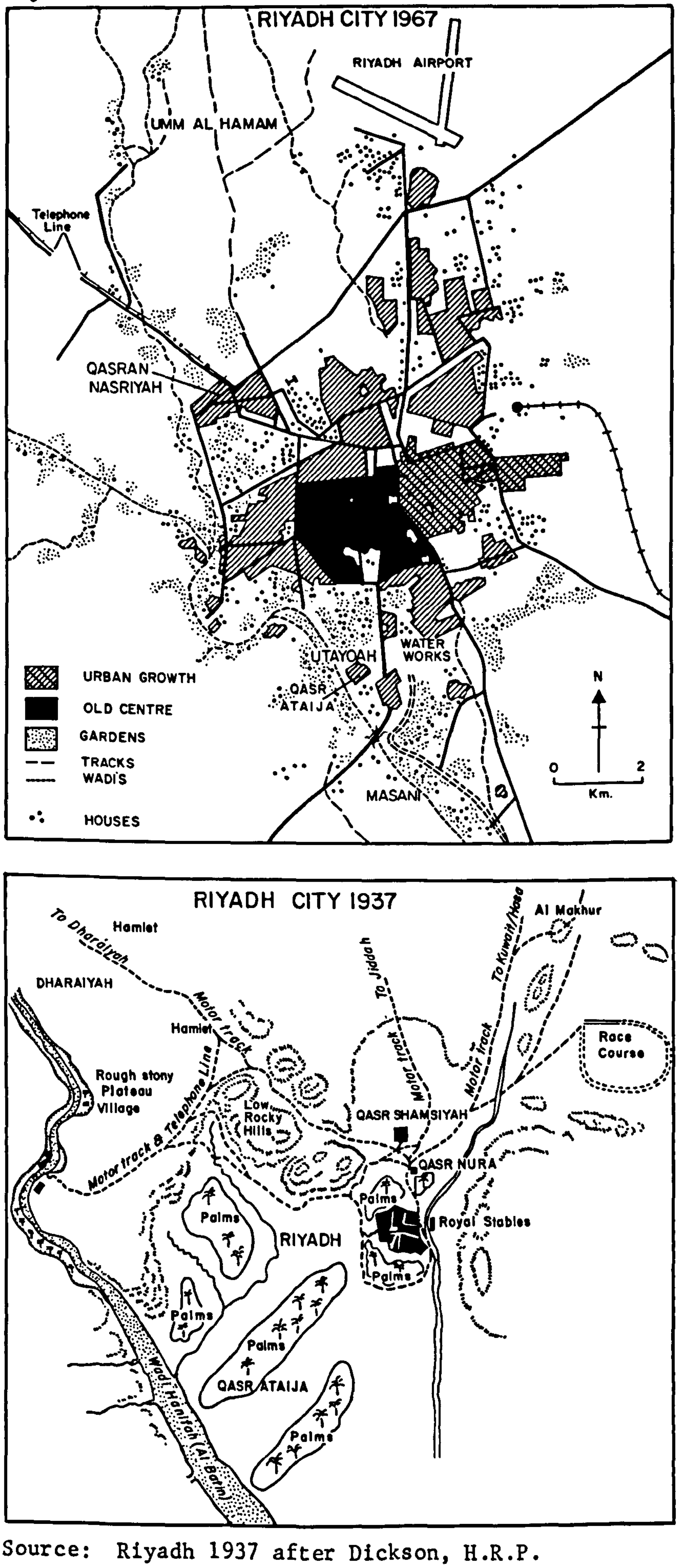
8.1.3 Trends in land use

Farming in Saudi Arabia has been experiencing many changes. The most important is the recent tendency towards the production of market-orientated crops to meet the expansion of urban areas. Urban areas have strongly influenced the location and type of farming in areas near or accessible to the town; furthermore, they have encroached upon sizable areas of cultivable land, and inflated land values to such an extent that it no longer pays to continue traditional farming operations in or around most of the urban centres in the country.

The changes which have affected Riyadh's agricultural areas illustrate the changing patterns of agricultural land use that have taken place around all urban areas of the country over the last twenty years. It is obvious from Figure 8-1 that since 1936, the city centre has expanded greatly and has over-run much agricultural land. Adjacent areas that used to be cultivated in 1937 have become mainly housing land. Wadi Bat-ha which used to have sizable agricultural activities has completely lost its agricultural importance and become instead the centre of the city. The nearest agricultural activity is now concentrated in Wadi Hanifa, to the west of Riyadh.

Another fundamental reaction to urbanization has been an acceler-

Fig 8·1 THE URBAN EXPANSION IN RIYADH SINCE 1937



Source: Riyadh 1937 after Dickson, H.R.P.

ation in the process of restructuring farming areas and the adoption of near-city farming. This process can be illustrated by observing the changes that affected cropping patterns in Riyadh area during the period 1968-1974.

Table 8-4

Cropping pattern for 1968 and 1974 in Riyadh in donums

	1968		1974	
Crop	Area	%	Area[4]	%
Palm and orchard	5,702	29.9	28,000	37.2
Alfalfa	1,183	6.3	6,000	7.9
Vegetables	2,018	10.6	9,000	11.9
Cereals	10,139	53.2	32,500	43
Total	19,042	100	75,500	100

Source: Based on MAW Basic Statistics 1968
Based on SCET Socio-economic Development Plan, Central Region, 1974, p.41

The comparison of the cropping pattern of the cultivated areas around Riyadh in 1968 and 1974 indicates the impact of urbanization. As shown in Table 8-4 the cultivated areas have in fact expanded by reclaiming new lands all along the main wadis, thus urban development has encouraged an increase in cultivated areas because of the increase in the demand for farm products specially vegetables, alfalfa and dates. On the other hand, urban expansion has been very effective in pushing agricultural activities away from the city to nearby areas like Wadi Hanifa and further agricultural areas as indicated in Figure 8-1. Moreover cropping patterns have changed considerably. Cereal areas have decreased from 53.2% in 1968 to 43% in 1974. Areas cultivated with permanent crops, mainly dates, have increased due to the fact that dates are commonly grown in gardens in the area. The area of alfalfa and vegetables has also increased and this indicates their importance as the main commercial crop demanded by the town markets. So on the whole one can see that urban-orientated

4. The large difference in cultivated area is attributed mainly to the expansion of agricultural areas around Riyadh after the discovery of deep water resources. The data for 1974 cover larger areas than those of 1968.

crops are taking a priority over traditional crops like cereals.

However taking the country as a whole, it is apparent from Table 8-5 that the urban impact on the nation's cropping pattern is not strong. Indeed cropping patterns are still largely traditional and rural-orientated, this is due to the fact that urban development is taking place only in some parts of the country rather than in the country as a whole.

Table 8-5

Cropping pattern in Saudi Arabia for 1968-1971/72

- % of donums

Year	Wheat	Mill.Sorg.	Veg.	Alfalfa	Perm.Crop
1968	21.6	58.6	7.1	4.9	7.8
1971/72	5.3	80.9	5.7	2.4	5.7

Source: Appendix 8-b,c

The most obvious trend indicated in Table 8-5 is that the area planted with rural-orientated crops such as millet and sorghum has increased from 58.6% in 1968 to 80.9% in 1971/72, at the expense of vegetables, alfalfa, and permanent crops. This situation is caused mainly by the traditional dominance of millet and sorghum in the south-west of the country which is still largely rural. It is for this reason that the coastal south had almost 97% of the nation's sorghum and millet area in 1971/72 (Fig.8-3). There are many reasons why the coastal south is a major sorghum and millet area, the most important being: (a) cultivated areas in the south-west are rain-fed and because of their tropical character are suitable for these crops. (b) These crops constitute a traditional diet; and (c) the same crops are grown repetitively on the same land, which is only left fallow during the interval between the harvesting of one crop and the sowing of the next.

The substantial decline in wheat areas is the only indication in Table 8-5 of urban influence on the national cropping pattern, and this is a significant trend, because it shows that the impact of urbanization

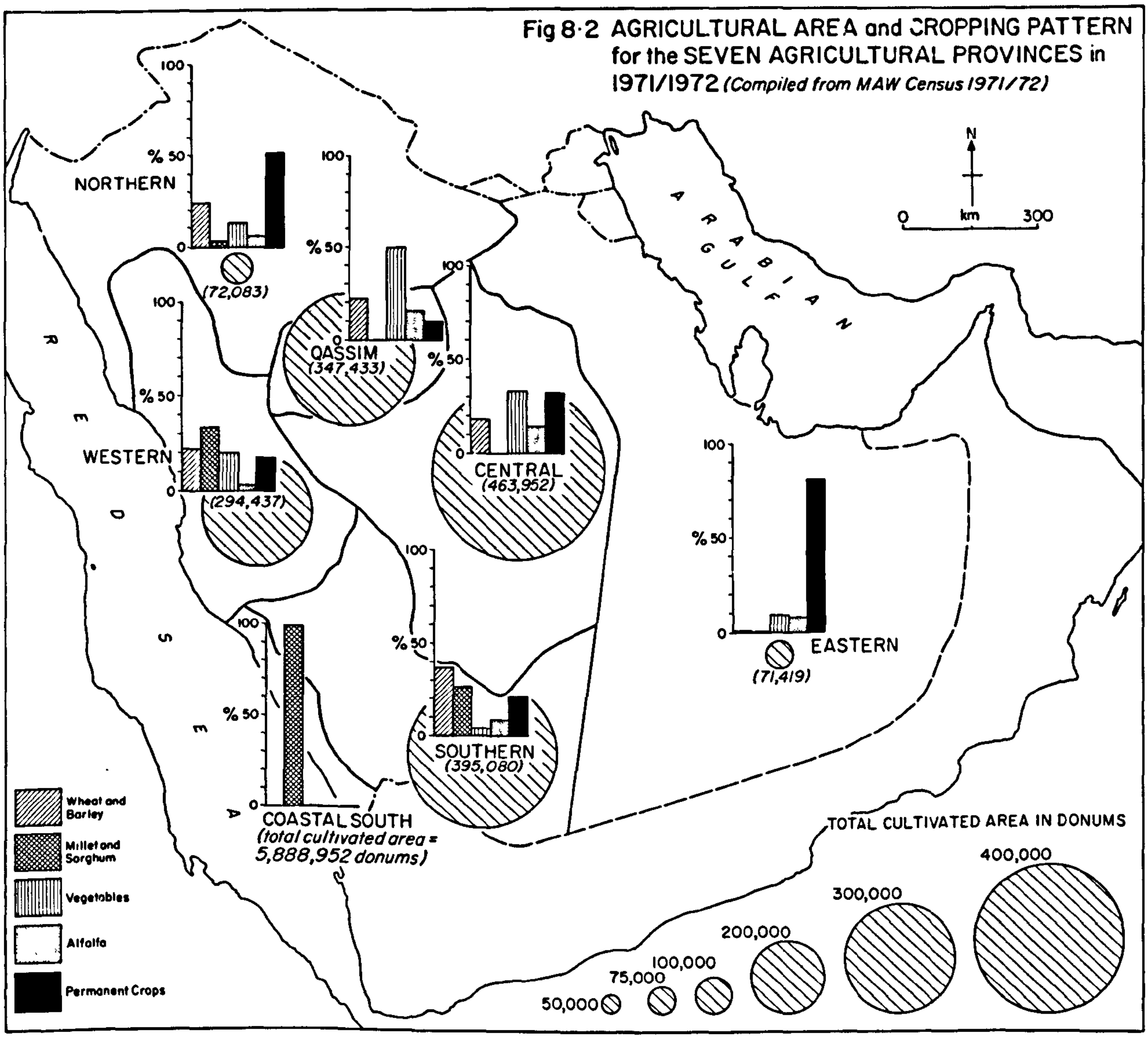


Fig 8·2 AGRICULTURAL AREA and CROPPING PATTERN for the SEVEN AGRICULTURAL PROVINCES in 1971/1972 *(Compiled from MAW Census 1971/72)*

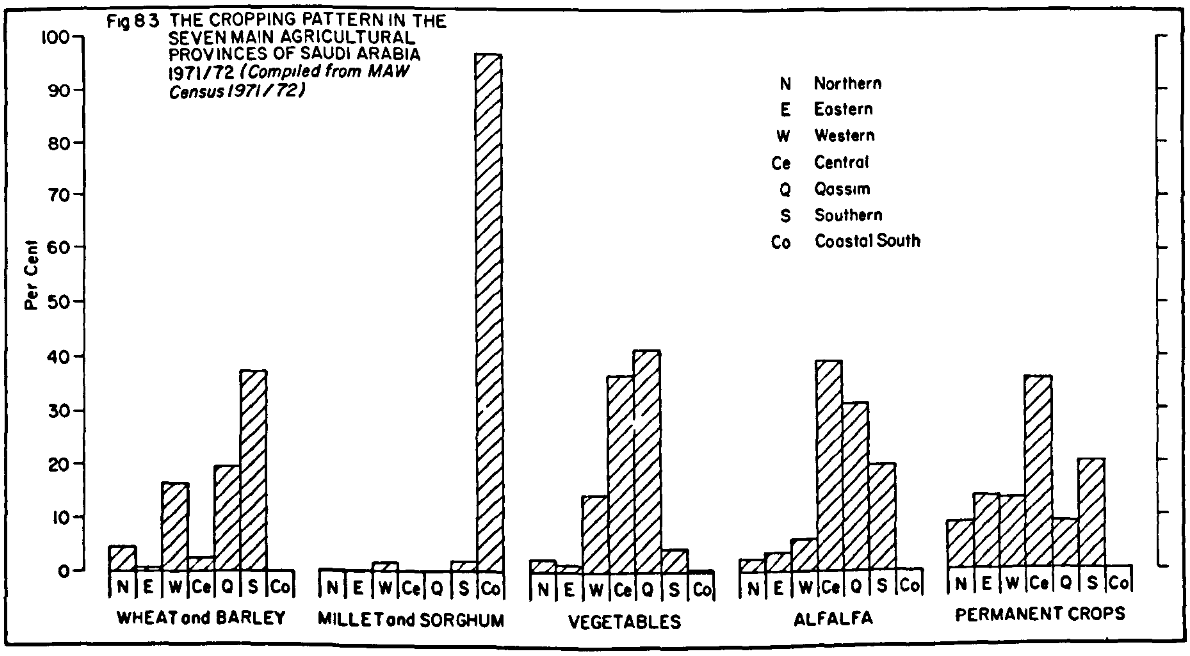


Fig 8·3 THE CROPPING PATTERN IN THE SEVEN MAIN AGRICULTURAL PROVINCES OF SAUDI ARABIA 1971/72 *(Compiled from MAW Census 1971/72)* is regional in character. Wheat is usually raised in the central areas and very little of it is cultivated in the south. Due to the fact that urban development in the central area is very strong, wheat as a traditional rural crop was affected and most of its areas were allocated to market-orientated crops.

The exclusion from consideration of the coastal south and the southern provinces (largely rural) would produce a completely different situation. As shown in Table 8-6 the influence of urbanization in restructuring cropping patterns is active. Wheat as a basic food crop has decreased in area, from 43.6% in 1968 to 20% in 1971/72, and urban-orientated crops such as vegetables and permanent crops (especially fruits) have increased. The alfalfa area has stayed the same, which indicates that nationally livestock farming has not expanded greatly in the last few years. The bulk of the alfalfa produced is used for household and farm animals.

Table 8-6

Cropping pattern for the country in per cent of arable areas excluding the southern and coastal south provinces

Crop	1968	1971/72
Wheat	43.6	20
Millet and Sorghum	6.8	8.3
Vegetables	19.5	32.7
Alfalfa	11.7	11.7
Permanent crops	18.4	27.3

Source: Based on Appendix 8-a

On a regional basis the variation in cropping patterns from one province to another is clearly visible and the process of change affecting cropping patterns is obvious in urban areas. Comparison of the two cropping patterns of 1968 and 1971/72 for the seven provinces shown in Figure 8-2 indicates clearly that the more urbanized an area, the more substantial is the change in the nature of the cropping patterns.

This can be illustrated by comparing the cropping patterns of the central province with those of the coastal province. The first area is largely urbanized, the second is largely rural. In the case of the central province, vegetables and permanent crops have gained in area from 24.7% and 9.9% in 1968, to 33.4% and 32.8% respectively in 1971/72. Alfalfa has increased from 12.1% in 1968 to around 15% in 1971/72. The situation in the coastal south is the opposite. In 1968 the sorghum and millet area occupied 98.2% of the cropped area. In 1971/72 the area of these crops approached 100%, while urban-orientated crops were negligible. The rural character in that area has persisted, since the coastal south (more than any other region) is physically isolated from other parts of the Kingdom. There are no roads connecting it with the rest of the country. Aircraft serve as the main transport link with other areas of the state. It is expected that as soon as asphalted roads are constructed to connect the region with Mecca, Jeddah and Madina, urban-orientated crops will start gaining ground.

On a crop basis, the comparison between the seven provinces (Fig.8-3), again indicates that the most urbanized areas, western, central and Qassim, have most of the nation's vegetables, alfalfa, and a sizable part of the permanent crop acreage, while rural areas produce most of the food crops. For example, 77.1% (36.1% and 41%) of the vegetable area in 1971/72 was in the central and Qassim provinces respectively. The coastal south had almost 97% of the sorghum and millet area. Excluding the southern and coastal south, the other five provinces had 95.1%, 80.5% and 79.9% of the vegetable, alfalfa and permanent crop areas, and only 4.0% of the sorghum and millet area.

8.1.4 The impact of crop pattern changes on livestock farming

The trend towards market-orientated crop production has affected livestock farming in a profound if largely indirect manner. There are three main effects:

(a) There has been a positive effect on the area of alfalfa land in most of the urban areas in the country since 1968; stabilization in some provinces, and increase in others (Fig.8-2 and 8-3). In the central province, for example, the alfalfa area increased from 12.1% in 1968 to around 15% in 1971/72. The Qassim alfalfa area, although decreasing, is still sizable. Both western and northern areas have increased. This trend would indicate that animal production is gaining ground in these areas. However, on a national basis the alfalfa area was almost the same for both years (11.7%) and this indicates that, on a national scale, livestock production has not expanded sizably and the increase in some provinces has not been substantial enough to affect the national alfalfa area. The national alfalfa area could only be expected to increase if commercial livestock production were expanded; hence the next few years might change the picture.

(b) One negative aspect of land limitations and cropping changes has been that the priority of other crops - mainly urban-orientated crops - has been emphasised at the expense of fodder crops (grasses, legumes) with an animal feeding value. It is for this reason that alfalfa is the only fodder produced mainly for animal feeding in the country. In the case of Saudi Arabia the bulk of grain produced is used for human consumption. It is only the green residue of these crops that is used for the animals. Therefore, the spatial character of fodder production in the country is geographically orientated and differs from one area to another. Because the south and south-west have a negligible alfalfa area they rely on green residue of grains (sorghum, millet),while the rest of the country relies mainly on alfalfa for animal feeding.

(c) These changes - more now than at any other time in the past - seem to indicate and encourage a trend towards some degree of specialization in livestock farming. The new dairy farms which have sprung up in the last few years around some of the major urban centres in the country are a development in this direction, (the new dairies around Riyadh will be dealt with in this study) and are an example of the urban influence.

It is worth noting that the trend towards livestock specialization has not been caused only by the direct influence of urban demand for milk and other animal products, which is substantial, but is also indirectly a result of recent changes in farming. Three points might be chiefly noted:

(i) The scarcity of cultivable land offers farmers limited choices as far as expanding their farming activities is concerned. Farmers have to choose between two main options; either emphasising animal production which means using most of the area of their farms to grow fodder, or emphasising mainly crop production. The first option - animal production - excludes crop production and entails a concentration on fodder, while the second option - crop farming - excludes any concentration on fodder. Therefore one of these two alternatives has to be chosen at the expense of the other and that explains why commercially mixed farming (crop and animals) has not expanded.

(ii) Most near-city farming has specialised in the production of fruit and vegetables, which have no significant value for intensive feeding; hence animals have no place on these farms.

(iii) It is easier for farmers to grow vegetables and fruit than it is for them to raise livestock, because vegetable and fruit growing require relatively limited skills, smaller investment, less man-power, and less complicated marketing procedures.

8.2 Types of livestock farming

Livestock farming in the country is of different kinds, and is not as homogeneous as pastoralism. In fact, heterogeneity is a main feature, for not all animals are raised on farms and a great number are raised in villages and cities. Moreover, the practices and methods of livestock husbandry vary greatly. However, the variation retains common features, one of the most important being that the bulk of the animal feed comes from the farm, on zero-grazing bases supplemented occasionally by local or imported foodstuffs. All animals are confined to some kind of housing. The system can be divided into three main types:

(1) livestock raised in households;

(2) livestock raised on rural farms;

(3) commercial livestock farms.

8.2.1 Livestock raised in households

This type of animal rearing has evolved mainly to supply urban and rural households with milk. Animals, mainly goats and to a lesser extent cows and sheep, are kept by a great number of households in almost every town and village in Saudi Arabia, to provide milk for household needs. The phenomenon has two causes. One is that the Saudis, or at least those of an Arab origin, can be traced to either nomadic or peasant stock (Chapter 2); hence they are used to consuming milk as their basic diet. The second is that neither pastoralists nor farmers produce or sell milk in commercial quantities.

Although there is no national estimate of the number of animals kept in cities and villages, some recent regional estimates indicate the number to be substantial. For instance, in 1965 the number of goats in Jeddah, Mecca and Madina towns (JMT) was estimated at about 67,000, or 48% of the total animal units in area JMT (Table 8-7). This is, in all probability, an under-estimate since animals kept indoors are hard to count. Goats are the main animal type because of their obvious advantages; they are small enough to be kept in homes, consume less feed and are less selective in their feeding habits. Some cows are kept, but on a limited scale and only by the more able of farm owners or families. The MAW office in Jeddah has suggested that not less than 120 households in and around Jeddah area kept one house cow; in Unayzah town which is an agricultural area there are an estimated 5,000 house cows.[5]

Table 8-7

Livestock in the JMT area (1965) A.U.

	Cattle	Sheep	Goats	Camels	Total	%
Farmers	440	17,150	10,100	-	29,450	21.1
Pastoralists	-	13,800	20,400	1,800	43,200	30.8
Towns	-	-	66,990	-	66,990	48.0
Total	440	30,950	97,490	1,800	139,640	100.0

Source: SRI, op.cit., p.189

In spite of the large numbers of animals kept in urban and rural dwellings, this type of livestock raising is a temporary phenomenon and has no potential for further growth or development, for the following reasons:

(a) as soon as other sources of milk develop (dairies) this source will disappear. In fact - although no estimates are available - a great number of urban households have already abandoned their household animals in favour of powdered and canned milk, as indicated by the rapid increase in imported milk and milk products during the last few years.

(b) The housing of animals in urban areas is becoming more and more a source of irritation to municipalities, because most of these animals are left on their own to scavenge in the streets.

(c) Animals are costly to keep in houses and make satisfactory sanitation difficult.

8.2.2 Livestock raised on farms

The prevalence of a subsistence economy over the centuries has produced an agricultural system adjusted to self-sufficiency. Hence

5. ODA, Milk Production and Marketing Survey in Saudi Arabia, (1972), p.4

traditionally nearly every farm has a few animals. Their role in the farms is a consuming and fertilizing agents, although the use of animals for draught work is still common in the south-west. Animals are chiefly used to produce milk, but manure and meat are by-products.

The use of animals for draught work is more and more declining and water pumps are increasingly replacing animals. Table 8-8 shows that in 1966 only 18.9% of irrigated land[6] was irrigated without the use of pumps, while almost 81% used mechanical means (mainly pumps).

Table 8-8

Irrigated lands: Sources of water and hectares (1966)

Source of water	Hectares	%
Artesian	15,212	6.9
Ordinary well (with engine)	163,786	74.2
Ordinary well (without engine)	41,717	18.9
Total land irrigated (wells)	220,714	100

Source: Ministry of Finance, Statistical Yearbook, (1966), p.131

In the same way, mounting imports of agricultural equipment for soil preparation are making draught animals redundant in many parts of the country, a development encouraged by government subsidy and loans to farmers.

Milk is a traditional item of diet. A few cows and goats are usually kept on farms in consequence. All the milk produced is consumed by the farm households. Manure is a by-product and is used as an all-purpose fertilizer. If animals are too old to be useful or for some other reason redundant, they are slaughtered, hence meat too is usually a by-product.

8.2.3 Commercial livestock farming

This type is a very recent development and an off-shoot of the second type (livestock raised on farms). It aims largely at the pro-

6. This irrigated land does not include the eastern and Qassim regions which are the most important areas of irrigated agriculture. However, animals are very little used in these areas for water elevation.

duction of milk and meat. Several main features distinguish this type of livestock rearing from the previous two types:

(a) livestock is raised mainly for commercial ends. The whole purpose of such enterprises is the utilization of a large part of the land, labour and finance available for the production of meat or milk or both for the market and not for home consumption.

(b) Animals raised are either cattle for the production of milk, or sheep for the production of lamb and mutton. Camels and goats have not yet been commercially raised.

(c) Feeding is based on the system of "zero grazing", i.e. harvesting forage either manually or mechanically and feeding it to animals in stalls. Imported concentrates are increasingly used as supplementary feed.

(d) The trend is towards the spatial and functional separation of livestock raising from crop production, and away from the traditional association of animals and crops.

The emergence of commercial livestock farming - although slow - has been a natural and necessary reaction to the changes brought about by increasing urbanization in parts of Saudi Arabia. The most important of these changes are:

(a) The creation of a substantial demand for fresh milk and meat, mainly as a result of the increase in urban per capita income, especially among middle and upper-class earners. Unfortunately a regional per capita estimate is not available. However, an unpublished sample survey of 94,938 families in Riyadh, Jeddah and Dammam covering the main western, central and eastern urban areas (excluding high income families) has indicated that 65% of them have an income ranging from 600-900 SR and over (Table 8-9). Such an income is higher than for the rural sections of the country.

(b) Traditional farm animals and urban-housed animals have been unable to meet the increasing demand for milk and meat either quantitatively or qualitatively. The increasing imports of manufactured milk, e.g. powdered, canned and processed milk products, have not on the one hand met the highest nutritional standards, nor on the other proved wholly acceptable to an urban population used to fresh milk products. So this situation has been one to encourage specialized milk and meat production in farms.

Table 8-9

The relative distribution of the monthly per capita income for a sample population selected for Riyadh, Jeddah and Dammam (1969-1970)

	Less than 300 SR	300-599	600-899	900-over	Total
Riyadh	5	35	37	23	100
Jeddah	1	48	39	12	100
Dammam	1	13	33	53	100
Total	3	32	37	28	100

Source: Ministry of Finance, Report of Family Budget for 1969/70, (Unpublished, Arabic, Riyadh, 1972), p.59

(c) The re-structuring of land use as a result of urbanization has meant the absorption of more cultivable land for dwellings, roads and other facilities. The land left has had to be intensively used for the production of crops that are high in demand. Hence the traditional association of animals and crops has had to be abandoned in some cases in favour of specialized animal production.

Dairy or meat producing farms found in the country at present are still in their early stages of transition. The term semi-specialized would be appropriate, since they are still tied in their practices and methods to traditional ways. Most of these farms have not adjusted their input in the way efficient specialization would require. There is a trend towards specialization in such farms rather than any organized and decisive transformation of the traditional ways.

8.2.4 Meat Production

It has always been a traditional farming practice for some farmers in the country to keep a few sheep as a side activity, to utilize the farm's waste and unused food and foodstuffs. The recent increase in per capita income in urban areas and the consequent higher demand for lamb and mutton has encouraged more farmers to turn to sheep feeding and fattening. Sheep fattening in farming areas is mostly seasonal in character and small in scale. Usually most of the fattening takes place a few months before Eid al-Adha, a season of high demand for lamb and mutton, when almost every Saudi family will slaughter as a sacrifice no less than one animal: usually a lamb or sheep.

Sheep production (raising and fattening) is practiced in most cases on a stratified pattern (Chapter 6), with rearing being done mostly in the desert and fattening occurring in agricultural areas. Regional or national data to show the extent of this practice are not available; however, Table 8-10 extracted from the Agricultural Bank Annual Report, indicates that in 1972/73 the bank granted a sizable loan for purchasing sheep both for raising and fattening. Traditionally, both farmers and pastoralists are involved in obtaining grants for sheep raising.

Table 8-10
No. of sheep supplied by grant during 1972/73

Branch	Raising	Fattening
Riyadh	3,233	107
Jeddah	464	-
Buraydah	1,993	124
Abha	580	-
Madina	587	-
Hofuf	430	779
Hail	672	80
Total	7,959	1,089

Source: Agricultural Bank, Ninth Annual Report 1972/73, p.59

However, the 1,089 sheep supplied by grant for fattening in 1972/73 were mainly for farmers producing or purchasing roughage for fattening. Therefore all the areas to which grants were made in that year for fattening were areas with a sizable proportion of agricultural land. For example, Hofuf is the largest oasis in the country, with the largest loan in 1972/73, for fattening 779 sheep.

The expansion of sheep feeding is largely by means of alfalfa and other fodder products. Concentrates are used on a very limited scale because they are not manufactured in the country on a large scale, and because they are expensive: 600-800 SR/ton. The only large sheep farm in the country is Haradh. The project, at present, comprises about 30,000 head of Najdi sheep based on irrigated pastures (alfalfa, and other grsses). This project has not been examined in detail in this chapter because (a) it is state-owned, hence does not represent the average farm, (b) sheep farming was adopted here as an alternative system; the original project layout was for cropping and settlement, (c) it is a non-profit-making scheme, hence it does not face the economic problems confronting other farmers (Chapters 3 and 2). On the other hand, the new trend towards dairy farming in the country - largely a private venture and mainly in Riyadh - has been chosen as a case study to illustrate the principal problems faced by the emerging livestock farming industry as a whole.

8.2.5 Dairy farming

Dairies in the country are still few and are either small family concerns or government-owned farms. The largest are state farms which are mainly research stations, the animals being primarily kept for scientific purposes. However, the milk produced on these farms is sold to nearby areas. There are three main state research farms with dairy cattle, located at Dirab, Hofuf and Madina. Between them they have about 120 milking cows. Apart from the milk from these few public farms, most of the milk consumed is from private farm or household, or is an imported and reconstituted product.

To evaluate the present character of commercial livestock farming in the country and its main limitations, a sample survey of nine dairies in and around Riyadh's urban area was undertaken. The survey was based on a questionnaire (Appendix) undertaken by the author in November and December 1974. The nine were the main dairies around Riyadh at the time of the survey, and the result of the recent trend towards commercial livestock farming and away from the traditional mixed or pastoral livestock production. They can be used to illustrate the present state of commercial livestock farming, its major problems and potential.

8.3 Riyadh and Dairy Development

Riyadh is the political capital of Saudi Arabia, and is situated on the lower course of Wadi Hanifa (Fig.8-1) a tributary of the great Wadi Sehaba system, near the centre of the Arabian Peninsula. It has been an important tribal and regional political centre for the last two centuries and is becoming more important since the completion of a railroad to Dammam on the east coast in 1951, and a surfaced highway. In the mid-1960's, the town became the centre of a national road system.

Riyadh dairies were chosen as a case study because (a) all recent dairy development in the country have been located in and around main urban centres, (b) the urban expansion in the Riyadh area is the largest in the country, with an annual growth rate of around 13% a year, mostly as a result of the continuous migration to the town from surrounding rural areas, (c) the high per capita income (Table 8- 9) generated by the concentration of government agencies, related services and the growing industrial base has made the market for milk a profitable enterprise.

Dairy development around Riyadh is recent and a result of urban expansion. The first dairy was started in al-Kharj by the founder of Saudi Arabia, His Majesty King Abdulaziz al-Saud in 1953. The Arabian

American Oil Company (Aramco) was asked to plan and manage this farm. Until 1960 this farm was the main dairy in the country and provided the Royal household and to a less extent, Riyadh market, with milk. After 1953 no sizable dairy was established until 1963, when the owner of dairy No.5 realised that "milk was a valuable, demanded, and largely unavailable commodity in the market".[7] The remaining seven dairies were established in the period between 1967 and 1973, as shown in Table 8-11, with the largest expansion taking place in the last quarter of that period.

Table 8-11

Dairy development in Riyadh area

Farm No.	Year	Time Seq.Years	Ownership
6	1953	0	Government
5	1963	10	Private
3	1967	14	Private
8,1	1970	17	Private
9,2	1972	19	Private
7,4	1973	20	Private

Source: Field work,1974

At present the total milk supply for this area comes from (a) households and imported milk, which constitute the main source, but whose output it is not possible to estimate, (b) reconstituted milk from three factories in Riyadh and some from Dammam (c) fresh milk from the nine dairies around Riyadh. Table 8-12 indicates that, with the exception of source (a), the estimated milk supply from (b) and (c) for the city is 49.3% reconstituted milk and 50.7% fresh milk mainly coming from the nine dairies surveyed in this study.

7. Mr. Soliman al-Hosain, al-Kharj, Dec.1974

Table 8-12

Estimated dairy milk supply for Riyadh 1974 in kg.

Sources	kg.	%
Fresh		
Dirab Station	500	
Dairies around Riyadh	1,970	
Total	2,470	50.7
Reconstituted from Riyadh	1,800	
" " Dammam	600	
Total	2,400	49.3
Sub-total	4,870	100.0

Source: Field work,1974

8.3.1 Location forces influencing the patterns of dairy farming in Riyadh area

Although urbanization has meant the end of most of the farming activities in the city, Riyadh still has a sizable area of agricultural land such as house gardens, allotments, date palm gardens, and even actual farm land all along Wadi Hanifa (Fig.8-1). Thus the town has, to some extent, retained something of its agricultural character despite overwhelming concentration of population.

Farming in the past influenced the city because the city would never have existed had it not been for Wadi Hanifa oasis. Now and because of urbanization, the city in its turn influences and directs the location and character of farming not only nearby but often considerable distances away, not only in Wadi Hanifa and its tributaries but also in the al-Kharj area (74 km.to the south) and, at an even greater distance, in Qassim 400 km.to the north.

The relationship between urbanization and urban-farming, particularly in the development of commercial dairies, is very close and suggests that the concept of the theoretical zoning of agricultural land use (Von Thünen, Chapter 6) may be usefully employed in seeking an explanation of the location pattern of dairy farming in the Riyadh area. The main nine dairies analysed in this chapter are of two types, found in two separate locations. One dairy type is input-orientated and located close to or within the area where fodder and water are available, - in a relatively abundant quantity - that is, mainly in the al-Kharj area. These dairies are established in farms and produce most or a sizable part of the fodder they need; thus they are dairy farms rather than city dairy units. The transportation of fluid milk the distance of 74 km.(from al-Kharj to Riyadh) causes it to deteriorate because the weather is hot most of the day and most of the year, hygiene is inadequate, and modern cooling equipment is not available. So the milk produced in this area is partially processed into cultured butter milk (leban) which is less perishable than fresh milk. The location of input-orientated dairy farms is found in the al-Kharj area within zone two, referred to as the outer milk zone in Figure 8-4.

The second type of dairy is market-orientated and urban, located within or on the fringe of Riyadh along Wadi Hanifa. This type is more market-orientated than it is input-orientated in that it is not located at the point where most of the feed is produced. Dairies of this kind are very much of a "factory type", with very little or no agricultural land and buying in most if not all foodstuff from the outside. Urban dairies concentrate on the production of fluid milk which is highly perishable and can only be transported a limited distance from the point of production, thus these dairies are within a restricted radius of the urban market they supply. The area within this radius is referred to as the inner urban market zone in Figure 8-4.

Thus it is apparent that the location of milk production in Riyadh is spatially limited to the two concentric zones shown in Figure 8-4; that is zone one for urban dairies and market-orientated activity and zone two for farm or input-orientated dairies. This spatial limitation is due to the fact that the industry is very much a new one, still semi-

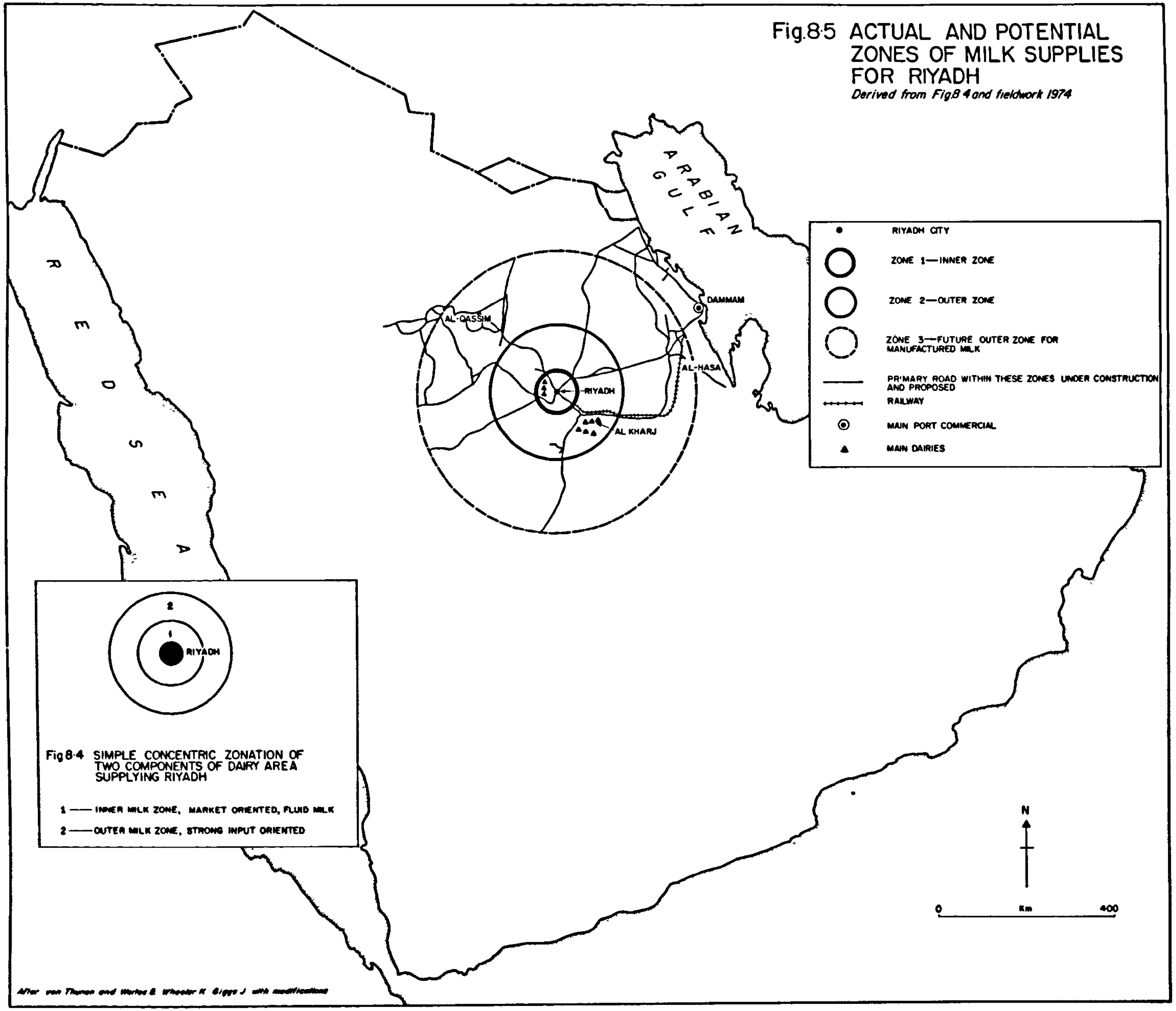


Fig. 8.5 ACTUAL AND POTENTIAL ZONES OF MILK SUPPLIES FOR RIYADH

Fig 8.4 SIMPLE CONCENTRIC ZONATION OF TWO COMPONENTS OF DAIRY AREA SUPPLYING RIYADH specialized, not yet developed to the extent of producing surplus quantities of milk, so as to make use of modern factories to process surplus milk into bulky products i.e. cheese, butter etc. Therefore these dairies have to be reasonably close to Riyadh and no further than al-Kharj or similarly located areas at the same distance from Riyadh.

Figure 8-5 depicts the limits of milk zones in real world, showing that zone one includes mainly Wadi Hanifa and the outer zone includes the al-Kharj oasis. This zoning differentiates a developing dairy activity in a developing country like Saudi Arabia from those in developed countries where the number of milk zones are three, the third being an outer zone orientated towards the production of strongly input-orientated products i.e. butter, cheese etc. This third zone is a future possibility for Riyadh, when Qassim - and al-Hasa, with their abundant agricultural areas - become part of a third zone where milk in excess of immediate needs is processed into milk products. Zone three in Figure 8-5 defines the future limits of this development. However such a development cannot be expected without the improvement of the present road network connecting these areas with Riyadh and the encouragement of expanding large modern dairies in these areas.

8.3.2 The size and scale of the dairies

As shown in Table 8-13, three of the nine dairy farms surveyed in Riyadh are urban units; the average land size is 7.2 hectares, which is very small compared with an average size of about 409 hectares for dairy farms in the al-Kharj area. As a result of the high price of land in Riyadh two of the urban units are renting their farms while all the dairy farms in al-Kharj own their land. Moreover, the urban units are located on average 4.4 km.from Riyadh and their land is used almost 100%, while the dairy farms are located on average 74 km.from Riyadh and only 65% of their land is utilized because their lands are large and not as highly valued as that of the urban units.

Table 8-13

Urban and rural dairy farms around Riyadh 1974

Type	No.	Ave.size	% cultivated	Rented	Location	Distance from Riyadh km
Urban units	3	7.2 ha.	100	2	Wadi Hanifa	4.4
Dairy farms	6	409 ha.	65	-	al-Kharj	74

Source: Field work,1974

As seen in Table 8-14 the scale of the surveyed dairies is small. The largest is the government farm in al-Kharj with a total of 346 animals, while the smallest has 25 animals. The nine dairies have a total of 818 animals, made up of 208 milking animals, 251 dry cows, 145 males and 214 heifers for replacement. The dairies' average herd size is 91 animals and the average number of milking and dry cows is 26 and 31.4 respectively; these figures also indicate the small scale of the operations.

Herd composition i.e., the percentage of milking cows, dry cows, males and heifers to the total dairy herd, can give a better indication of the present scale and the limited potential of these dairies. As is seen in Table 8-14 the herd composition varies greatly and shows that most of these dairies are in their herd building stage. For example, dairy No.7 has 93.8% of its herd as heifers because it is a new farm. Dairies No.5 and 6 have 56% and 28.9% of their herds as replacement heifers. Number 6 is a government farm where government regulations do not give the management a free hand to dispose of undesirable animals; it is for this reason that this farm has almost 32% of its herd as males. For these dairies as a whole the herd composition is 25.4% milking cows, 30.7% dry cows,17.7% males and 26.2% heifers. This average indicates that the percentage of dry cows is higher than that of milking cows;

at the time of the survey many of the dairies had purchased dry cows and some of their cows had problems of sterility and rapid degeneration, the result of bad management. The number of males is high as a result of keeping a large number of them for long feeding periods. The percentage of heifers for replacement is 26.2%, which is reasonable because there are few heifers for sale in the market and the owners tend to keep all their heifers for their own use.

Table 8-14

Scale and herd composition of Riyadh dairies 1974

No.	Herd Size: Total Herd	Milk Cows	Dry Cows	Males	Heifers		Herd composition %			
	1	2	3	4	5		2	3	4	5
1	82	28	44	6	4	100	34.1	53.7	7.3	4.9
2	80	35	20	5	20	100	43.8	25	6.3	25
3	116	55	35	10	16	100	47.4	30.2	8.6	13.8
4	50	4	30	3	13	100	8	60	6	26
5	25	3	5	3	14	100	12	20	12	56
6	346	40	95	111	100	100	11.6	27.5	32.0	28.9
7	32	-	-	2	30	100	-	-	6.3	93.8
8	47	23	13	3	8	100	48.9	27.7	6.4	17
9	40	20	9	2	9	100	50	22.5	5	22.5
Total	818	208	251	145	214	100	25.4	30.7	17.7	26.2
Ave.	91	26	31.4	16.1	23.8					

Source: Field Survey, Figures are rounded to the nearest

8.3.3 Investment and income

With the exception of al-Kharj farm (which is non-profit-making) all these farms are privately owned by individuals and all are profit-making. The invested capital is considerable, as shown in Table 8-15, the total investment for the eight dairies being over SR 12 million, varying from a lower figure of SR 500,000 to a higher figure of SR 2.4 million.

Table 8-15

Investment in Riyadh's nine dairies

(SR 000)

No.	Land	%	Animals	%	Building	%	Pumps	%	Machine	%	Total
1	1,750	72	370	15.2	250	10.2	50	2.1	10	0.4	2,430
2											2,000
3	rent	-	300	57.7	200	38.5	-	-	20	3.8	520
4											500
5											1,300
6											
7	1,500	80	28.8	1.5	200	10.5	160	8.4	10	0.5	1,899
8	1,000	64	176	11.3	300	19.2	35	2.2	50	3.2	1,561
9											2,000

Source: Field work,1974

However, these investments are not all in the milk side of the farm but are in the whole farm as a unit. These farms do not separate their activities; moreover, with the exception of al-Kharj farm, they do not have an accounting procedure for the farm as a whole or for each activity. Only four dairies were able to help in detailing the main aspects of their investment. Land is by far the largest part of these farm investments, amounting to not less than 64% and to a proportion as high as 80%. Such a high proportion of the total investment is in land because of the present high prices of land in this area; all the operators owned their land long before the present increase in prices. It is for this reason that some of the owners are thinking seriously of abandoning dairying for a more profitable activity.

Animals and buildings come as a second and third priority. Animal prices are very high and if a good milking cow is available, SR 3,000 to 4,000 is paid for it; pure-bred cows are not available for sale but have been recently imported from overseas.

There are rarely specialized dairy buildings on such farms, the farm buildings being used indifferently for all the farm activities.

The income from dairies is not known. During visits to these dairies no accurate figures were available to enable a realistic economic appraisal of production. Accounts are not kept, production per animal and costs are not recorded. However all the recent MAW studies have shown that the economics of the present dairy enterprises are very doubtful.[8]

All the farmers who were questioned stated that they did not make a profit from the dairy side of their farms; dairying was an activity that supplemented the farm's total income. As shown in Table 8-16 none of these nine farms specializes in dairy and fodder production alone.

Table 8-16

Farm incomes

No. of farms	Income from other activities
3	no less than 10%
2	20%
4	50% and over

Source: Field work, 1974

Other crops and activities constitute 50% of the income for four dairies, 20% for two dairies and less than 10% for three dairies. All these dairies as shown in Table 8-17 produce either all or some of their own fodder, mainly alfalfa. Seven produce dates and other trees. Chicken and meat are produced by four. Two farms sell petrol as a result of their location on a main road.

Table 8-17

Type of activities practiced besides dairy farming

No. of dairies	Type of activities
7	Dates
4	Other trees (grapes and oranges)
4	Chicken, meat, petrol
9	Forages
4	Grain

Source: Field work, 1974

8. ODA, op.cit., p.8, and interview with some MAW staff

The farmers who were interviewed felt that their other activities, besides milk production, provided security that they needed for the time being, because (a) the major managerial problems they are facing are too great to allow them easily to plan their way ahead in dairy activities (b) MAW has not started helping and planning for this type of agricultural activity, (c) the skills required in dairying are beyond their traditional abilities, and beyond what the labour market in Riyadh can provide.

8.3.4 Cattle Breeds

Almost two thirds of the cattle of these dairies can be considered as cross-bred (crosses between local and imported animals). Government farms in al-Kharj have contributed greatly to this situation, since most of the private dairies have bought their animals from the farm or used some of its bulls for breeding. Breeding is uncontrolled and Zebu bulls and cows are indiscriminately used for breeding with better imported animals with no regard for efficiency. Local animals are used by four of the farmers, all of whom intend or desire to replace them because of their low milk yield. As a result of the uncontrolled programme of breeding, it is expected that cattle standards will degenerate. The lack of improved bulls for breeding purposes adds another dimension to this problem.

8.3.5 Production level

The small scale of these dairies is also indicated by their low production level. From the survey undertaken, the total amount of milk produced for 1974 was estimated to amount to 707,730 kg. Almost 30% of this quantity is diverted away from the market because it is consumed by calves, used for home consumption, or wasted as a result of the lack of cooling equipment. The quantity of milk produced varies greatly from one farm to another. The highest is 550 kg.daily from the state farm in al-Kharj, the lowest 20 kg.from dairy No.4 and 0 kg.for 5 and 7 (the last two dairies having no milking cows at the time of the survey). This low production is mainly due to the following factors: (a) the milking cows kept in these farms constitute a small percentage of the total herd composition: around 26.5% (b) most of the milking cows are low producers either because they are local Zebu or because they have been crossed with local Zebu breeds, (c) most important of all, there is an almost total lack of modern expertise in dairy management.

8.4 Management and some related aspects

The chief obstacle facing dairy development is the lack of a scientific approach to management. When the nine respondents were asked to indicate their three main problems their answers were: (a) the shortage and high cost of man-power, (b) the lack of and cost of concentrate supplement, which was acute at the time of the survey, (c) the lack of an organized processing facility, (d) the lack of an extension and advisory service for dairy production.

8.4.1 Man-power

All the nine dairies complain bitterly about the lack of unskilled and, more acutely, skilled labour and its high cost. None of the dairies has any employees who is qualified or has practical experience in dairy management or related subjects.

As seen in Table 8-18 the total force employed is 106 labourers, of which 43.4% are non-Saudis, mainly Yemenis and Palestinians. Yemenis are usually employed for unskilled jobs and Palestinians for the semi-skilled jobs. 89.6% of the labourers employed are unskilled and 10.4% are semi-skilled. Most of the skills available in these dairies are the results of brief experience in the field. The lack of an experienced manager is the rule rather than the exception, only one dairy being managed by a Palestinian with some limited experience. The rest are managed by their owners who on the whole have no experience, except that obtained since they started their operations. None of these farms has a veterinarian of its own and all rely on the MAW veterinarians in both al-Kharj and Riyadh.

Table 8-18

Number employed by Riyadh oasis

	Total	Saudi	Foreign	Semi-skilled	Unskilled
No.	106	60	46	11	95
%	100	56.6	43.4	10.4	89.6

Source: Field work,1974

Labour wages are high, averaging SR 650-700/month for semi-skilled and SR 350-400/month for unskilled workers. The shortage of unskilled labour at the time of the survey was acute as a result of (a) National demand for labour for a large number of public and private projects all over the nation, (b) the Yemen government's discouraging of migration from the south, because of its own growing needs for labour.

None of the employees in the dairies has any chance of formal training; the owners cannot afford it, and the government has no school or organization that provides training in dairying. The MAW has only two staff with a dairy background and they are busy doing office work and tender analysis in the MAW headquarters.

8.4.2 Feeding

Livestock raising in farms and particularly in dairies has been possible as a result of the traditional cultivation of local alfalfa. Over much of Saudi Arabia with the exception of the mountainous and coastal regions of the south-west, a large part of the cropped area has always been used for alfalfa production, and livestock farming has always been maintained basically on this fodder. As shown in Table 8-19, the alfalfa area in Riyadh and al-Kharj districts occupies a sizable proportion of the cultivated area. The alfalfa area in Riyadh has increased from 5% of the cultivated area in the district to 8%. In al-Kharj the alfalfa area, although it has decreased slightly as a percentage of the total cultivated area since 1967, has increased considerably in real terms from 23,050 in 1967 to 28,000 donums in 1974; therefore, in both districts the alfalfa has increased considerably. In Riyadh the alfalfa area has increased since the index year 1967 by 245% and in al-Kharj by 121.5%.

Table 8-19

Alfalfa production in Riyadh and al-Kharj districts (donums and %)

Dist.	Year	Cultivated	Alfalfa	% of cultivated area	% increase in alfalfa area
Riyadh	1967	51,150	2,450	5%	100
	1974	75,700	6,000	8%	245
al-Kharj	1967	89,600	23,050	25.7%	100
	1974	120,000	28,000	23.3%	121.5

Source: 1967 SRI op.cit.,p.235 based on Resource Survey (unpublished)
1974 SCET op.cit., p.35, (unpublished)

Green and dry alfalfa constitutes the main forage for the nine dairies surveyed, mixed with straw and sometimes supplemented with millet or wheat. The feeding system used by the dairies is zero grazing, where fodder is cut and then fed either green or dry to the animals. All the respondents use green forage as their basic fodder, six use dry forage, usually together with green fodder and three use supplements (Table 8-20) with a combination of green and dry forage. Two dairies do not use dry fodder because they do not have the facilities to cure and bale it. Also the small size of the alfalfa plots (Plate 8-1) makes the use of baling machines pointless. Most of the farmers who use dry alfalfa have their own bales and they usually bale their own dry fodder and sell whatever extra they have. Five of the respondents produce their own fodder, the rest have to buy it in for some of their needs. Supple-

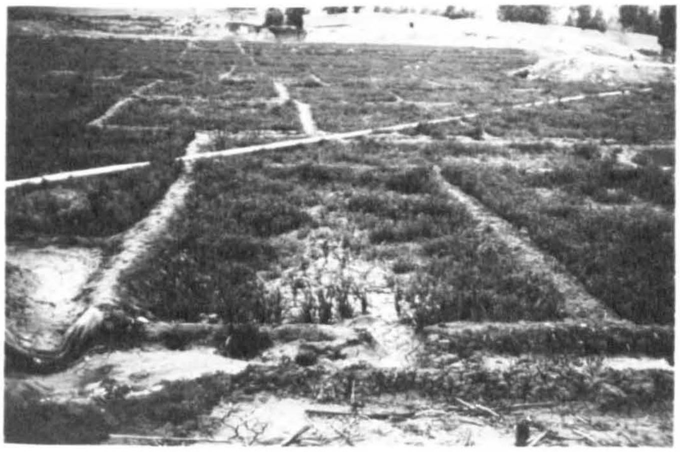


Plate 8-1 Alfalfa plots are very small all over the country. This makes the use of baling machines and modern irrigation systems difficult.

Plate 8-2 Most of the milking machines used by Riyadh dairies are small and portable.

Plate 8-3 Rudimentary methods are used by most of Riyadh dairies for cooling milk.

ments are usually of imported protein or of locally produced or imported grains; at the time of the survey imported concentrates, costing up to SR 800/ton, were not available on the market.

Table 8-20

Feeding system of Riyadh and al-Kharj dairies 1974

Feeds	No.users	Feed combination	No.users
(a) Green forage	9	abc	3
(b) Dry forage	6	a	2
(c) Supplements	3	ab	6
(d) Grazing	none	ac	1

Source: Field work,1974

Only three dairies including al-Kharj farm are using supplements on a semi-regular basis. They do not give it on the basis of their animals' output but more or less indiscriminately, some animals receiving more than they should and others less. In dairies 2 and 9 at milking time all animals were given the same amount of feed. Some of the dairy cows seen in al-Kharj farm and farms 2 and 3 seem to be overfed. The owner using supplements has stated that he takes as his model al-Kharj farm, there being no other example to follow. al-Kharj farm uses a very high protein ration. The data obtained from the Manager and the Ministry of Finance show that the daily feed rations used by al-Kharj farm for milking animals is an average of 60 kg. alfalfa and an average of 4.5 kg. of meal (barley and wheat) per head, which was calculated to supply almost 1,905 gr. of DP (digestable protein)[9] as shown in Table 8-21 .

Table 8-21

Feed value of al-Kharj ration

	kg	DP gr.
Alfalfa	60	1,620
Meal	4.5	385
Total	64.5	1,905

9. MAW Research Department

This ration is higher than the norm. A full-grown 500 kg. cow producing an average 10 kg. of milk per day throughout the year (gestation of five months) would require per day an estimated total of 850 DP in grams.[10]

For most of these dairies, feeding is basically dependent on alfalfa (Medicago sativa), of which there are several local varieties, giving all-the-year-round production of up to 70-100 tons/hectare. The reliance on alfalfa can do no more than maintain the animals at a modest level of production, by itself it cannot be expected to provide the nutrition needed for maximum production. Most of the dairies surveyed cannot afford the costly protein supplement, and their very limited experience in the field makes it difficult for them to use it wisely. Moreover, the inefficient management procedure employed by the dairies makes the importance of using protein supplement very much secondary to the importance to be attached to the type of animals used, the processing and storing facilities. The use of costly concentrates under low management standards is a waste of investment and resources.

8.4.3 Milk processing and treatment

Milk treatment and processing in the dairies is often elementary in standard and suffers from two major weaknesses: (a) the lack of modern dairy facilities and (b) widespread lack of basic notions of hygiene. With the exception of the government farm in al-Kharj, none of the producing farms has any modern pasteurising or cooling equipment. As shown in Table 8-22 only two farms use mechanical milking continuously. Three dairies use both hand and mechanical milking. The machines used are portable ones (Plate 8-2). Cooling milk before sale is only undertaken by three of the farms, one of these being al-Kharj farm. The other two use home freezers. Pasteurisation at 155^{o}F is practised at al-Kharj farm,

10. Ibid

the rest boil their milk over gas stoves (Plate 8-3 and 8-4).

Milk processing is limited to al-Kharj, which handles only the milk from known cows to produce fluid milk, leban (sour milk) butter and yoghurt. The al-Kharj farm is the only one with satisfactory - if elderly - dairy processing facilities. The rest of the farms dispose of their milk either in the form of untreated fluid milk or in the form of leban. Sixty-100% of the milk sold is in the form of leban, this indicating the consumer's preference for this product, besides the fact that sour milk has always been known for its better storage properties. Only three farms separate fat, and two of these farms use home washing machines for this purpose. No sterilization of equipment was observed by the author in any of the dairies except al-Kharj farm.

There are rarely specialized dairy buildings on such farms, the farm buildings sometimes are an extension of the owner's house (Plate 8-5). The housing layout indicates a low level of management. The area provided for animals is small, sanitation is lacking and milking is usually done in the open anywhere in the animal area (Plate 8-6).

MAW Services: The MAW unit in al-Kharj is small, with little decision-making power, and is directly controlled from the MAW Office in Riyadh, and there is little time for field work. With a total of 44 employees the branch has only one veterinarian and two assistants.

The veterinarian of the unit is the only one in the area and usually stays at the office; he has no systematic programme for travelling or field visits. When dairy owners were asked how often the veterinarian made visits, they all without exception complained about the difficulties involved in getting the government veterinarian to come to their farms. The routine adopted by the MAW unit is considered by them to be unnecessarily slow and inefficient. Moreover most of the owners did not have much confidence in the service available, probably because it had

Plate 8-4 Old methods are used for heating milk in a Riyadh dairy.

Plate 8-5 Animal housing in some Riyadh dairies is an extension of the farmer's own house.

Plate 8-6 Areas provided for animals are small and sanitation is lacking (Deriyah, Riyadh).

been inadequate to prevent previous cases of animal deaths. The al-Kharj unit does not have any acceptable facilities for analysing blood, milk or other samples, and two farmers complained that two blood samples were spoiled by the branch, before it sent them to the MAW laboratory in Riyadh.

Table 8-22

Milking methods, treatment and processing applied in Riyadh Dairies

Methods and Processes	No. of Farms
Mechanical milking	2
Mechanical and hand milking	3
Hand milking	2
Milk cooling (two household refrigerators)	3
Pasteurisation (one using pasteuriser while the other two use rudimentary methods)	3
Separation (two using washing machines)	3
Large storage room	1
Large cooling vat	1
Milk sold untreated	5
Leban	5
Butter	3
Yoghourt	1
Sale in closed carton	3
Open containers	4

Source: Field work, 1974
Two dairies are not in production (5 & 7)

PART FOUR

LIVESTOCK DEVELOPMENT

INTRODUCTION

The development and rationalization of the livestock sector in the Kingdom of Saudi Arabia is an important and complex task. The sector has relatively large and unexploited developmental possibilities but the problems impeding its expansion are numerous. The previous eight chapters - each contributing its own share within its own scope - have attempted to expose, analyse, and to evaluate the main problems within the livestock sector in the country so as to help in arriving at two main objectives: to examine and appraise the main structural problems facing the livestock sector, and to provide an overview of the livestock sector in Saudi Arabia as presently constituted.

It is the hope of the author that, in view of the findings of the previous chapters, the magnitude of the difficulties facing livestock development in the country is clearly appreciated. Based on the results of the previous chapters is the third objective of this thesis: the development of the livestock sector, which will be elaborated upon as the main theme of Part Four.

Part Four is made up of two chapters. Chapter Nine argues the case for livestock development within the national context. It starts by giving an idea of the nature of economic development in the country, emphasizing the main aspects and problems of the present state of the national development. At the end of this chapter the role that livestock can play in enhancing a balanced national development is put forward.

Chapter Ten deals directly with the strategies suitable for developing the livestock sector, and it puts forward the author's own suggestions on how to rationalize the development of the livestock sector and how to overcome its present state of disequilibrium.

However Chapter Ten does not elaborate solutions for every problem mentioned earlier in this study; solutions to many of the problems were indicated - if not directly then indirectly - in previous chapters. Nor does this chapter elaborate the detailed methodology of over-coming every livestock problem, because this is the task of planners and administrators. What this chapter hopes to achieve is to define the objectives and priorities, and to underline the basic strategies, of livestock development in its totality both as an economic and an agricultural sector.

CHAPTER NINE

THE ARGUMENT FOR LIVESTOCK DEVELOPMENT

9.1 Trends in Saudi Arabian Development

In the last 30 years, commendable developments have been accomplished by the government of Saudi Arabia in all fields, particularly those of transportation, communication, water, education, industry and social benefits. The isolated Arabia of 1930 has now become a modern state with a vital international role to play, and the events of the energy crisis in 1973 indicated a promising future for the country.

The economic development of the last three decades is mainly the results of the discovery of oil and it was the oil income that induced the process of modernization and shaped the present economic structure.

Few countries have undergone so sudden and drastic a transformation of their economic prospects as Saudi Arabia. Up until 1950 Saudi Arabia was the prototype of a poor country and the bulk of the people lived by subsistence farming and pastoral activities. In 1947 an Arabist, Gerald de Gaury, wrote "The imports of Arabia were comparatively small, but exports were almost non-existent. The only large source of income - from overseas pilgrims - would be brought to an end by the war. The development of oil fields had only just begun; and they were embarrassed for ready money".[1] Saudi Arabia in the late 1960's was no longer a poor country but was rather the prototype of a rich country where the average income had surpassed 600 U.S. dollars. On the basis of this single simple measure, Saudi Arabia is already approaching a level comparable to that of some countries which are no longer considered under-developed.

It is only natural that this drastic and sudden economic change, coupled with the lack of an early planning procedure, precipitated a state of unbalanced growth manifested in economic and spatial dualism.

1. de Gaury, G., Arabian Journey: and other Desert Travels, (London; George G.Harrap,1950),p.31

9.1.1 Economic Dualism

The structure of the country's economy is very dependent upon the export of only one commodity, oil, which accounts for almost all of its commodity export and for over 90% of its foreign current receipts in 1973. The contribution of oil to the total revenue increased from 86% in 1970 to 87.3% in 1971.[2] The spatial pattern of oil development has been orientated towards the overseas market, mainly Japan and Europe. Thus the economy is a dual economy consisting of two major sectors; one is the very modern, highly capitalised oil sector and the other is the non-oil sector, largely agricultural and traditional in character. The oil sector is highly developed, the most productive sector, and features a high rate of growth. In 1962/63 the oil share of the GDP was slightly more than 40%; in 1970/71 it reached 61.1% and it is forecast to continue increasing.[3] Oil production continues to expand, making the Kingdom since 1970 the largest oil exporter in the world, and existing agreements call for regular annual increases in posted prices throughout 1976. The importance of the oil sector in the Kingdom's economy is overriding and this trend, as forecasted by CPO, will continue into the foreseeable future.

The non-oil sector - mainly agriculture (including livestock) - leads the oil sector only in terms of employment and space. The agricultural share of the labour force accounts for 40%,[4] well above all other sectors. Agricultural land, mainly desert ranges, cover 140.5 million hectares, almost the whole country. The dominance of the agricultural sector in terms of space as well as occupation has been negated by its insignificant economic contribution and its prolonged state of under-development. The agricultural sector's share of the GDP declined

2. CPO, Report of the Central Planning Organization 1394,A.H., (Riyadh; CPO,1974),p.32
3. Ibid.
4. Ibid.,p.109

from 10.1% in 1962/63 to 4.6% in 1970/71 and the livestock share in the GDP was extremely low, around 1.5%.[5]

9.1.2 Uneven Regional Development

It is only natural that the persistent economic dualism manifested by the development of the oil sector should result in a spatial dualism in the form of an unbalanced regional development, affecting particularly the rural areas, and this is exactly what has occurred in the last 30 years.

Table 9-1 shows that the process of urbanization is concentrated in only a few towns. Populations of thirty thousand or more are found in only nine cities out of around 11,193 settlements in the country. There are only nine towns that have more than ten factories.

Table 9-1

The concentration of urban population and industrial development

City	Population (000)	No. of Factories
Riyadh	370	211
Jeddah	285	221
Dammam	65	72
al-Khober	25	27
Madina	113	22
Hofuf	106	15
Mecca	244	56
Buraydah	58	10
Taif	109	20
Unayzah	31	9
Total	1,406	663
Total number of factories in all the country		700
Per cent		94.7%

Source: Population compiled from SRI, A Programme for the improved marketing of agricultural commodities in Saudi Arabia, (Menlo Park; Calif., SRI,1971)

Number of factories compiled from Industrial Studies and Development Centre, Factories operating and factories under construction, (Riyadh; Ministry of Industry,1973)

5. Derived by the author in the general introduction of this study

The uneven regional development in the country is illustrated by Figure 9-1, which is constructed on the basis of three indices: the distribution of industries, the concentration of urban population and the main lines of transportation. If we consider the spatial pattern of all these elements within the country we can see that most of the national development has been concentrated in three main zones. These three zones are the most developed in the country and are located along a horizontal central belt, separated from each other by sparsely populated areas and connected with each other by a competent transportation network. The polarization of this developed belt is identified not merely with the three zones, but more precisely with a few cities that are substantially urbanised and are rapidly becoming more so, e.g., Dammam, Riyadh, Mecca, Jeddah. The extreme eastern zone includes the oil producing, processing and exporting coastal towns and their urban peripheries. The central zone includes Riyadh and its suburbs which serve as the government headquarters, as well as the site of an expanding industrial and commercial centre. The belt ends with the western zone which is centred around Mecca and Jeddah. Jeddah, the largest port on the west coast, accommodates the foreign embassies and a large commercial and industrial base, while the holy city of Mecca receives more than a million pilgrims annually. All these three urban zones in the developed belt are on the whole motivated and activated by the income from oil, hence this belt deserves to be identified as the oil belt. Indeed the development in the central belt was initiated by the discovery of oil and has been intensified by the oil-induced economic growth. However, in the case of the western zone, the Jeddah and Mecca areas, pilgrimage activities help to create additional commercial wealth.

Most of the technological developments introduced to the country in the last thirty years in terms of modern industries and infra-structure

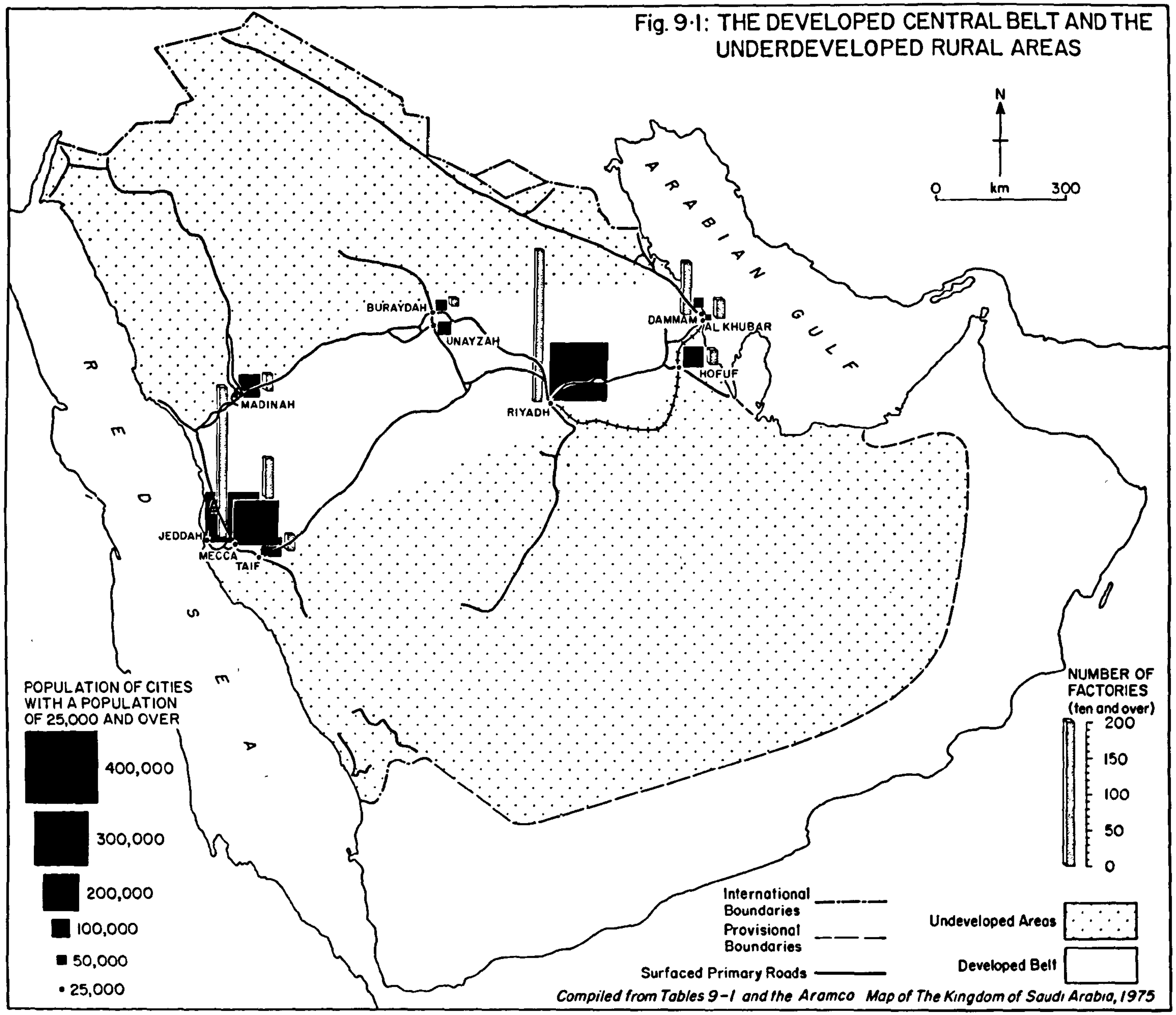


Fig. 9·1: THE DEVELOPED CENTRAL BELT AND THE UNDERDEVELOPED RURAL AREAS

Compiled from Tables 9-1 and the Aramco Map of The Kingdom of Saudi Arabia, 1975 are deployed in this belt. The rest of the country both north and south of the oil belt has undergone less development, and this is only natural because regional dualism became, in Higgins' words, "a reflection of technological dualism".[6]

Another example of the polarization of urban development in the country is illustrated by the Village-Town ratio. Although Johnson used it to measure the degree of central-place abundance or deficiency,[7] it serves our purpose as a yardstick to show the extent of the uneven regional development in the country. Table 9-2 shows that Saudi Arabia has a ratio of 157 which is very high, compared with some developed European countries that have one town to every 72 villages (Austria).

The high ratio for Saudi Arabia indicates a large rural area and a few urban centres. The 71 centres with a population of more than 2,500 in the country in 1963 are located either close to the oil areas or are the sites of the government's regional administrative centres and rely mainly on activities generated - directly or indirectly - by national government spending.

Table 9-2

Number of villages for each central place with over 2,500 inhabitants for selected countries (1963)

Country	Villages	Central Places	Ratio
France	5,075	489	10
U.K.	4,337	277	16
Norway	4,819	83	58
Austria	4,881	87	72
Saudi Arabia	11,193	71	157
Iraq	9,186	45	204
Syria	7,540	25	301
Yemen	9,532	15	635

Source: Collier's Encyclopedia, (New York; Growell-Collier & MacMillan,1966), UN Statistical Office, Statistical Yearbook, (New York; UN,1968)

6. Higgins, B., Economic Development, Principles, Problems and Policies, (London; Constable, 1959),p.20
7. Johnson, E.A.J., The Organization of Space in developing countries, (Cambridge, Mass.; Harvard Univ.Press,1970),p.177

The disadvantage of this clear case of polarization lies not only in the great deficiency in the number of centres that facilitate regional contacts. There is also the far-reaching problem that the development of the existing centres fosters the continued growth of the developed belt rather than enhancing development within each region. This induces a "brain-drain" from the rural areas by attracting the able individuals to these centres and to the large urban towns in the developed belt, thus widening the spatial imbalance.

The concentration of development in a central belt did not stem from deliberate planning nor is it a totally misguided emulation of other countries; and it certainly cannot be attributed to the common phenomena of ex-colonised nations, the development of whose core areas was financed largely by the exploitation of agricultural commodities. Some of these reasons or all of them may apply to some LDC's that have difficulty in accumulating capital or "that were colonized and exploited by western powers".[8] However they are not valid in the case of Saudi Arabia, because the country at large is not the ex-colony of any Western power and capital in reasonable quantities has always been available - at least since 1950. The evolution of the polarized zone on the east coast was a spontaneous process sparked off by the discovery of oil and sustained by the subsequent continued growth in oil production. The growth of government services and organizations has accentuated the polarization of the central and western zones by the need to build its infrastructure, administration and the suitable urban centres to facilitate national development.

9.2 Main Causes for the uneven Regional Development

If these previous reasons can explain the evolution of the concentrated development in the central belt, they clearly do not explain

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8. As in the case of Nigeria; see Logan, M.L., "The Spatial System and Planning Strategies in Developing Countries" in Blunden, J., Brook, G., Edge, G., and Hay, A., (eds.), Regional Analysis and Development, (London; The Open University Press, 1973)

the under-development of the rural sector. The state of under-development of the non-oil sector - largely the agricultural sector - can be attributed largely to the following reasons:

9.2.1 Transplanted Development

The fact that the oil sector became highly developed does not mean that the same process can be repeated in other sectors. The oil development was initiated and sustained by foreign agencies, oil companies, and relied on imported Western expertise, organization and technology. It did not have to put up with the problems associated with under-developed rural societies that agricultural development had to deal with. It was a clear case of a totally transplanted development by and from a developed society to an under-developed one. The country gained no experience in planning or implementing the oil development so as to apply it to other sectors of the economy, hence the country was not equipped to emulate the oil development in the non-oil sector.

9.2.2 Centripetal effect of the developed belt

The intensification of concentrated development in the central belt has resulted in the exploitation rather than the development of other areas. This is a universal phenomenon and, as Myrdal and Hirshman have both emphasised: "The polarization and backwash effects of concentrated development...will benefit the city and will therefore increase regional imbalance, at least in the short term",[9] this is supported by the fact that the city is likely to be most exploitive of the resources in its hinterland while it is growing, and as it grows it attracts resources from wider and wider areas. This is exactly what has accompanied the central belt's development since 1930. It has attracted human resources, and the infra-structure that has developed in rural areas all through this period has made it possible.

9. Myrdal, G., Economic theory and under-developed regions, (London; 1957): Hirshman, A.O., The struggle for economic development, (New Haven; 1968),p.187: Logan,M.L., op.cit.,p.288

9.2.3 The inefficiency in the use of capital as a factor for development

The country's financial resources are more than adequate. Indeed it is uncommon for an under-developed country to have the luxury of not facing a universal scarcity of capital. In 1971 the increase in exports jumped 33.6% while the increase in imports was only 8%, with an impressive net surplus of SR 4,649.5 million.[10] To the reassurance of the many LDCs, the experience of most of the oil exporting states, including Saudi Arabia, indicates that not being a "have-not" is no magic formula for development. Moreover, the most frustrating lesson is that the efficient use of surplus capital is as complicated a matter as having insufficient capital. The reason is that capital in any quantity is only one factor and its role in development depends on the availability of other factors, mainly human resources and technology, which must be developed encugh to control the use of the capital available. The MAW's limited ability to absorb more funds is an example (Chapter 2). In studying development in Libya, Higgins repudiated both the implication of the Lewis model[11] that if capital were as unlimited as labour, growth could go merrily on without let or hindrance, and the implication of Nurkse's model,[12] that a country with a strong export should have no particular problems. Higgins concluded that Libya (which like Saudi Arabia, relies on oil and lacks human resources) has "both a strong export and a virtually unlimited supply of capital, but cannot really develop",[13] mainly because "it is unlikely that Libya will accumulate enough productive capital outside the oil sector and raise productivity in the non-oil sectors".[14] However, Higgins' forecasts of the unlikelihood of accumulating enough productive capital outside the oil sector and of raising the productivity of the non-oil sectors should not be extended

10. CPO, op.cit.,p.37
11. Lewis, A., "Economic Development with Unlimited Labour", The Manchester School of Economics and Social Studies, (May 1954)
12. Fie, J.,and Ranis,G.,Development of the labour surplus economy, (Homewood; Ill.,1964)
13. Higgins, B., op.cit., p.838
14. Ibid.,p.837

to Saudi Arabia. If the generous regional investment the Saudi Government is providing at present were devoted to potential "growth points" in rural sectors - mainly agricultural resources - a certain degree of productivity would evolve in the non-oil sectors.

9.2.4 Channelling of investment for Regional Development

The Saudi Government is conscious of its dependence on the oil sector, which it is hoped will be propulsive enough to engender rapid economic development. The objectives of the development plan explicitly aim at "diversifying the sources of national income and reducing dependence on oil and increasing the share of other productive sectors in the GDP".[15] The government has channelled huge investments into developing the rural regions. Improvement in roads, education facilities and administration received, after defence, the largest share of the budget in 1973/74. Channelling large investments into infra-structure which is badly needed does not necessarily generate regional development. As a matter of fact this can widen the regional gap by providing the urbanised areas in the central belt with the man-power needed. The fact that the resources of the rural areas have not been utilized and developed efficiently made the infra-structures more tailored to the needs of the central belt than those of the rural areas.

9.2.5 Over-centralization of Government Planning and Decision-making

At present the planning and decision-making relating to national development is centralized in the capital. As Saleh states: "the planning and implementation of development programmes requires a uniform organization of government as well as field areas...but such a uniform system does not exist in the case of the administrative units of the different government ministries in the country".[16] In such a situation one of the most frequently observed problems is over-centralization.

15. CPO, op.cit.,p.37
16. Saleh, N.A., The Emergence of Saudi Arabia Administrative Areas: A Study in Political Geography, (Univ.of Durham,Ph.D.,1975),p.327

The headquarters, i.e. MAW, is invariably a storm centre, with innumerable callers demanding that some one make decisions for them. With little delegation of authority, the regional directors in rural areas, for their part, transmit all cases to headquarters for consideration, not even attempting to make local decisions. As shown in Chapter Three, we find that the MAW branches have so little authority that ministers and high officials are over-burdened with details, with the result that policy formulation and planning is neglected.

The over-centralization of planning strongly affects agricultural organization, development, and location. Centralization could have advantages if high efficiency resulted from the widespread information and the capital and technology available to the headquarters in Riyadh. But centralization also has its definite shortcomings, when misjudgements may be applied to the agriculture of the whole country with extremely widespread effects, vastly greater than an individual farmer's or region's errors. Also people in the field cannot implement programmes that they see as practical and badly needed.

This state of over-centralization results in the impossibility - in some instances - of focusing on local problems or evaluating the local point of view, particularly when regional development must take into consideration the individual farmer's needs and those farmers are on the whole smallholders with limited resources.

Economic diversification necessitates the decentralization of decision-making in order to overcome regional difficulties and provide local areas with their needs for development. Floyd has stressed that "the first key to sound rural development strategy is decentralization or localization of planning...The promoting of smallholder agriculture will depend on a thorough knowledge of the human and physical elements in the man/land equation over restricted areas around the country, <u>not</u>

on technically sound but dehumanized, nationwide blue prints for rural rehabilitation, drawn up in capital-based government offices".[17]

9.3 Towards a Balanced Regional Development

It is obvious from earlier discussion that economic dualism has induced the spatial concentration of development in one belt, leaving the rest of the country largely under-developed (Fig.9-1). In other words, the country is under-developed because the greater part of it, in terms of space, human and natural resources, is still under-developed. Then it is only natural that the approach towards development should aim at the reconstruction of the present spatial emphasis in development so as to narrow the regional growth differentials, or as Johnson more eloquently expressed it: "the problem is not how to eliminate these differences since that is probably impossible, but how to reduce them if that can possibly be done, and how to prevent them from becoming wider".[18] As long as the aim of development is to attain a diversified economic base, and reconstruct a balanced spatial development then the answer can only be found in the mobilization of government allocations towards tapping, regenerating and then efficiently utilizing the rural resources which are basically agricultural in nature.

9.3.1 The Development of Regional Resources

The argument for the development of regional resources is that a viable development in any area has to be based on the area's own resources and potentials. Therefore, development in terms of infra-structures do not always serve this purpose. Schools, roads etc., may create certain employment activities, but if these developments are not utilized for the benefit and the activation of their areas' own resources then - as already stated - they tie these areas to the main centres to the benefit of the latter.

17. Floyd, B., Small-scale Farming in Trinidad and Tobago: Problems and Prospects, Preliminary Report, (Department of Geography, University of Durham;1976),p.14
18. Johnson, op.cit.,p.162

The development of regional resources will widen the occupational opportunities and increase the total regional employment. The development of an agricultural resource has a "spread effect" in generating other services, and agro-industry is one of the benefits a region will gain from efficient agricultural development, thereby providing not only markets for farm products but employment for young people who prefer non-farm occupations. A development in that direction transforms a region from "centrifugal to centripetal", that is it becomes able to attract and utilize its own human resources, rather than exporting its skills to other regions.

We do not have to go far away to find an example: the development of the central belt became possible because its natural resource - oil in the east - was developed, thus generating the present state of development in this region. Without the tapping and the continuous exploitation of oil such a scale of development would never have happened. Another example is the Mecca and Jeddah areas: a substantial part of the commercial activities, as well as certain aspects of the development in the western zone of the developed belt, have been generated by the utilization of the pilgrimage season. It is a resource similar to tourism that contributes greatly to the area. Although the government at present is putting in more than it is getting out of it, still its utilization by the community has contributed greatly to the growth and the development of the Mecca and Jeddah areas.

Certainly other areas of the country with their varied agricultural resources offer opportunities. It is not expected that their resources will be as productive as oil, but if utilized efficiently they will definitely accumulate for their own regions a reasonable productive capital, and will enhance a more viable regional development. If a sizable part of the nation's financial resources were invested in resource-orientated projects in areas that have comparative advantages, then the infra-structure already established will be more useful because it will not only connect the regional centres with the developed belt but, more importantly it will activate regional development and relate the resources of each region with those of the country, for the benefit of all. In other words, a differentiated development that aims at the resource rather than only at the infra-structure will incorporate these regions more into the growth of the economy, so that they will become contributors to the national economy rather than being subsidised recipients.

The investment in resource-orientated projects may not produce the desired results if these projects are randomly chosen, without a wise evaluation of the available "spatial investment choices". This task, in Johnson's words: "calls for technical judgment involving geographic, economic, sociological, and other scientific aspects of prospective growth points".[19] This may explain the questionable success of the major agricultural projects that were initiated in largely under-developed agricultural areas, namely the al-Hasa and Haradh irrigation and drainage projects. These projects are resource-orientated investments and are supposed to generate local development by tapping the agricultural resources of these areas. Their apparent failure cannot be blamed on the lack of resources or the need for such projects, but those responsible for their initiation did not take into consideration how to relate the spatial goals and targets of these projects with the socio-economic environment in these areas. The numerous causes for the failure of these projects to attain their main targets are outside the scope of this discussion (the relevant and main causes are summarized briefly in Chapters Two and Three)[20] but the main points should be emphasised here. The al-Hasa project provided a very sophisticated irrigation and drainage

19. Johnson, E.A.J., op.cit.,p.164
20. The two projects, their problems and history, are analysed in Speetzen, H., Land Settlement projects and agricultural development, (Univ. of Durham, Ph.D., 1974)

system but did not offer an implementable agricultural plan that would help farmers either to adapt to the new system or adapt the new system to their traditional ways. The Haradh project was designed in Speetzen's words, "for the wrong people"[21] i.e. the al-Murra Bedwin, who were not prepared to settle agriculturally but instead are spontaneously migrating to urban centres.

9.3.2 Priorities for economic development

A balanced regional development necessitates concern with all sectors of the economy, be they industry or agriculture. The country in its present stage of development cannot afford to neglect one for the other, because they are inter-dependent with respect to both input and output. The argument for industry or agriculture in economic development has been one of the most frequently elaborated themes by a great many writers.[22] The relevance of this argument cannot be evaluated until it is viewed within the context of a specific country and its overall needs, potentials and limitations. A global generalisation of this argument is as misleading as to conclude that all countries have similar potentials and drawbacks for economic development, which is not true. Each under-developed country is a special case, because each has its own particular limitations and problems. What is considered to be a critical development problem in one country may not be of the same magnitude in others.

In Saudi Arabia the priority argument gained some attention; a Saudi writer stated: "there is no reason for Saudi Arabia with its abundant capital to waste time in turning first to agriculture...the country needs rapid development, and it is prepared to invest to ensure that industrialization is the way for its development". The writer concluded that "the country needs a great push in industry; then the pull will

21. Speetzen, H., op.cit.,p.469
22. The most important writers have been reviewed in the following references: Brookfield, H., Inter-dependent Development, (London; Methuen & Co., 1975),p.70-75: Meier, G.M. (ed.), Leading issues in economic development, (U.S.A; Oxford Univ. Press,1970),pp.393-443:Eicher,C., and Witt, L., (eds.), Agricultural Economic Development, (London; McGraw Hill,1964)

come from industry to agriculture".[23] The contrary view states that as long as the country is enjoying, as at present, an abundant financial resource, there is no reason at all to introduce unnecessary bottlenecks. Indeed, recent planners and writers in development have abandoned the confrontation approach in favour of the importance of both industry and agriculture. Meier has emphasised that "the concern now is rather with the inter-relationships between industry and agriculture and the contribution that each can make to the other".[24] The limitations of over-emphasising industrialization over agriculture have lately been understood with an increasing recognition of the vital role that agriculture can play in the national development. "There are no basic reasons why the agriculture sector of any country cannot contribute substantially to economic growth" writes Schultz. "There is no longer any room for doubt whether agriculture can be a powerful engine of growth..., but it is necessary to invest in agriculture".[25]

The endorsement of industry over agriculture by some Saudis can be traced to two main reasons: (a) the country's limited agricultural resources, water in particular, and (b) the country's ability at present to import all of its food needs. The scarcity of water resources in itself is a strong argument in favour of the urgent need to invest in agriculture, because, as Brookfield stated: "it is only the fact of scarcity that makes it possible to exploit scarcity".[26] The scarcity of water, and hence of agricultural land, makes agricultural development so delicate a matter as to place the priority of agricultural development on the same footing as oil, in the sense that water (especially deep groundwater) is an exhaustable commodity like oil, and if not utilized

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23. Mansour, H.O., The Discovery of oil and its impact on the industrialization of Saudi Arabia: Historical Analysis, (Univ. of Arizona,Ph.D., 1973),p.10
24. Meier, op.cit.,p.391
25. Schultz, T.W., Transforming traditional agriculture, (London; Yale Univ.Press,1964),p.5
26. Brookfield, H., op.cit.,p.207

efficiently can easily be wasted. This is a very good reason for aiming at an efficient organised agriculture; this requires not only investment but technology and planning. As for the other reason that the country is able to import its food needs, this is obviously self-defeating because the country should not rely for ever on imports. Oil will not continue for ever, hence the oil income should be used for the development of agricultural resources, to provide the country with lasting, if not totally adequately local sources of food that could at least narrow the gap. Furthermore, since agriculture employs the majority of the population and constitutes the main land user, then as was concluded by al-Sheikh: "neglecting and undermining this predominant [agriculture] sector is a serious mistake which may lead such [under-developed] economies to indefinite backwardness".[27]

9.4 The case for livestock development

In the previous discussion the author has outlined the present state of economic development in Saudi Arabia stressing two main features, economic dualism and its derivative; spatial dualism. The continuation of these two extremes will no doubt hinder and delay the process of balancing the national development; this must be overcome by diversifying the economic development on the spatial as well as the economic front. The author advocates approaching diversification by investing in the development of regional resources with equal emphasis on industrial and agricultural resources.

In the light of this rationale the author argues that livestock development can provide a vital contribution to the national development by providing those regions which already possess substantial livestock resources with a viable local economy that will preserve the regional resources, accumulate investment, and provide those regions with other

27. al-Sheikh, A.H., Agriculture and Economic Development with Special emphasis on a strategy for Saudi Arabian Economic Development, (Univ. of Edinburgh, Ph.D., 1970), p.224

derived industrial and commercial activities that are based on the efficient utilization of livestock products and by-products.

9.4.1 The neglect of livestock development

The livestock sector has been greatly neglected by planners as well as writers in the field of agricultural and national development. The literature concerned with development, specially agricultural development has failed to stress and identify the role that livestock can play in agricultural and national development. A review of geographical literature proves this point and shows that agricultural geographers have failed both to identify the livestock sector in its own right and to stress the spatial as well as economic contribution of livestock to development.

It is difficult to ignore the trend of an implicit confrontation for the priority of crops over livestock that has been going on within the agricultural sector. The only differences between this confrontation and that of industry versus agriculture is that the first was not publicized nor exposed. On an international scale, six factors may explain why the livestock sector has been neglected.

(1) The contribution of agriculture - including livestock - as a whole to the development of less developed countries (LDC's) has been under-estimated for a long time. It was only recently that planners started to emphasise the importance of agriculture and the inter-relationship between agriculture and industry. Thus livestock as an agricultural sector was under-estimated too.

(2) The international trade of most under-developed nations depends on the export of cash crops (cotton, rubber etc.) that are needed by the industrial world. Thus the emphasis in agricultural development is crop-orientated. Industrial nations interested in the development of agriculture in the LDC's tend to focus on crops which they themselves need,

and this explains the fact that most agricultural exports from the LDC's to the industrial world are crops rather than animal products.

(3) Livestock commodities are not a major part of the export trade of many under-developed nations because most of these commodities are perishable products that cannot be exported to developed nations unless there is a highly developed technology that can cater for the processing of these commodities. Few under-developed countries have the technology. It is mainly for this reason that developed nations like Australia and New Zealand are able to utilize livestock exports to their advantage, while some under-developed countries with great livestock resources cannot do the same. For example, the Sudan is a rich agricultural country, yet almost all of its animal exports (almost 96.6% in 1974), are destined for neighbouring countries (U.A.R., Saudi Arabia, Libya)[28] while almost none is sold to industrialized countries because the Sudan does not have the technology to process animal products to suit the high western standards.

(4) There is a general consensus that animal agriculture, while a major component of the rural sector, is the most traditional sector of the economy. This argument is supported by McDowell who suggested "that there has been more resistance to the use of innovations with animals than with plants, due to the greater emotional involvement with animals".[29] This is a myth, because the tie to animals is no more emotional than the tie to the land. Farmers as well as pastoralists are tied economically, rather than only emotionally, to their activities. As far as the Bedwins in Saudi Arabia are concerned, the author in his eight years' experience with them saw little resistance to improvements to their activities (Chapter 3). Only the lack of capital in certain cases, or the lack of someone to guide and advise them in other cases, makes them reject new ideas. Dairy and sheep farmers around the urban areas are eager for new

28. Arab Organization for Agricultural Development, A study of the technical and economic possibilities for meat production for the Republic of Sudan, (Khartoum; Khartoum Univ.,1974), (Arabic),p.214
29. McDowell, R.E., Improvement of livestock production in warm climates, op.cit.,p.652

machinery and new methods but cannot gamble on things they know nothing about. The allegations against the peasant and the Bedwin are many and complicated, and the uninitiated should scrupulously avoid them; however, recent writers have come to deny these allegations by pointing to particular case studies in different under-developed countries which proved the falsehood of these allegations. Johnson[30] and Schultz[31] have both given numerous examples from different countries to support this new attitude. The fact that recent technology and management innovations have not been successfully introduced to a large part of the pastoral sector nor to the farmers in Saudi Arabia can be largely attributed to the lack of communication; the local point of view and local expertise play no part in the process of agricultural transformation either in its planning or its implementation stages. The lack of local understanding of how to use new ideas and the inability of foreign advisors to understand the local problems has resulted in an absence of meaningful dialogue between the local producers and the government officials who are there to help them.

(5) There is an erroneous consensus that the world food needs can best be met by plants alone. Moore and others have quoted many who advocate that livestock are not efficient in resource utilization, and who also relate these erroneous conclusions to the assumption that livestock compete with humans for the proteins from cereals and oil seeds. But these authors on the basis of recent research have concluded that:

> Although the emphasis on cereals and oil seed proteins has some basis...we contend that generally accepted concepts regarding the efficiency of livestock production in terms of the use of available resources are erroneous. We contend that because livestock use forages and other feeds edible to humans, the use of limited amounts of cereals as livestock feeds can enhance the efficiency of producing proteins for humans in terms of total food resources utilization. Further-

30. Johnson, E.A.J., op.cit.,p.375
31. Schultz, T.W., op.cit.,pp.41-44

> more, there are promising research leads which, if exploited, can markedly increase the efficiency with which animal proteins can be produced.[32]

The U.S.Agency for International Development (AID) has emphasised that the "productivity of animal agriculture should be as responsive to scientific and technical improvement as crop farming".[33]

(6) The neglect of livestock in the development plans of the less developed countries has resulted in individual countries emphasising crops rather than livestock, to such an extent that some voices have become increasingly critical of this trend. The United States Agency for International Development had warned that "much less progress has been made in programmes of assistance to livestock in developing countries".[34] Moore and associates have stated: "neglecting animal agriculture to a passive contribution to world food deficiencies indicates a failure to appreciate the full impact of feed inputs into livestock production".[35] The neglect of animal agriculture has become so obvious in many LDC's that McDowell has observed: "As the pressure to meet the requirements for food grows, the enthusiasm of governments to allow aid towards animal production seems to decline".[36] McDowell reported that in certain cases "governments tend to channel their major resources, including those obtained from outside, into plant agriculture".[37]

The situation in Saudi Arabia is no exception to this common trend, and agricultural development in the past few years has been aimed largely at water, and to a lesser extent at crops and related activities, while very little investment has been devoted to the livestock sector. This

32. Moore, L.A. et al.,"Ruminant Livestock, their role in the world protein deficit", Agriculture Science Review, Vol. 5,No.2,(1967),p.1
33. AID, "The role of animal agriculture", Development Digest, Vol.10, No.2, (1972),p.45
34. Ibid.
35. Moore, L.A., et al.,op.cit.
36. McDowell, R.E., Effective Planning for Expanding Livestock Production in Developing Countries, (Dept. of Animal Science, New York State College of Agriculture, New York;1969),p.1
37. McDowell, R.E., Improvement of Livestock Production in Warm Climates, (San Francisco; W.H.Freeman & Co.,1972),p.654

situation is illustrated in detail in Chapter 3, which shows the small budget allocations for livestock development.

9.5 The importance of the development of the livestock sector in Saudi Arabia

The vital role that the livestock sector can play in the national development rests on the following facts: (a) The sector is an important local resource. More than 90% of the country consists of pastoral ranges, hence the development of these areas necessitates the development of the livestock sector. (b) The sector as a resource can contribute greatly in narrowing the differences in regional development by providing the rural regions with an active economy. (c) This sector has been neglected for too long (d) Further delay in the development of this sector will cause more deterioration to livestock resources, particularly to ranges.

To be more specific, the development of livestock will attain for the nation among others the following benefits:

(1) The development of livestock will not create something new but will merely rejuvenate and revive this sector, so that it can play its natural role in the economy. Livestock development can be attained simply by improving on the old methods and introducing new ones.

(2) The development of livestock will help in holding down the present trend of Bedwin migration to urban areas, and preserve for them a viable economy which is a valid contribution to the nation. al-Sheikh, in his analysis of the Bedwin settlement projects, doubted their validity and he stressed that the Bedwins "might be best settled as livestock producers, namely, producers of sheep, goats and camels, the animals which they love and with which they are familiar".[38] With a modern system of livestock rearing, rural communities will be able to diversify their farming activities so as to attain from their land the best possible economic results.

38. al-Sheikh, A.A., op.cit.,p.226

(3) Over 90% of the country area is desert ranges that provide either seasonal or annual grazing capacity. This vast resource is submarginal and the bulk of it is entirely unsuitable for producing crops, but can only be efficiently utilized by pastoral animals; there is no other way - known at present - to utilize this resource. Economic benefits, and the conservation and preservation of these vast resources can only be attained by the efficient development of the livestock sector.
(4) The country's sizable animal wealth (over 8.5 million animal units), which is worth hundreds of millions of Saudi Riyals, needs care and efficient management. The development of the livestock sector will allow the nation not only to preserve this wealth but to increase it, organize it, and manage it to produce other benefits in terms of new agro-industries based on livestock products, services and related commercial activities.
(5) Livestock development, particularly the pastoral system, can be initiated rapidly and at less cost than other agricultural sectors, because it does not require (at least in its initial stages) massive irrigation projects and land reclamation schemes where considerable time has to elapse before these basic infra-structures become ready for use. Rapid progress in livestock development is possible and can be sustained if provided with suitable government policies and planned investment.
(6) It is not likely that the country will ever be self-sufficient in livestock products, still less be able to export them, because on the one hand the resources are limited and on the other hand the demand for animal products, enhanced by the increasing purchasing power and the annual increase in population, will increase. However, it is erroneous to view the development of a sector only in terms of its contribution to exports or to total self-sufficiency. An efficient, balanced livestock sector can participate substantially in supplying a sizable part of the national livestock needs, and that is a commendable goal. More-

over, total self-sufficiency in urban fresh milk production is quite possible and a sizable supply of meat can be accomplished in the long run, if livestock development is approached wisely.

(7) The country is endowed with a surplus of capital that needs to be invested. The nation is at present facing the embarrassing dilemma of finding a useful national outlet for investing its abundant financial resources. Furthermore, oil is an exhaustable resource, so it is only natural that the country should derive the maximum benefit from it, while it lasts. A livestock sector can help in this respect. The sector in its present low state of under-development can absorb a sizable amount of investment that could be channelled towards both range conservation, revival and development, and the livestock industry i.e. dairy, meat and feed processing, and the infra-structure needed i.e. marketing, transportation and the technology involved. Livestock development will transform these surplus financial resources and preserve and develop the national animal wealth.

CHAPTER TEN

STRATEGIES FOR LIVESTOCK DEVELOPMENT

10.1 Defining the Objectives

Ambiguous objectives make the task of development difficult to achieve. Ambiguity is mainly caused by a lack of reliable information which provides a distorted picture of the requirements needed for development. The goals of the country's development plan illustrate this problem. In the plan the objective for livestock development is "to optimize the use of resources to achieve a gradual but sustained growth in output".[1] The MAW's agricultural development plan (1975-1980) defines livestock development in terms of "growth" by focusing on "keeping pace with the rapidly expanding demand for animal products and significantly lowering the dependence on imports".[2]

Concepts of "optimum" and "growth" require a great deal of qualification and explicit definition. "Optimization" is a limitless and timeless process, and fails to indicate the starting and the ending points of this process. There is no evidence of any recent breakthrough in attaining a state of "optimum" use of resources i.e. water, ranges or any other resource, nor can this be expected, because progress in technology reveals previously unknown facts about the relationship between resources and their uses. Therefore, the concept of "optimum use of resources" is an abstract objective that cannot be defined in attainable terms. Similarly "growth", as Mesorovic and Pestal define it: "is a process, not an objective; it cannot be pointed at physically...rather it must be conceptually defined".[3]

Aiming for growth *per se*, for more animals and more animal products, appears to be the cornerstone of the present MAW livestock development

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1. CPO, op.cit.,p.109
2. MAW, Development Plan 1395-1400 Part I, The Agricultural Sector, (Draft, unpublished), p.51
3. Mesorovic, M., and Pestal, E., Mankind at the turning point, (The second Report of the Club of Rome; 1975),p.2

plan, and this may in fact lead to the opposite situation: the over exploitation of resources leading to their gradual destruction.

Livestock development does not imply growth in every one of its elements, because the growth in any one element may depend on the non-growth of one or more other elements e.g. the development of ranges at the present time depends amongst other things on the non-growth or even decline in animal numbers. Once again Mesorovic and Pestal are correct when they write: "to grow or not to grow is neither a well-defined nor a relevant question until the location, sense, and subject of growing and the growth process itself are defined",[4] and so these two authors advocate "growth with differentiation" rather than undifferentiated growth which is synonymous with cancerous growth. Objectives for development should be clear, specific and should not rely on illusive targets that are impossible to materialize.

10.1.1 Prospectives in Priorities

Objectives for the development of livestock are supposed to indicate what development is for, and it has to be directly related to the requirements of the present state and condition of the livestock sector. Because of the lack of a comprehensive understanding of the problems for livestock, emphasis has been placed on the least important targets for development. For example the MAW in formulating its livestock plan for the period 1975-1980 stresses secondary targets and leaves out the important ones. The MAW plan calls for expansion in seven sectors with goats and beef first on the list. Goats were considered a priority and it was decided among other things to: (a) increase the production of meat and milk from goats, (b) determine the best breed and strains for milk and meat production, (c) test alternative management practices to determine ways to improve management, and (d) study the feasibility of import-

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4. Ibid.,p.3

ing different breeds of goats for production or breeding.[5] As already emphasized (Chapter 4 and 6) goats are not a priority, and should not be, because they are over-lapping animals, and compete with sheep, cattle and camels on the farm and on the range. Goats are ideal only for households and mountainous areas.

The plan also emphasises beef animals, as the second target after goats, calling for an increase in beef production through research and later through the extension of research results. Foreign breeds will be imported, tested and improved by upgrading or cross-breeding with local strains. The best feeds for beef production will be determined as well as the best methods of handling, packing and marketing beef.[6] As already emphasised (Chapters 1, 6 and 8), arable land is too limited to feed all kinds of animals. Pure-beef breeds are unknown in Arabia and are not expected to become an Arabian speciality. Beef animals are too demanding and need great fodder resources and so in Saudi Arabia whatever beef is going to be produced in the country will have to be from dairy breeds.

Animal types are not the only livestock development problem. What the author has tried to emphasize all through this study is that the main problems facing the livestock sector are structural in nature and the whole framework of the sector needs reconstruction and reorganization.

The starting point for formulating practical objectives for the development of the livestock sector is to give a clear picture of what the livestock sector at present is suffering from; then the remedies can be visualized and accordingly the objectives can be outlined.

10.1.2 The present condition of livestock

It has been shown in the three previous parts of this study that each of the main elements surveyed: the environmental constraints, social

5. MAW Development Plan, op.cit.,p.52
6. Ibid.

situations, animal types, distribution and livestock systems, suffers from formidable handicaps and inefficiencies. For the sake of explication let us assume that a healthy livestock sector can be viewed as a structure in a balanced state. To take this line of analogy further a healthy livestock sector is such that the positive forces in each of its elements are strong enough to prevent negative forces from reversing the trend and to prevent a disequilibrium in the livestock sector.

Unfortunately the state of the present livestock sector is far from this ideal situation. Among its failings are a lack of awareness of Saudi Arabia's environmental limitations, inefficiency in the use of man-power and water resources, an undifferentiated growth in animal population, over-exploitation of range resources and livestock production systems that are rudimentary and traditional. Moreover, it lacks regional emphasis on animal potentials and there is a lack of correlation between animal use and the resources available. These negative forces are so overwhelming as to cancel out the positive aspects, causing ruptures and disintegration which in turn lead to a state of disequilibrium.

The aim of any plan for the development of livestock should be to remedy these problems. The most urgent need is to <u>overhaul</u> the structure of the livestock sector as a whole rather than just to improve certain parts. This can be done through the improvement of livestock systems because such an improvement will have a "spread effect" on its components: animals, ranges, industries, management etc. To illustrate this point the development of, for example, goats or sheep <u>per se</u> has very little value in itself until the system they belong to is developed. In other words the development of any of these animals outside the context of a certain unified system might disturb the balance of the whole sector. Sheep play different roles in pastoral and/or livestock farming systems; the first can only maintain sheep while the second is best at fattening sheep, thus the type of sheep needed for ranges is different from that needed for the farm. Goats are ideal for households and their numbers should not be so large as to compete with camels and sheep on the ranges or with cattle on farms.

10.1.3 Objectives

Livestock development must take into consideration environmental constraints and the limited livestock resources: it must strengthen regional specialization in animal types according to the resources available in each region, and prevent the over-lapping of livestock production systems and animals which induce the wastage of resources. The traditional land use which resulted in the evolution of two independent livestock production systems, pastoralism and livestock farming, must be preserved by improving each system according to its own type of resources, limitations, problems and potentials. In view of the above, livestock development objectives should aim at attaining the following goals:

(1) In pastoral development, priority should be given to the conservation, protection and management of range resources. A range code should be formulated, stressing conservation and its enforcement rather than the over-use of ranges. Pastoral activities and the man-power involved must be organized so as to lend themselves to national supervision, regulation and guidance through the establishment of a pastoral organization.

(2) Livestock farming should be modernised and transformed from being semi-specialized or traditional and labour intensive into a modern, efficient, capital-intensive system. The aim should be towards the maximization of the efficient use of available limited cultivable land. Modern technology and high producing animals should be introduced, and specialization in the dairy industry and fodder production should be encouraged.

(3) The national bodies dealing with the livestock sectors should be improved and strengthened. New private and public organizations should be established to foster, co-ordinate, and modernize livestock activities and to plan for their development.

In order to attain the above objectives for livestock development the following points must be taken into consideration:

(a) The livestock sector is not a one-dimensional phenomenon, but is in an essence an eco-system of many elements, i.e. animals, ranges, environmental and human factors etc. The development of the whole sector depends on how successfully the development of each element in each region may be harmonized with others within the eco-system.

(b) The development requires a system approach so that a "holistic view" can be taken of the envisaged livestock sector: then planners can look at the sector rather than focusing development on isolated phenomena. In other words the development should be differentiated so as to approach analytically pastoralism and livestock farming and their elements. Development should occur in different places at varying rates along different paths within each section of the livestock sector.

10.2 Strategies Rationalizing Livestock Development

10.2.1 Environmental Limitations

Livestock development must take into consideration environmental limitations. It is apparent that nature is rigid and resources are limited and fragile. Rainfall is sporadic and slight, and the evaporation rate is high. Thus there is little or no increment to the groundwater reserve. The fact of the matter is that, apart from the erratic rainfall, most of the country's water at the present time is derived from the supply provided by the pluvial phase of the Pleistocene Period. The groundwater reserve is not only static but also reversable and this process could be easily aggravated by over-pumping.

The water situation has two main limitations. Water scarcity, which is an ecological phenomenon, man can do little to alter. But the misuse of water is a man-made problem. Water is frequently misused as it is pumped and mined at an alarmingly high rate that surpasses the maximum recharge. The water losses caused by either traditional or impractical irrigation systems are so great that much water is lost through evaporation, seepage, transportation and surface run-off. Inappropriate drilling and a lack of suitable controls for water usage are also major causes of water wastage.

If the mismanagement of such a vital resource continues, the consequences could be hazardous. It is an ecological fact that a resource, no matter how resilient, can be pushed to a "point of no return" or, more exactly, to a threshold beyond which limiting factors become so severely operative that recovery, in periods meaningful in the human time-scale, become impossible.[7]

The limited water resources coupled with other harsh environmental constraints will not allow the country to produce a wide range of livestock products, therefore <u>priorities must be established</u>. The country's resources can allow livestock development on two types of land. One is the very limited amount of cultivable land, around 500 thousand hectares, distributed in different parts of the country around irrigated oases, but livestock and crops have to share these small enclosures. For livestock to contribute effectively, efficient use has to be made of these limited areas. The other space is the vast mass of desert ranges which are already over-grazed and misused. These two spatial options are fixed factors that cannot basically be altered, but they could be improved upon to the advantage of livestock. No improvement in these two options can be attained by the over-exploitation of these limited resources - as is

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7. Dasmann, R.E., Milton, J.P., and Freeman, P.H., <u>Ecological Principles for Economic Development</u>, (London; John Wiley & Sons,1973),p.48

happening already with the over-grazing of ranges and the over-exploitation of water resources. Improvement depends on living with these limitations and efficiently utilizing them to their utmost, but no further.

10.2.2 Pastoral Development

There are three main elements of this system: the ranges, al-Badiah and animal types, and each suffers from major drawbacks. To develop this system these drawbacks must be overcome within the context of the overall pastoral system. It should be stressed that the underlying principle for the development of this system is the emphasis on conservation and the use without misuse of range resources.

Ranges: The country's range resources are largely desert ranges, which are seasonal and have sparse and scattered vegetation and cannot stand undifferentiated use. Ranges have been over-exploited by over-grazing, over-stocking and man's misuse. Range conditions have not been observed, improved or maintained throughout the recent history of the country hence their grazing capacity is diminishing through gradual stages of destruction. Letting this irredeemable damage continue will deprive the nation of a valuable resource. Correcting this situation necessitates drastic approaches.

Conservaton will have to become the priority and the guiding principle. In other words, we should sacrifice the short term rewards of producing more animals and animal products in favour of the long term, lasting reward of a healthier and more productive range resource that could become a viable national asset. Conservation can only be attained by restoring as much as possible of the range capacity, by preventing misuse and over-grazing, by the following approaches:

(1) Cutting animal numbers on ranges: This proposal is a drastic measure, and is found to be unpopular, particularly if the cut is substantial: which is the exact opposite of the popular attitude which conceives of

livestock development in terms of more animals. Moreover, a drastic cut in animal numbers will mean more short-term reliance on imports of animals and animal products, which the national and MAW development plan aims at reversing. However, there is no other way, animal numbers must be <u>cut to size</u>, the size the present ranges can carry.

On the basis of Tables 7-5 and 7-8 a reduction of around 50-70% of the total animal population on the ranges is a <u>necessity</u>. Certainly the cuts will have to vary from one region to another, and the process has to be gradual, but on the whole the cuts will have to be very large. Areas in the north, centre and east of the country will need more de-stocking because they are the ones that are suffering most. The proposal to reduce animal numbers will not be instantly accepted by the public, particularly al-Badiah, mainly because the extent of range deterioration has not been comprehended by many. Moreover, livestock development has always been viewed by the majority in terms of <u>growth</u> in the numbers of animals or animal products. However, these attitudes must be changed and the need for conservation must be argued for. At present the country can afford to make large reductions in the animal population on the range, because its balance of payments is strong enough to allow the country to increase its imports, to make up for the animal reduction. A partial but heavy reliance on imported animals and animal products for - say - the coming twenty years to meet the reduction in animal population on the range, can only be productive if supported by an active, planned, and well organized programme for the conservation of range resources. The temporary heavy reliance on imports should be viewed as an investment for the future, because the development of ranges will in the end preserve for the nation a vital resource.

The cut in animal numbers can be attained directly or indirectly by the following measures: (a) <u>Subsidies</u>; financial incentives can be used to regulate the number of animals on the range. Subsidies should be paid for animals that are withdrawn from the range, the young, the very old and the unproductive. For example, young lambs five to six months of age should be withdrawn from the range as soon as possible, to be fattened in the irrigated areas because fodder on the ranges is too poor to fatten them. By taking young animals to the irrigated areas two things can be accomplished. First, these animals will be finished in a shorter time and will gain more weight by feeding on higher quality feed, and second the range will be relieved and competition for range vegetation will be less. For varying reasons the very old and the unproductive should be withdrawn from the range as soon as possible, because they are only competing with more productive animals for valuable fodder while they are too poor to gain much weight. (b) Regulating the number of animals on the range can also be attained by allocating a certain number of animals for each range according to the ranges' present carrying capacities, so as to avoid over-stocking. This measure is a difficult one to apply, but if pastoral centres (to be elaborated later) were to succeed then such a target can be attained in stages and through a long term plan.

(2) The restoration of the al-Hema system; the al-Hema system is perhaps the oldest known conservation system the world has ever known and is based on the protection of ranges from being over-grazed or misused. But since 1930 and even as late as the mid 1960s many hemas have been opened to all and many have been damaged. The al-Hemas should be restored and their management should be left to local committees, under the supervision of the MAW. An al-hema Code must be established to regulate the use of all hemas.

(3) The restoration of the conservatory measures of tribal territories. In the past the country was divided into tribal territories and every

tribe had the right to prevent any other tribe from ranging in their areas, hence ranges were usually protected from over-grazing. The pastoral organization that used to prevent the freedom to graze everywhere should be restored. The idea of each tribe having its own ranges, if encouraged, might induce tribes to improve and consider government advice to protect their own ranges. What should be aimed at is the territorialization of ranges rather than making them available to all; hence migration can be spatially restricted.

(4) The control and regulation of water points. Water points should be drilled in areas where they can improve range use. They should not be randomly drilled in clusters inside rich ranges. They should be on the fringe of ranges. Water points should be closed when a range is overstocked so that pastoralists have to move to other areas; in this way water points can serve as a vital instrument regulating the spatial and seasonal use of ranges.

(5) Rotation of grazing. At present all ranges are used all year round and at all stages of plant growth. The fact that vegetation is seasonal makes heavy grazing very destructive, particularly in late spring and summer. If grazing is very heavy in the early period of plant growth or seeding time, many plants are over-grazed before they can grow or cast their seeds. The problem can be eased by not leaving animals in one range for a long period; animals should be moved about. Some areas should not be grazed in the summer - mainly sandy areas. Ranges should not be grazed except after a few weeks of rain. Therefore, a national rotation programme has to be introduced with an organization to maintain and regulate it, but it has to be preceeded by a comprehensive national range survey to discover the location, nature, condition and types of vegetation in every major range area.

(6) Reseeding. Most of the vegetation in many ranges has vanished as a

result of root grubbing and over-grazing. Some vegetation species have disappeared. Therefore, there is an urgent need for the restoration of vegetation, mainly by reseeding areas that can be protected (Hemas, territories, other enclosures). The programme should aim at reseeding all these sites with the species best adapted to existing conditions.

(7) Ending man's misuse of ranges. The damage inflicted on ranges by over-grazing has been aggravated by man's misuse, in the grubbing of roots and shrubs. This practise has recently escalated through the commercialization of desert wood for fire and heat. All the major cities and towns have wood markets piled high with branches, roots and large shrubs from the desert. This activity has to be stopped in the places it hurts the most and that is in the market. Prohibiting the sale of wood and closing the markets would end this mass destruction of ranges; at the same time it would induce users to look to petroleum products as an alternative which is available in the country and is relatively cheap. Both urban and rural communities can have easy access to petroleum products. However, the Bedwins are the most attached to fire wood and changing their way of life may not prove easy; but with time they may accept advice. In any case, their consumption of desert wood is not as large as that of the urban and rural communities, hence stopping the commercial aspect will save most of the wood from being destroyed.

al-Badiah

The acceleration rate of Bedwin migration, mainly to urban areas, has no doubt had damaging affects on pastoralism. However, this trend is not among the causes of the problems facing pastoralism; it is rather a symptom. The state of disequilibrium in pastoralism has been going on for a very long time, causing pastoralism to become less viable, hence unable to support its own population. Thus, it is only natural that the pastoral population will have to decline because the larger the population in the range the smaller the per capita income. The answer for many is therefore migration. To a certain extent Bedwin migration is good for pastoralism, in the sense that fewer people and fewer animals can - if properly guided - result in more efficient pastoralism. In other words, the migrating Bedwin is a form of a redundancy that pastoralism can do without. These redundant people, if orientated with the needs of other sectors of the economy, can provide a badly needed manpower source. The development of pastoralism, at least in the short-term, should not aim at reversing the migration trend, but rather at organizing it so that it occurs properly, without interrupting pastoral activities. Therefore a policy is urgently needed that can regulate the dynamic changes that are affecting Bedwin organizations by stressing the following main points:

(a) The leavers should be prepared for a new productive career in other sectors of the economy through an Orientation Programme and Subsidy.

(b) The stayers should be supplied with extension service subsidies and organized help in developing viable pastoral animal units.

(c) A mobile training and vocational school should be organized that mainly stresses elementary education and animal management practices so as to relate the younger generation more efficiently to their pastoral heritage and economic system.

Animal Types

Since ranges are poor, feed supplies are limited, and large distances have to be covered by animals - while temperatures are persistently high and animal management is rudimentary - then it is to be expected that only very specialized animal types will survive under desert conditions. Therefore, the approach towards the improvement of range animals calls for emphasis on the following main points:

(1) Stressing specialized animal land use. The adaptability of camels,

sheep, and goats to desert conditions varies from one animal to another. Camels are the least spatially restricted, because they can range further and last longer without water, they can be herded with a minimum of control and are not very selective in their grazing behaviour, especially under poor conditions. Sheep are restricted spatially by the availability of water points and markets, and they are selective in their grazing behaviour. Goats are like sheep in their limited grazing radius and like camels in being non-selective in their grazing behaviour. This varied behaviour and range use is useful because, by restricting certain areas to particular types of animals, over-lapping can be eliminated. A policy should be adopted which emphasises specialized animal land use, through some type of zoning similar to that shown in Figure 6-2, where camels are restricted to outer ranges, sheep to inner ranges that are closer to markets and water points, and goats to where they are best suited, in households.

(2) Animal feeding. Any attempt to improve the performance of pastoral animals must take into consideration just what desert ranges can offer. Improvements in animal feeding must be made within the context of the more critical and badly needed improvements; genetic and physiological adaptation to the desert environment. It is well known that feeding pastoral animals with imported concentrates and green fodder will increase their performance greatly, but this is an artificial improvement imposed on the pastoral system which it cannot maintain. Improvement in feeding should be based on the capabilities of the range through all or some of the following:

(a) not allowing animal numbers to exceed range capacity, hence animals can have access to more vegetation; (b) in droughts and seasonal feed shortages, or in some oases before and after lambing, feed supplements should be made available; (c) young lambs should be withdrawn as soon as possible to fatten in the irrigated areas, and finally, (d) ranges should be improved and conserved.

(3) Breeding. At present there is no national policy concerning breeding systems, and breeding is indiscriminate. Through the process of natural selection that took place over many centuries, desert types gained certain characteristics and potentialities related to the environment of their natural habitat, which gave them essential basic advantages over other breeds. Therefore, the improvement of pastoral animals should be done from within rather than from the outside. Cross breeding with other animals from outside the country should be approached cautiously and should be limited to the research stations. All the available evidence indicates that careful selection within the pastoral animal population is the safest and most constructive long-term policy for livestock breeding on the ranges.

Pastoral Centres

Plans for the development of pastoralism must be implemented through an organization that has direct contact with pastoralists and their ranges. Pastoralists are in continuous movement both in time and space. The dimension and scale of their mobility depends on the location of vegetation, water points, and the season. Therefore, planning for the development of pastoralism should take into consideration pastoral mobility by decentralising the organization responsible for pastoral development, in order to keep in touch with pastoralists. Pastoral Centres can be very useful if their locations, aims, and facilities are established for the sole purpose of improving pastoral activities. Before dealing with the location of these centres, it is most important to underline their basic aims.

Aims. These centres should constitute the focal point, where pastoralists, policy makers and market forces meet together for the advantage of all. Most important of all pastoralists should be provided with: (a) organized markets to dispose of their animals; (b) facilities for farmers and pastoralists to meet; (c) information about prices, range locations, water points, weather and - most important of all - where to go and not to go; (d) sources of feed supplies when needed; (e) facilities for government services, banking and business. The government (the MAW or other agencies) should improve its services by: (i) decentralizing, directing and operating its pastoral activities to conserve ranges, and regulating migration, water points and range rotation; (ii) centralising its extension and social services for pastoralists; (iii) directing its pastoral subsidies and other fiscal and administrative regulations and (iv) collecting information about pastoral activities.

Facilities. Pastoral Centres should provide the following main services: (a) large and well organized and operated animal markets; (b) slaughter houses with large cooling facilities; (c) regional offices of the MAW pastoral and range organization and its veterinarian activities; (d) a large feed supply available at all times; (e) pastoral vocational schools that have seasonal as well as permanent facilities; (f) government and business agencies (Medical facilities, banking etc.), and (g) the establishment of supporting industries based on animal products, such as abattoirs, meat processing, the curing of hides and skins and other similar industries.

Locations. These centres should be centrally located within pastoral regions, so as to serve the whole region; they should be accessible to all ranges, and within easy reach of the main national road network. As shown in Chapter Seven, the country's main ranges and related pastoral activities are roughly located in five main areas: (1) the north, bordering on Iraq, Jordan and Kuwait, (2) the south, all along the Empty Quarter, (3) in the east, all across Dahana and Summan, (4) the north-western ranges extending from Aqaba to Mecca and, (5) the south western ranges extending from south of Mecca to the Yemen border. In each of these areas there is a certain amount of pastoral activity, and so each needs a centre. However, these centres should not be established all at once. It is advisable to start with one area at a time, because the lessons learnt from the first centre will help later centres. The northern area would be a good starting point, because its pastoral community is well-orientated with active markets in Iraq and Jordan, and has learnt to take advantage of government facilities; the al-Jawf area is an ideal site for a pastoral centre because of its central location (Fig.7-9) in relation to the main ranges and to the main roads leading to the rest of the country. The main guiding principle in considering a site for the centre is that it should be on the fringe of both ranges and urban areas so as to benefit from both without damaging the ranges or interfering with urban activities.

10.2.3 Livestock Farming

Livestock farming must, however, never be looked upon in isolation. It must rather be seen as an agricultural segment which must fit in with the total farming pattern of any region. The development of livestock farming cannot be attained until the standard of management practices as a whole is raised. It should be stressed that livestock farming has to compete with crop farming for land and particularly water and because these two resources are limited and inputs are costly, livestock farming must be efficient.

The strategies for the development of this system are totally different from those for the pastoral system. Livestock farming suffers mainly from the under-exploitation and inefficient use of irrigated areas. Besides animals the main elements that should be improved are feed resources, processing, and management. As shown in Chapter Eight all the dairies surveyed are trying to do three major tasks at the same time on the same farms; i.e. produce milk, process and market milk, and produce much of the fodder they need. All three activities are performed inefficiently. Specialization in one of these should be encouraged. Although financial resources are not a major concern, the technology and skills needed are desperately short. The main emphasis should be on the following improvements:

Animal Types

Up to now a clear policy on the types of dairy animals that should be used in farming areas has not been established. The Zebu, Zebu crosses, and a variety of imported breeds are used indiscriminately all over the country. The success of livestock farming depends on the efficient utilization of the costly inputs that go on milk production. Therefore, it is essential that high-producing animals are used. The planners of this field must choose from the following five alternatives:

(1) The Zebu breed.

(2) Selection within the Zebu breed.

(3) Grading up local breeds with western breeds.

(4) Developing a new breed.

(5) Reliance on western breeds.

(1) The first alternative - the Zebu breed - is out of the question. The breed records under farming as well as research environments show its performance to be low compared with average imported dairy cattle. There-are no exceptional factors either in terms of performance or even adaptability that encourage total reliance on this breed.

(2) Selection within the Zebu breed is an uncertain option, because selection within a national breed is only helpful in regions that have a suitable type of existing stock. This approach will take a long time to produce results. For example, in Ceylon it was estimated that it would

take 200 years for the productivity of their indigenous Sinhala breed to be raised by selective breeding to the same level as that of the Jersey cattle imported to the Island.[8] Asker, et al. have stated that in developing countries such as Egypt, selection using native cows to increase milk production by 30% requires 80 years.[9] Such a slow rate of improvement will result in marginal economic gains.

(3) Grading up the Zebu needs constant research of a high quality and, as Yousef, et al. emphasize: "attention must be focused upon the whole range of energy exchange processes, from consumption of feed through the biochemical processes of utilization to the calory significance of growth products and excreta".[10] Thus this approach should be limited to research activities until a concrete result is produced.

(4) The development of a new breed necessitates the recognition of the distribution of the desired genetic characteristics in the potential foundation animals. Therefore, this method is usually a long term process, requiring a large number of animals managed under a carefully planned breeding programme.

(5) Reliance on imported breeds is the most suitable option. An attempt to adapt them in a pure-bred state over succesive generations is the most ideal situation. In the case of Saudi Arabia this approach has been successful and there is no indication of any major problems. The ability of foreign breeds (mainly Jersey) to adjust and adapt to local Saudi conditions in the last 20 years testify to the advantages of this option. After all, the main goal is to find an efficient dairy breed that meets the economic needs and pays for the costly inputs of the irrigated areas. It is a waste of resources to rely on low-producing animals when they consume high-cost fodder.

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8. William, S.C., and Payne, W.J.A., An Introduction to Animal Production in the Tropics, (London; Ingrams, 1959),p.187
9. Asker, A.A., Ragab, M.T., and Hilary, S.A., "Genetic improvement in milk yield in two herds of cattle and buffalos in Egypt", Ind.J.Dairy Sci., Vol. 8,(1955),pp.39-48
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Feed Resources: The intensification and modernization of alfalfa production

Alfalfa is a highly productive crop with year round growth in irrigated areas, and it is the main fodder used for livestock in most of the Kingdom. While alfalfa is a very common crop, little of it is harvested for use as dried forage and very little is processed into bales. Thus the potential advantages of storability and easier transportability are not realised except for a small proportion of the crop. The potential advantages of alfalfa as a profitable agricultural product and input are available only to a limited extent to livestock producers. Alfalfa is commonly fed to livestock in the green state without drying or other preservation. While it is an excellent, palatable feed when so handled, it is heavy to transport, being about three quarters water, and is perishable and subject to rapid loss of its palatability and food value if not used within a very few days.

Alfalfa is a high-cost feed in Saudi Arabia partly because of the risks inherent in a perishable commodity, partly because of the cost of transporting the water in green alfalfa, and partly because of the inefficiencies and high cost of production when hand labour is utilized for harvesting in an economy where labour is expensive. Extensive use of alfalfa as a livestock feed, and thus the stimulation of indigenous dairy enterprises and lamb fattening projects, depends on the reduction of the price of alfalfa as well as on the rationalization of perishability and weight problems. Large plots, and the mechanical harvesting and baling of alfalfa can solve many of the foregoing problems. When dried, alfalfa weight is reduced to one third or one quarter of its green weight, due to the evaporation of water. Palatability is still high, and food value is essentially unchanged except for the probable loss of some of the leaves. If perishability is drastically reduced, baled alfalfa hay can be stored for months with practically no further loss of food value (except for vitamin content). Compressed into bales or cubes, the crop can be handled more readily than in loose form, and the bale or cube becomes a new standard unit replacing the green bundle. The efficient utilization of irrigated areas for the production of this fodder necessitates the commercialization, modernization and mechanization of alfalfa production with the emphasis on larger areas and the adoption of baling,cubing,pelleting or other methods of storing.

Feed industries: concentrates and protein supplement

These provide a very important feed source: they are either imported whole or the basic materials are imported and then mixed locally. This type of feed is vital for maximum production in dairy as well as sheep fattening units. This type of industry is still in an embryonic state and so far there are no definite plans for the establishment and development of this industry in Saudi Arabia. Moreover, feed supplements are not on the market all the time. New plants should be planned for the future. Government regulations concerning feed composition and quality control must be decided upon and incorporated into law, and qualified bodies should be established to enforce such regulations. Special assistance must be given to private bodies for the establishment of feed factories. Considering the limited agricultural areas available in the country for the production of animal feed - forages and cereals - it is essential that the country should look for other feed sources. The discovery of other protein sources could alter the animal feed supply picture. These protein sources could include certain types of single cell protein (SCP) - yeast, fungi, bacteria and algae. Experimentally, these protein sources have been obtained by using petroleum as the growing medium. Considerable research on SCP sources has been done in many developed countries; in particular, the Japanese are conducting research on algae and the Europeans are testing yeast and bacteria grown in petroleum distillates as a source of protein. Moreover some of these developments have reached the stage of commercial production on a modest scale and larger scale production especially that from hydrocarbon substracts is aimed at the compound animal feed market.[11] However the potential use of such products for animal feed will depend primarily on how they compete economically with conventional feeds. At present SCP sources have not been competitive in cost with other sources of protein.

So far the long term potentials of SCP are promising and it has been forecasted that by the year 2000[12] scientists may have solved these cost problems, making SCP another commercial source of protein.

Considering the fact that the country has abundant oil resources, and the fact that the oil sector - companies - is the most technologically developed sector in the country, then it is only natural for the country to participate in the international research race to make the SCP another commercial source of protein. The government should persuade and subsidise local and international companies to develop jointly the production of SCP for animals.

Milk processing

Milk processing is the most rudimentary aspect of dairy production in the country (Chapter 8). Very little dairy equipment is used, and what is used is usually manual or not suitable for some reason or another. Milk delivered to the market is not usually pasteurized or treated. The dairy producers in the Riyadh area made it clear during the author's research that they do not know what machinery should be used or how to use it. It is a gamble for all these dairies to purchase dairy equipment because most of them are small and the skilled man-power is almost non-existent.

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11. Tolan, A., and Hearne, J.F., "The potential of single cell protein for animal feed", in Proc. of the Conference on animal feeds of tropical and sub-tropical origin, (London; Tropical Inst., 1975), Abst. from WAER Abst. Dec. Vol.17, No.12, (1975), pp.701-702
12. U.S.Dept. of Agri., A good life for more people, (1971), pp.337-338

The treatment of milk must be industrialised, in order to safeguard the consumer and generate for the producer a reliable market. The industrialization of milk processing includes the installation of machinery for purification, pasteurisation, homogenisation, separation, and other treatments. This calls for costly plant and materials that are complex and need qualified man-power to operate and maintain. Because of the lack of qualified staff it is essential that central dairy processing plants are established in areas that have a sizable dairy herd, such as al-Kharj. The plant should collect milk from the farmers in its area, process the milk and market it. All the area's dairies should be represented in the management of this central dairy. The plant organization should keep an eye on the standard of hygiene and the method of milking and storing used by the dairies. This plant should be responsible not only for processing the milk but, more important, for establishing standards and extension services for the dairies which supply it.

10.2.4 Stratification

It has been advocated all through this chapter that the approach towards the development of the livestock sector should be system-orientated. Thus each system - pastoralism and livestock farming - should be rationalized and reorganized within the context of its own eco-system; the individuality of each system, its own type of resources, and its environmental human and managerial constraints must be reorganized. Nevertheless the individuality of each system should not be stressed to the extent of under-estimating their common ties and the fact that the two systems constitute two segments of the whole livestock sector. Ideally the two systems should constitute two elements of one process rather than two separate processes. Each one should complement the other in order to utilize resources efficiently.

Unfortunately, in the case of Saudi Arabia, this complementary character has not been properly developed, or even attempted. At present there is a wide gap between the two systems. Thus the country has lost, and as long as things stay this way, will continue to lose the advantages that could be provided by a healthy unified livestock sector.

The strategies for livestock development cannot be achieved without the efficient utilisation of the complementary relationship between the two systems, which can be approached by a pattern of stratification.

Within the context of this discussion, it is necessary to distinguish sharply between the stratification and the integration of the two systems. The later may imply an outright consolidation of the two systems into one and that is an undesirable approach, because an unbalanced integration would induce a certain degree of over-lapping in the resources used.

Stratification should be viewed in this discussion as the process by which the complementary elements shared by the two systems can be co-ordinated and harmonised for the benefit of both systems and for the development of the whole livestock sector. In practical terms stratification can be attained by the following main approaches:

(1) Stratified feeding. The pastoral system should be a means of utilising ranges only for the production and maintenance of animals, while on the other hand livestock farming should feed the young intensively in time for market, and in addition, should raise partial replacements and grow forages for supplementary feeding. The benefits of this stratified pattern lie in the removal of growing stock from desert ranges: this would mean that animals would cease to undergo the severe cyclical environmental hardships that prevent them from gaining weight. The removal of young stock would ease the pressure on the range and allow pastoral breeding stock to feed without competition; this could lead to a better nutritional plan for the remaining animals, which in turn would

lead to a higher feeding value for the breeding stock left on the range.

Stratified processing. Both systems produce various products: meat, milk, fibre, wool etc., hence the efficient utilisation of these products demands the establishment of a livestock-based industry. The planners of this industry should search for ways and means of processing and utilising the products of the two systems.

Stratified planning. Although each system should have its own specialised organizations that are provided with specialised staff to deal with the needs of each system, nevertheless planning for the two systems should aim at narrowing the gap between the two systems and should see to it that the independent developments taking place in each system in the end aim at complementing each other for the well-being of the whole livestock sector.

10.2.5 Organization for livestock development

Until livestock development is recognised as a national goal in its own right, with the status and authority accorded to water and crops, and with direct access to the highest level in the MAW, it is unlikely that the attention and resources necessary to promote livestock development on the scale now suggested will be made available. The MAW's organization, man-power and regional structure face major problems and cannot be expected to implement the changes needed for livestock development without some major reorganization and basic changes within the MAW. The following main issues must be considered:

The reorganization of the MAW structure. At the present time the available livestock services in the MAW are scattered in different departments, with minimum co-ordination, and authority and little decision-making power. These services are also acutely lacking in professional and technical staff. This level of organization cannot authorise the mobilization of resources to implement the development needed. Livestock services must be expanded, regrouped and reorganized into a main livestock division with the authority to make the main decisions concerning its own budget, and the use of resources and staff. It is essential that livestock planners should be placed at the highest levels of the MAW hierarchy because livestock development requires commitment from above. Livestock programmes cannot be implemented without being supported at the decision-making level or, as Bunting has more eloquently stated: "I assume a person with programme responsibility for something is more likely to take an interest in it than is a person who at one time indicated support but is no longer officially responsible".[13] In other words, the needs of livestock development cannot be taken care of until its advocates are at the top.

Man-power. The livestock division should be staffed with a large number of specialized technical and professional staff. The shortage in qualified staff is a chronic problem that will last for a long time to come. The efficient utilization of the available staff can improve the situation in the following ways:

(a) The present recruitment of qualified staff should be enlarged. The wisest course of action would be to retain a large number of expatriates to fill the jobs that cannot be filled with local expertise. Because of language problems, recruits have mainly come from Arab countries. However, all Arab countries have shortages in qualified staff, most of them face major problems in modernising their agriculture and in most cases their experts are not up-to-date with modern livestock technology. Therefore, it would be more advantageous to recruit from Western countries specially in technical fields like dairy production, feed production, livestock extension and veterinarian services. The fact that a large number of the MAW's senior and junior staff speak foreign languages

13. Bunting, A.H., "Agricultural Sciences", in Leagans, J.P., and Loomis, C.P., (eds.), Behavioural Change in Agriculture, (London; Cornell Univ. Press, 1971), p.452

would make the exchange of knowledge possible.

(b) The number of qualified Saudis that are available at the MAW and those who are approaching graduation should be utilized efficiently and trained to carry larger responsibilities. At present, decision-making in the MAW is limited to very few posts and this discourages able young people. There is a need for decentralising decision-making so that bottlenecks can be avoided. This calls for the establishment of more departments with wider responsibilities for heads both of departments and of lower level organization i.e. sections.

(c) The present regulations prohibit non-Saudis from holding executive jobs, and this is obviously for security reasons, specially with jobs that entail financial or personnel aspects. However, if we take into consideration the fact that there are very few experienced Saudis in certain specialized fields, then it is only natural that certain technical departments and sections must be headed by non-Saudis. Thus, it would be advantageous for the MAW to relax the Saudisation approach for those departments or sections that are mainly technical and need experience, such as ranges, training, and dairy etc.

(d) The real solution to the shortage of staff can only be reached by agricultural education, chiefly in the form of practical and vocational training for the future. Prime consideration must be given to measures aimed at improving the background of the present staff and up-dating their knowledge at all levels specially those who deal directly with farmers and pastoralists.

(e) It is important that the graduates and students of the agricultural college in Riyadh be orientated to the MAW's needs while they are in college. Moreover, they should be acquainted with the country's agricultural problems. At present there is almost no co-ordination between the MAW and the agricultural college; furthermore, very few practical courses - ranges, dairy, animal management - are taught. It is essential that a close relationship between the agricultural college and the MAW is established. University graduates will not fill up all the gaps, especially at the technical level. Therefore, there should be a technical-college two-year certificate course which would qualify students for extension work. Courses should have direct relation to national problems and to the needs of the MAW and other related organizations.

Regional Structure. The MAW regional structure is over-extended and spread too thinly in the field. There are over 60 branches responsible for MAW field activities. These branches are badly co-ordinated and overlap each other. They are on the whole under-staffed, areas with less agricultural potential having more staff than areas with greater potential. Areas with large animal numbers have less veterinarians than other areas with fewer animals etc.

There is an urgent need to reorganize the regional structure by consolidating some small branches and strengthening the main regional departments. For the forseeable future there should be efficient but limited MAW regional offices to serve the main agricultural regions in the country. It is premature to delimit these regions or to decide on the location of the main offices without an extensive and independent study of a large number of factors, mainly the distribution, location and potentials of the nation's agricultural resources. Other factors both political and geographical, and the availability of markets and infra-structure, must be evaluated. On the basis of such a study the present large number of branches should be reduced to fewer but more efficient main regional offices. The consolidation of the MAW's field activities into fewer divisions will encourage the efficient utilization of man-power and make it possible to delegate more authority to regional branches. The final aim should be that the MAW headquarters should dispose of its direct involvement in regional agricultural activities and concentrate mainly on planning and co-ordination.

Finally a cautionary note must be sounded. Although the development of the livestock sector is a necessity, its development will not be easy, because this sector is the most traditional and its development will require a very considerable degree of organization and technological skill which the country does not at present possess. Short cuts, outright emulation of other countries and bits and pieces of mutually unrelated policies may not solve the problem. The development of the livestock sector will necessarily be a whole and unitary process, and many features of its present state will have to be transformed by a rationalizing and reorganizing of its structure. This will very profoundly depend on the ways and on the speed with which the sector is modernized and on the extent to which the reorganization and transformation of the sector is successfully brought into being. A radical development of this kind demands patience and a search for fundamental solutions. The government as well as the migratory Bedwin and the oasis farmer will have to be involved. This aspect of development will have none of the dramatic appeal that glamorous projects such as the al-Hasa, Haradh, and Jizan dam projects can provide. However the development of this sector may be far more important because it will directly influence the lives and visibly improve the welfare of the people and the country, and contribute to the over-coming of the country's chronic state of spatial as well as economic dualisms.

CONCLUSION

This study has considered the livestock sector in Saudi Arabia under two aspects. There is the present situation, with a livestock sector traditional, rudimentary in its methods and inefficient in utilizing the valuable but limited resources available. And there is the future, which will require a development of this sector only to be achieved with great effort, and whose shape will very profoundly depend on the ways in which and the speed with which the livestock sector is modernized and rationalized by the deployment of large scale technology and efficient organization.

The deterioration in the livestock sector is a recent development. As late as 1930 Saudi Arabia was not only self-sufficient in livestock products but also an exporting nation. However since the 1930's the livestock share in the economy has started to shrink substantially to the extent of becoming a minor sector, its share in the economy only around 1.5% of the GDP in 1972. The most important factor in this decline has been the recent and gradual evolution of a state of imbalance in the overall structure of the livestock sector.

This study has analysed some of the main causes of this state of disequilibrium. Among these causes are a lack of awareness of environmental limitations, inefficiency in the use of man-power and water resources, an undifferentiated growth in animal population, over-exploitation of range resources, and livestock production systems that are rudimentary and traditional. Moreover the livestock sector lacks regional emphasis on animal potentials and there is a lack of correlation between animal use and the resources available. These negative forces are so overwhelming as to cancel out the positive aspects, causing ruptures and disintegration which in turn lead to a state of disequilibrium.

A few points stand out clearly as having a direct bearing on the

problems to be overcome in the development of the livestock sector:
(1) The limited water resources coupled with other harsh environmental constraints will not allow the country to produce a wide range of livestock products, therefore priorities must be established. The country's resources can allow livestock development on two types of land. One is the very limited cultivable land, distributed about different parts of the country, in irrigated areas. Livestock and crops have to share these small areas. For livestock to contribute effectively, an efficient use has to be made of these limited areas. The other space consists of the vast desert ranges which are already over-grazed and misused. These two spatial options are fixed factors that cannot basically be altered, but they could be improved upon to the advantage of livestock. No improvement in these two options can be attained by their over-exploitation. Improvement depends on living with their limitations, efficiently utilizing the two kinds of land to their utmost, but no further.
(2) al-Badiah population has always been and still is the largest social organization specialising in livestock production and they are the main pastoralists and the backbone of pastoralism. The accelerating rate of Bedwin migration, mainly to urban areas, has no doubt had damaging effects on pastoralism. However this trend is not among the causes of the problems facing pastoralism, it is rather a symptom. The state of disequilibrium in pastoralism has been going on for a very long time, causing pastoralism to become less viable, hence unable to support its own population. Thus, it is only natural that the pastoral population must decline because the larger the population in the range the smaller the per capita income. In this study it has been emphasised that to a certain extent Bedwin migration is good for pastoralism, in the sense that fewer people and fewer animals can - if properly guided - result in more efficient pastoralism.

(3) The overwhelming task of developing the livestock sector cannot be undertaken without the availability of efficient administrative and policy making organizations and institutions. The only institution available at present with the authority to plan and implement plans for the development of the livestock sector is the MAW. The MAW's organization, man-power and regional structure are inefficient and face major problems; it cannot be expected to implement the changes needed on a national scale for the development of the livestock sector. Drastic and basic reorganization of this institution is an urgent necessity.

(4) The main livestock types in the country are camels, cattle, sheep and goats. Their distribution in the country is markedly regional: cattle are found only in irrigated areas, camels in the arid deserts, sheep and goats are widely dispersed. However all the findings point to the low concentration of animal types and a consequent low animal production throughout the country as a whole. Whatever relative concentration takes place usually is due to ecological factors. Animal potentials and the efficient use of land resources have never been realised.

(5) The classification of livestock production in the country is determined by the negative aspects of two major sets of factors. The first is the arid ecological factors, mainly climate and water resources. The second is the traditional socio-economic nature of the farming and pastoral communities in the country, which are characterised by a low level of economic and technical development. Due to the determining significance of ecological and socio-economic factors, it is appropriate to classify livestock production on the basis of two criteria; the first is the principal types of land available in the country, and the second is the animal adaptation to these land types. The operation of these two criteria produces three main livestock systems; pastoralism, livestock farming and household animal raising.

(6) Pastoralism, the most important livestock production system in the country is in a state of decline. There is a disequilibrium within pastoralism as a result of the misuse of pastoral resources, mainly range resources, which are crucial to pastoral activities, and it is to this misuse that pastoral decline can be largely attributed.

Evaluation of the state of the ranges, their conditions, capacities and stocking rates indicates that they are deteriorating all over the country and that over-grazing and over-stocking are the rule rather than the exception. Certainly climatic variations contribute to their poor state, but such variations are not wholly to blame. The poor state of the ranges in the country has resulted from the action of a chain of factors, constituting a complicated ecological vicious circle where climate, man, and animals and their seasonal movement have acted as the destructive agents. This cycle has been in operation for a long time, but has been accelerating in the last 30 years with the advent of the roads, trucks and water wells. The scale of destruction has been so severe lately that the lack of immediate remedy might destroy some ranges as grazing areas for ever.

(7) This worsening situation has evolved as a result of numerous causes, mainly (a) the enlargment of the scale of seasonal migration and (b) the opening of the tribal territories, the demarcation imposed by international borders, and the abolition of the al-hema systems. All these factors have induced the intensive and undifferentiated over-exploitation of range resources. (c) changes in land use, mainly the reclamation of more land for settlement, irrigated crops and dry farming, have led to the reclamation of sizable areas of the ranges. When ranges are turned into cultivated areas all the native range vegetation is destroyed. (d) pastoralists' abuse of ranges to feed their animals and in bad seasons to keep them alive. The combined collective grazing of camels, sheep and goats

on a range site creates a state of over-lapped grazing, where all the animals with their innate selective grazing behaviour graze different plants, different parts of the plants at different heights leading to a partial or total destruction of the plant, (e) the large number of wells drilled in or close to range sites and thus encouraging over-grazing, (f) man's misuse of ranges. The most important is the grubbing and cutting of trees and shrubs for fuel.

(8) Livestock farming is the second most important livestock system in the country, and it is the main system for cattle raising and sheep fattening. Animal farming has been modestly gaining ground in central oases where alfalfa areas are sizable. However on a national basis livestock farming has not expanded sizably. The scarcity of cultivable lands and the expansion of urban areas have influenced livestock farming greatly, where urban orientated crops have been gaining ground at the expense of fodder crops. The scarcity of cultivable lands offers farmers limited choices as far as expanding their farming activities is concerned; they either emphasise animal production which means using most of the area of their farms to grow fodder, or emphasize mainly crop production. Therefore one of these two alternatives has to be chosen at the expense of the other and that explains why commercially mixed farming (crop and animals) has not expanded.

There are three types of livestock farming: (a) livestock raised in households, this being a temporary phenomenon with no potentials for further growth or development (b) livestock raised on farms as a side activity - mixed farming - this too is giving way gradually and mainly in urban areas to the specialization in either crops or animals (c) commercial livestock farming which aims largely at the production of market orientated products - mostly meat and milk. The emergence of this type has been a natural reaction to the changes brought about by the expansion of urban areas, so it is mainly regional in character.

Dairy development has been more pronounced in the last few years and has been chosen in this study to illustrate the problems facing modern commercial livestock farming. Dairy development around Riyadh indicates dairy farming in the country is still semi-specialized, small in scale, and inefficient. The obvious managerial problems faced by the Riyadh dairies are too great to allow them to plan their way ahead. The skills required in dairying are beyond their traditional abilities and beyond what the labour market can provide. Milk treatment and processing is often elementary and rudimentary, and there is a lack of modern dairy facilities. (9) As long as the aim of national development is to attain a diversified economic base, and reconstruct a spatially balanced economic structure, then the answer must be found in the mobilization of government help in tapping, regenerating and then efficiently utilizing the rural resources which are basically agriculture in nature. There is a need for a differentiated development that aims at the resource rather than simply at the infra-structure and which will incorporate the different regions more into the growth of the economy, so that they become contributors to the national economy rather than being subsidised recipients. In the light of this rational aim, the author argues that livestock development can make a vital contribution by providing those regions which already possess substantial livestock resources with a viable local economy that will preserve the regional resources, accumulate investment and provide these regions with other derived industrial and commercial activities that are based on the efficient utilization of livestock products and by-products. (10) In the development of the livestock sector careful thought should be given to proper objectives. Such development has to be directly related to the requirements of the present state and condition of the livestock sector. It should take account of the present ills of the livestock sector and promote genuinely relevant remedies.

The most urgent objective is to overhaul the structure of the livestock sector as a whole rather than just to improve certain parts. This can be done through the improvement of livestock systems because such an improvement will have a spread effect on its components; animals, ranges, industries, management etc. The traditional land use which resulted in the evolution of two independent livestock production systems, pastoralism and livestock farming, must be preserved by improving each system according to its own limited resources and potentials. The development should be differentiated, with variation of emphasis and speed within each section of the livestock sector.

(11) Pastoral development necessitates overcoming the drawback that ranges, al-Badiah and pastoral animals suffer from, within the context of the overall pastoral system. The underlying principle in the development of pastoralism must be an emphasis on conservation and the use without misuse of range resources.

Livestock farming should never be considered in isolation. It must rather be seen as an agricultural segment which must fit in with the total farming pattern of any region. It should be stressed that livestock farming has to compete with crop farming for land and particularly water. Moreover, livestock farming suffers mainly from the under-exploitation and inefficient use of irrigated areas. Thus the development of this system cannot be properly promoted until the standard of management practice as a whole is raised or even transformed.

(12) The strategies for livestock development cannot be pursued without the efficient utilization of the complementary relationship between pastoralism and livestock farming, which can be approached by a pattern of stratification where the individuality of each system is not stressed to the extent of under-estimating common ties and the fact that the two

systems constitute two segments of the livestock sector as a whole.

(13) Livestock development requires commitment from above. Livestock programmes cannot be implemented without being supported by an able and efficient organization. Until livestock development is reorganised as a national goal in its own right, with the status and authority now accorded to water and crops, and with direct access to the highest level in the MAW, it is unlikely that the efforts necessary to promote livestock development on the scale now suggested will be forthcoming. Thus it is necessary that the MAW structure be reorganized so that the livestock services are expanded, regrouped and reorganized into a main livestock division with the authority to make major decisions and to concert its own plans.

Appendices

Notes on Sources of Data and Methods of Statistical Analysis

Appendix 2-a

al-Badiah Population and Rank as a percentage of the population of 17 Major Administrative Regions in the Kingdom for 1962/63 (%)

Region	District	Rank	%
Central and Northern Areas	el-Khasra	1	86.5
	N. Boundaries	2	77.4
	Afif	3	76.7
	Qurayyat	4	72.3
	N.Districts	5	66.9
	Hail	6	66.8
	al-Jawf	7	59.3
	Najran	8	31.9
	Ranya	9	25.9
	el-Qasim	10	23.4
	Bishah	12	22.2
	Riyadh	13	17.9
Western Area	Madina	10	24.5
	Asir	14	16.4
	Mecca	16	5.3
	Jizan	17	2.1
Eastern Coastal Areas	Eastern Districts	14	16.4

Source: Compiled from al-Falali, M., Project for Settlement and Modernization of al-Badiah in Saudi Arabia, prepared for International Labour Organisation 1964, (Arabic), p.46

Appendix 5 - a

Total animal Population and their Regional distribution in AU and % for 1968 on a District basis.

Animal Units

District	Cattle	Camel	Sheep	Goats	Total
Tabuk	150	20050	6440	19790	46430
GOBIAT	50	2700	710	2310	5770
Al-Jawf	2850	13600	5930	8960	31340
HAIL	8300	30050	41160	18060	97570
Qassim	89450	88250	114750	39110	331560
RIYADH	29550	1250	14980	10130	55910
AL-KHARJ	43350	5550	15610	12510	77020
SUDIR	22400	10150	24470	16500	73520
WASHM	7000	450	3300	1990	12740
DWADMI	10400	7350	12030	10500	40280
GHAIYAH	12200	4400	10840	10510	37950
BISHAH	50405	44700	163567	37851	296523
BANIAH	3250	23995	18481	5168	50894
G.Z.	65350	10695	78625	35472	190142
AFLAG	7950	2400	4370	3920	18640
SULAYIL	1550	1700	580	530	4360
W.DWASIR	6400	17950	6210	2710	33270
NAJRAN	17500	13800	11962	12760	56022
GUNEIDA	152165	43920	57047	173779	426911
JIZAN	302760	79360	72690	150439	605249
ABHA	101400	10450	115000	33730	260580
JANOB OBID	21750	15900	48050	14970	100670
TAIF	47300	11450	75680	18790	153220
M.J.I.	2550	7550	16100	8030	34230
ALULA	1900	17250	4280	15710	39140
MADINA	8850	18150	20420	41760	89180
E. PROV	41480	7325	18257	20169	87731
TOTALS	1058260	510895	961539	726158	3256852

% Per cent

	Cattle	Camel	Sheep	Goats
TABUK	0.32	43.18	13.87	42.62
GOBIAT	0.87	46.79	12.31	40.03
AL-JAWF	9.09	43.40	18.92	28.59
HAIL	8.51	30.80	42.19	18.51
QASSIM	26.98	26.62	34.61	11.80
RIYADH	52.85	2.24	26.79	18.12
AL-KHARJ	56.28	7.21	20.27	16.24
SUDIR	30.47	13.81	33.28	22.44
WASHM	54.95	3.53	25.90	15.62
DWADMI	25.82	18.25	29.87	26.07
GHAIYAH	32.15	11.59	28.56	27.69
BISHAH	17.00	15.07	55.16	12.76
BANIAH	6.39	47.15	36.31	10.15
G.Z.	34.37	5.62	41.35	18.66
AFLAG	42.65	12.88	23.44	21.03
SULAYIL	35.55	38.99	13.30	12.16
W.DWASIR	19.24	53.95	18.67	8.15
NAJRAN	31.24	24.63	21.35	22.78
GUNEIDA	35.64	10.29	13.36	40.71
JIZAN	50.02	13.11	12.01	24.86
ABHA	38.91	4.01	44.13	12.94
JANOB OBID	21.61	15.79	47.73	14.87
TAIF	30.87	7.47	49.39	12.26
M.J.I.	7.45	22.06	47.03	23.46
ALULA	4.85	44.07	10.94	40.14
MADINA	9.92	20.35	22.90	46.83
E. PROV.	47.28	8.92	20.81	22.99

Source: synthesized from different MAW agricultural sources for 1960-1968

5 - b The Statistical Approach for the Delimitation of Animal Combination Regions

The theoretical curve outlined below was used as a standard measurement to determine the identity and number of animal types involved in the basic land use pattern of each of the 26 districts:-

One animal type	= 100% of animal types in an area
Two animal combinations	= 50% in each of two animal types
Three animal combinations	= 33.3% in each of three animal types
Four animal combinations	= 25% in each of four animal types

The problem became one of accurately measuring the actual occurrence of percentages within the individual districts against the previous theoretical curve. The standard deviation formula was adjusted for this purpose, and expressed as follows:-

$$a = \frac{\sum d^2}{N}$$

where d is the difference between the actual animal type percentage in a given area and the appropriate percentage in the theoretical curve; and N is the number of animals in a given combination. Since the relative rank of amount deviation among the several possible combinations was desired and not the actual magnitude of deviation, the square root was not extracted in accordance with the standard deviation.

In demonstration of the performance of the technique, Tabuk district may be taken as a random example. The actual distribution of animal percentages in this district is: camels (M) 43.18%; goats (G) 42.62%; sheep (S) 13.87% and cattle (C) 0.32%.

As the combinations show, in the table below the deviation of the actual percentages in Tabouk district from the theoretical curve is lowest for two animal combinations. This result, therefore, under the system being used, establishes both the identity and the number of animals in the basic combinations for the district as MG. The same statistical process was computerised for all the 26 regions as shown in Table (5-8).

Standard Deviation for Tabouk District

Combination	One Type	Two Groups		Three Groups			Four Groups			
Animal type	M	M	G	M	G	S	M	G	S	C
% of animal units	43.18	43.18	42.62	43.18	42.62	13.87	43.18	42.62	13.87	0.32
% theoretical curve	100.00	50.00	50.00	33.30	33.30	33.30	25.00	25.00	25.00	25.00
Difference	56.82	6.82	7.38	9.88	9.32	19.43	18.18	17.62	11.13	24.68
Difference squared	3229.00	46.50	54.46	97.60	86.86	377.50	330.50	310.46	123.88	609.10
Sum of square difference	3229.00	101.00		562.00			1377.90			
Sum divided by No of animals	3228.00	50.40		187.37			343.51			

Source : Based on Weaver, J C, "Crop-combination Regions in the Middle West", The Geographical Review, volume XLIV, No 2, 1954, pp 175-200

5-C Coefficient of Localisation

This is calculated by comparing the percentage distributions by area of a given animal type with that of all animal types. Formally it is given by:-

$$C_i = \tfrac{1}{2} \sum_{j-1}^{N} \left| \frac{100\ X_i}{X_t} - \frac{100\ Y_i}{Y_t} \right|$$

where X_i is the number of animal units for a given animal X in the i^{th} areal region

X_t is the total regional animal units in a given animal type

Y_i is animal units in all types in area i

Y_t is total regional animal units in all types

The vertical brackets indicate absolute value of the expression, within, for example, the difference between the two percentages irrespective of sign. Table below shows the results.

Source: Method Adapted from Smith, D.M. Industrial Britain: The North West (Newton Abbot; David & . Charles, 1969), P P. 256-257

Coefficient of localization for Animal concentration and specialization

	Cattle	Camel	Sheep	Goat
TABUK	-1.41	2.50	-0.75	1.31
GORIAT	-0.17	0.36	-0.10	0.15
AL-JAWF	-0.69	1.70	-0.34	0.27
HAIL	-2.21	2.89	1.29	-0.50
QASSIM	-1.73	7.09	1.75	-4.79
RIYADH	1.08	-1.47	-0.15	-0.31
AL-KHARJ	1.74	-1.27	-0.74	-0.64
SUDIR	-0.13	-0.26	0.29	0.02
WASHM	0.27	-0.30	-0.05	-0.12
DWADMI	-0.25	0.21	0.02	0.22
GWAIYAH	-0.01	-0.30	-0.03	0.29
BISHAH	-4.34	-0.35	7.91	-3.89
RANIAH	-1.25	3.14	0.36	-0.85
G.Z.	0.35	-3.74	2.35	-0.95
AFLAG	0.18	-0.10	-0.12	-0.03
SULAYIL	0.02	0.20	-0.07	-0.06
W.DWASIR	-0.42	2.49	-0.37	-0.65
NAJRAN	-0.07	0.98	-0.48	0.04
GUNFIDA	1.28	-4.50	-7.17	10.83
JIZAN	10.03	-3.05	-11.02	2.14
ABHA	1.58	-5.95	3.96	-3.36
JANOB OBID	-1.03	0.02	1.91	-1.03
TAIF	-0.23	-2.46	3.17	-2.11
M.J.T.	-0.81	0.43	0.62	0.06
ALULA	-1.02	2.18	-0.75	0.96
MADINA	-1.89	0.82	-0.61	3.02
E.PROV.	1.23	-1.16	-0.79	0.09
C.L.	17.70	24.97	23.59	19.33

Based on appendix 5-a

5 - d Location Quotian

Calculated by the region's share of a particular animal type with its percentage share of the national animal units. The formal expression used by W. Isard, and adjusted to this study, is written:-

$$\frac{X_i/X_t}{Y_i/Y_t} \quad \text{or} \quad \frac{X_i/Y_i}{X_t/Y_t}$$

where X_i is number of animal units in animal type i in a given region

X_t is number of animal units in all animal types in the same region

Where Y_i is number of animal units in animal type i in the nation

Y_t is number of animal units in all animal types in the nation

Source: Adapted from Isard, W. Methods of Regional Analysis: An introduction to Regional Science, (Cambridge; MIT Press, 1961. P. 124.

5-e The Coefficient of Specialisation

The coefficient of specialisation has been used to compare the percentage distribution of animal units among animal types in any area with the total regional animal units. The formal expression, written by D.S. Smith is:-

$$Cs = \tfrac{1}{2} \sum_{j-1}^{N} \left| \frac{100X_i}{Y_t} - \frac{100\ Y_i}{1/_t} \right|$$

where X_i is the number of animal units in animal category i in an area X

X_t is total animal units in area X

Y_i is regional animal units in animal type i

Y_t is total regional animal units

Table B shows the results.

Source: Adapted from Smith, D S, op.cit., PP. 270-279.

Coefficient of Animal

specialization (cs.)

Districts	Cattle	Camel	Sheep	Goats	CS
TABUK	-32.17	27.50	-15.65	20.33	47.82
Goriat	-31.63	31.11	-17.22	17.74	48.85
AL-JAWF	-23.40	27.71	-10.60	6.29	34.00
Hail	-23.99	15.11	12.66	-3.79	27.77
QASSIM	-5.51	10.93	5.09	-10.50	16.02
Riyad	20.36	-13.45	-2.73	-4.18	20.36
al-Kharj	23.79	-8.48	-9.26	-6.05	23.79
Sudir	-2.03	-1.88	3.76	0.15	3.91
Washm	22.45	-12.15	-3.62	-6.68	22.45
Dwadmi	-6.67	2.56	0.34	3.77	6.67
Gwaiyah	-0.35	-4.09	-0.96	5.40	5.40
Bishah	-15.49	-0.61	25.64	9.53	25.64
Raniah	-26.11	31.46	6.79	-12.14	38.25
G.Z.	1.88	-10.06	11.83	-3.64	13.70
Aflag	10.16	-2.81	-6.08	-1.27	10.16
Sulayil	3.06	23.30	-16.22	-10.14	26.36
W. Dwasir	-13.26	38.27	-10.86	-14.15	38.27
Najran	-1.26	8.95	-8.17	0.48	9.43
Gunfida	3.15	-5.40	-16.16	18.41	21.56
Jizan	17.53	-2.57	-17.51	2.56	20.09
Abha	6.42	-11.68	14.61	-9.35	21.03
Janob Obid	-10.89	0.11	18.21	-7.43	18.31
Taif	- 1.62	-8.21	19.87	-10.03	19.87
M.J.T.	-25.04	6.37	17.51	1.16	25.04
Alula	-27.64	28.39	-18.59	17.84	46.23
Madina	-22.57	4.67	-6.63	24.53	29.20
E. Prov.	14.79	-6.77	-8.71	0.69	15.48

Source: Based on appendix 5-a

APPENDIX 6-a

SOME ASPECTS OF LAND USE AND TOTAL ANIMAL UNITS

	1	2	3	4	5	6	7	8
EASTERN	69466	6390	10696	58179	13163	13099	20318	17142
RIYADH	350644	156953	196960	152043	18243	1909	102334	68439
QASSIM	210459	134039	172824	37448	13722	4811	190122	42767
HAIL	56689	24117	24181	32508	2517	3484	91921	42222
AL JAWF	5973	648	786	5185	1087	2017	10954	20670
MADINA	28323	17306	14835	13381	1533	2085	31792	59266
MECCA	328079	160168	156370	42453	49801	24740	217351	197677
ASIR	119048	117520	84964	2091	43456	17409	312998	202193
AL-BAHA	39880	53298	22282	3039	24345	4001	74798	55336
JIZAN	3870658	6415583	16639	356	56650	16543	81056	76275
NAJRAN	30666	19553	23933	6731	1907	8020	40632	26480
BEISHA	137373	80534	59153	73678	16704	2944	64401	29430
TOTALS	5247258	7187109	783623	427092	243138	101062	1238667	837897

REGIONAL PERCENTAGES OF SOME ASPECTS OF LAND USE & TOTAL UNITS

EASTERN	1.3	0.1	1.4	13.6	5.4	13.0	1.6	2.0
RIYADH	6.7	2.2	25.1	35.6	7.5	1.9	8.3	8.2
QASSIM	4.0	1.9	22.1	8.8	5.6	4.8	15.3	5.1
HAIL	1.1	0.3	3.1	7.6	1.0	3.4	7.4	5.0
AL JAWF	0.1	0.0	0.1	1.2	0.4	2.0	0.9	2.5
MADINA	0.5	0.2	1.9	3.1	0.6	2.1	2.6	7.1
MECCA	6.3	2.2	20.0	9.9	20.5	24.5	17.5	23.6
ASIR	2.3	1.6	10.8	0.5	17.9	17.2	25.3	24.1
AL-BAHA	0.8	0.7	2.8	0.7	10.0	4.0	6.0	6.6
JIZAN	73.8	89.3	2.1	0.1	23.3	16.4	6.5	9.1
NAJRAN	0.6	0.3	3.1	1.6	0.8	7.9	3.3	3.2
BEISHA	2.6	1.1	7.5	17.3	6.9	2.9	5.2	3.5
TOTALS	100.0	99.9	100.0	100.0	100.0	99.9	99.9	100.0

Source: MAW Census Summer 1970/71

APPENDIX 7-a

Area and condition of ranges in the Resource Area in hectares(HA) and %

Area	Area Total HA	Range Total HA	%	Range conditions + HA*							
				Excellent	%	Good	%	Fair	%	Poor	%
I	37,500,000	37,000,000	30.8	555,000	1.5	4,107,000	11.1	10,656,000	28.8	21,682,000	58.6
II. III	22,600,000	21,587,000	18.0	2,374,570	11.0	3,453,920	16	7,339,580	34	8,418,930	39.0
IV	36,200,000	32,421,224	27	5,868,241	18.1	15,043,448	46.4	10,439,634	32.2	1,069,900	3.3
V	10,500,000	10,498,500	8.7	1,283,000	12.2	8,026,000	76.4	660,000	6.3	529,500	5.0
N.VI		13,285,100	11.1			3,156,900	23.8	8,386,400	63.1	1,741,800	
S.VI		5,360,000	4.5			3,676,700	68.6	1,683,300	31.4		
VI	19,400,000	18,645,100	4.5			6,833,600	36.6	10,069,700	54	1,741,800	9.4
Total	126,200,000	120,151,824	95.2	10,079,811	8.4	37,461,968	31.2	39,164,914	32.6	33,442,130	27.8

* condition is defined in Chapter Seven in the text

The estimated livestock population and carrying capacities for the Resource Areas in HA and AUT for (1967-69)

Areas	Range Area HA*	Stocking Rate		Carrying Capacity		Potential carrying capacity	
		HA/AUY	Animal No.	HA/AUY	Animal No.	HA/AUY	Animal No.
I	37,000,000	27.4	1,350,365	37.0	1,000,000	18.8	1,968,085
II III	21,587,000	20.0	1,079,350	27.0	799,519	12	1,798,917
IV	32,421,224	17.0	1,907,131	16.0	2,026,327	11.2	2,894,752
V	10,498,500	64.0	164,039	60.0	174,975	43.2	243,021
VI	18,645,100	16.0	1,165,319	8.4	2,219,655	5.4	3,452,796
Areas	120,151,824	21.2	5,666,204	19.3	6,220,476	11.6	10,357,571

* Animal unit (AU) = one sheep = one goat, camel and cattle = 5 animal units

Source: Synthesized from Kingery, C.E., Possibilities for Development and Management of Public Range Lands, (Riyadh;1971), This report is based on Resource Survey Reports. Also individual Resource Survey Reports have been used.

APPENDIX 8-a

The cropping patterns of the main crops in Saudi Arabia by province and representative of 1968 and 1971/72 in donums[a]

Province	Year	Wheat Barley	Millet Sorghum	Vegetables b	Alfalfa	Permanent crops	Total
Northern	1968	69,425	6,318	7,774	4,430	23,207	111,154
	1971/72	17,657	2,614	9,685	4,434	37,693	72,083
Eastern	1968	-	889	8,886	14,835	117,780	142,390
	1971/72	289	119	6,863	5,973	58,179	71,419
Western	1968	155,590	10,295	40,098	3,177	47,124	256,284
	1971/72	65,829	101,137	61,127	10,510	55,834	294,437
Central	1968	256,395	72,334	152,308	78,894	61,236	617,167
	1971/72	87,688	-	154,956	69,265	152,043	463,952
Qassim	1968	171,749	12,718	83,003	78,473	26,485	372,428
	1971/72	77,996	-	175,946	56,043	37,448	347,433
Total	1968	653,159	102,554	292,069	175,809	275,832	1,499,423
	1971/72	249,459	103,870	408,577	146,225	341,197	1,249,324
Southern	1968	255,147	98,752	19,113	39,154	63,617	470,783
	1971/72	148,532	106,990	18,636	35,383	85,539	395,080
Coastal South	1968	37,878	2,368,889	2,831	1,626	2,021	2,413,245
	1971/72	-	5,886,318	2,278	-	356	5,888,952
Country Total	1968	946,184	2,570,195	309,013	216,589	341,470	4,383,451
	1971/72	397,991	6,097,178	429,491	181,608	427,092	7,533,356

Source: Synthesized from MAW Basic Agricultural Statistics 1968 and MAW unpublished summary of 1971/72 Census.

a. hectare = 10 donums
b. includes melons
c. area of permanent crops for E.Prov. was not estimated for 1968, hence Resource Survey estimate was used for area IV. SRI op.cit.,p.71, cereals include mainly rice.

APPENDIX 8-b

The estimated area in east province of the main crops in the country in (%)

Province	Year	Wheat Barley	Millet Sorghum	Vegetables	Alfalfa	Permanent crops
Northern	1968	7.3	0.25	2.5	2.1	6.8
	1971/72	4.4	0.04	2.3	2.4	8.8
Eastern	1968	-	0.03	2.9	6.9	34.5
	1971/72	0.07	0.002	1.6	3.3	13.6
Western	1968	16.4	0.4	13.0	1.5	13.8
	1971/72	16.5	1.7	14.2	5.8	13.1
Central	1968	27.1	2.8	49.3	34.6	17.9
	1971/72	22.0	-	36.1	38.1	35.6
Qassim	1968	18.2	0.5	27.0	36.2	7.8
	1971/72	19.6	-	41.0	30.9	8.8
Total %	1968	69.0	4.0	94.5	81.2	80.8
	1971/72	62.7	1.7	95.1	80.5	79.9
Southern	1968	27.0	3.8	4.6	18.1	18.6
	1971/72	37.3	1.8	4.3	19.5	20.0
Coastal South	1968	4.0	92.2	0.9	0.8	0.6
	1971/72	-	96.5	0.5	-	0.1
Country %	1968	100	100	100	100	100
	1971/72	100	100	100	100	100

Source: Appendix 8-a

% are rounded to the nearest figure

APPENDIX 8-c

The estimated area of crops by provinces for Saudi Arabia (%)

Province	Year	Wheat Barley	Millet Sorghum	Vegetables	Alfalfa	Permanent crops	Total area
Northern	1968	62.5	5.7	7.0	4.0	20.8	100
	1971/72	24.5	3.6	13.4	6.2	52.3	100
Eastern	1968	-	0.6	6.2	10.4	82.7	100
	1971/72	0.4	0.2	9.6	8.4	81.5	100
Western	1968	60.7	4.0	15.6	1.2	18.4	100
	1971/72	22.4	34.4	20.8	3.6	18.8	100
Central	1968	41.5	11.7	24.7	12.1	9.9	100
	1971/72	18.9	-	33.4	14.9	32.8	100
Qassim	1968	46.1	3.4	22.3	21.1	7.1	100
	1971/72	22.4	-	50.6	16.1	10.8	100
Total %	1968	43.6	6.8	19.5	11.7	18.4	100
	1971/72	20.0	8.3	32.7	11.7	27.3	100
Southern	1968	54.2	20.9	3.0	8.3	13.5	100
	1971/72	37.6	27.1	4.7	9.0	21.7	100
Coastal South	1968	1.6	98.2	0.1	0.06	0.08	100
	1971/72	-	99.96	0.04	-	0.01	100
Country %	1968	21.6	58.6	7.1	4.9	7.8	100
	1971/72	5.3	80.9	5.7	2.4	5.7	100

Source: Appendix 8-a

% are rounded to the nearest figure

Appendix 8-d

Total cultivated area and cropped area in Saudi Arabia (Donums) 1968 and 1971/72

Use \ Season (Year)	1971/72 Winter	1971/72 Summer	1971/72 Throughout Year	1971/72 Total	1968 Winter	1968 Summer	1968 Throughout Year	1968 Total
Total cultivated area				5,247,258				3,964,674
Wheat	301,003				719,611			
Barley	96,997				220,573			
Millet	1,414,770	1,515,238				1,011,189		
Sorghum	1,925,267	1,241,963				1,559,006		
Vegetables	128,303	305,516					321,013*	
Seasame*			530,265				225,353	
Alfalfa			181,606				216,592	
Permanent crops			245,486				223,539	
Others+							16,235	
Total	3,866,340	3,062,717	957,357		940,184	2,570,195	986,497	
Total cropped area+				7,886,414				4,513,111

Source: MAW Basic Agricultural Statistics, 1968 and the summary of 1971/72 census.

Cultivated area: Areas determined by aerial photograph or ground surveys or by both to the under cultivation

Cropped area: Cultivated land plus recropped, double cropped and inter-planted land

*total for summer and winter

+including rice

Field Study Questionnaire for a Sample of Dairy Farms in Saudi Arabia

General

1. Name of the farm:
2. Precise location:
3. When did the farm start dairy operations?
4. Distance to the major market:
5. Type of ownership:
   (a) Independent
   (b) Co-operation of more than one owner
   (c) Government
   (d) Other
6. Size of farm:
   - hectares
7. Is it fragmented?
   yes   no
   Number of pieces
8. Proportion of the cultivable to the uncultivable area:
   %
9. Is your land a grant or purchased?
10. Number of water wells on the farm:

Farm Management

11. Animals are housed in:
    (a) fenced area
    (b) mud housing
    (c) fenced area with shelter
    (d) cemented housing
12. Do you keep records for your animals?
    yes   no
13. The hygienic situation for animal housing and equipment:
    (a) no disinfectants used
    (b) some measure of hygiene is used
14. Do you raise your own replacements?
    yes   no   purchase them
15. If you buy them, from where?
16. Do you do any culling?
    yes   no
17. Do you have a vet of your own?
    yes   no
18. If you do not have a vet, do you have access to one?
    yes   no
19. How far is the nearest vet to your farm?
    /kilometres
20. How often does the vet visit your farm?
21. How many animals died last year?
    none   adult cases (no.)   calves (no.)
22. What are the most common animal diseases on your farm?
    none   don't know   yes (name them)
23. Do you have any problems of mastitis?
    yes   none   don't know
24. Do you have any problems of T.B.?
    yes   none   don't know
25. Do you ask for annual medical check-ups for your employees?
    yes   no

Employment

Total Employment	Semi-Skilled	Unskilled	Availability of Manager
Number			
Saudi			
Foreigner			
Average salary			

26. The qualifications of the manager:
    (a) experience
    (b) technical certificate
    (c) B Sc or higher
27. Have you ever assisted your employees in obtaining further training either through the government or on your own efforts?
    yes no

Livestock

28. Do you have any animals in the farm beside cattle? (Numbers)
    no goats sheep camels
29. What cattle breeds do you have?
30. Their total numbers
31. Proportion of male to female?
32. The number of animals over six years old:
    Male Female
33. The number of milking cows:
34. The number of dry cows:
35. The number of heifers:
36. The number of breeding bulls:
37. Is your breeding bull:
    (a) imported
    (b) off-spring of an imported bull
    (c) local breed (name the breed)

Feeding

38. Type of feed used:
    (a) green forage
    (b) dry forage
    (c) concentrates
    (d) grazing pasture on the farm
    (e) grazing natural vegetation on the farm
39. What type of green forage is used?
    (a) alfalfa
    (b) others (name) and proportion
40. Do you produce all the green forage needed?
    yes no partial (proportion)
41. What is the price per ton of green forage bought from outside?
    SR /ton
42. Type of concentrate used:
43. Do you produce your own concentrates (or supplements)?
    yes no some (proportion)
44. Present price per ton of concentrates:
    SR /ton
45. Is your feeding systemised and related to the animals' capacity for production?
    yes no
46. Do you feed mother milk to your calves?
    yes (until how old) no

47. Do you feed calves milk replacer?

Milk Products and Processing

48. What is your farm's average daily production of milk?
49. What was your farm's total production of milk last year?
50. Average milk production per cow:
51. The highest milk production per cow:
52. Do you treat the milk produced before sale?
    yes no
53. If yes, what treatments? (name them)
54. Do you do any cooling?
    yes no
55. Do you process any of your milk on the farm?
    yes no
56. Does the farm have:
    (a) mechanical milking
    (b) hand milking
    (c) milk cooling equipment
    (d) pasteurisation
    (e) separation
    (f) large cooled storage room
57. In what form do you sell the farm milk?
    (a) untreated fluid
    (b) leban
    (c) butter
    (d) treated fluid
    (e) cheeses
    (f) yoghurt
58. Milk marketing:
    (a) at the farm gate
    (b) distributed to retailers (number)
    (c) to wholesalers (number)
59. Do you sell your milk in:
    (a) closed cartons
    (b) closed bottles
    (c) open containers

Income and Investment

60. Does your farm constitute you main income?
    yes no
61. Do you sell any other farm produce beside milk and milk products?
    (a) no (e) grains
    (b) dates (f) forages
    (c) other trees (g) meat
    (d) vegetables (h) others (name it)
62. What share of farm income is derived from these products?
    (a) less than 10% (d) less than 40%
    (b) less than 20% (e) less than 50%
    (c) less than 30% (f) over 50%
63. What are your sources of finance for expansion and investment?
    (a) sales
    (b) own savings
    (c) Ag.bank
    (d) other government agencies
    (e) private loan
64. Estimated total value of the farm at present:
    (a) land
    (b) animals
    (c) buildings
    (d) pumps
    (e) machines
    Total

Remarks

65. What are your main three problems?
    (a)
    (b)
    (c)
66. Do you think you will have a more profitable enterprise by:
    (a) staying as a dairy man
    (b) changing into other agricultural fields

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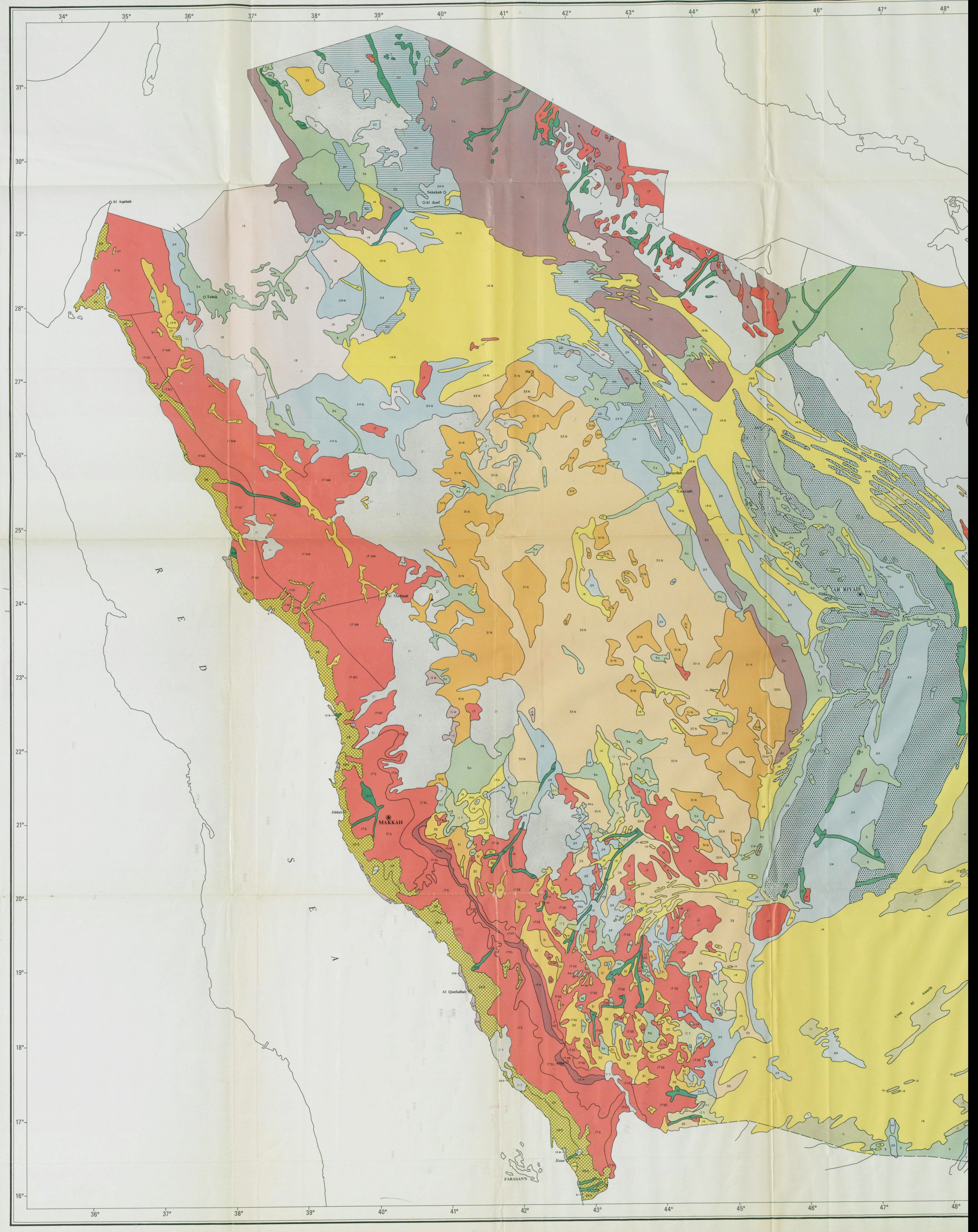
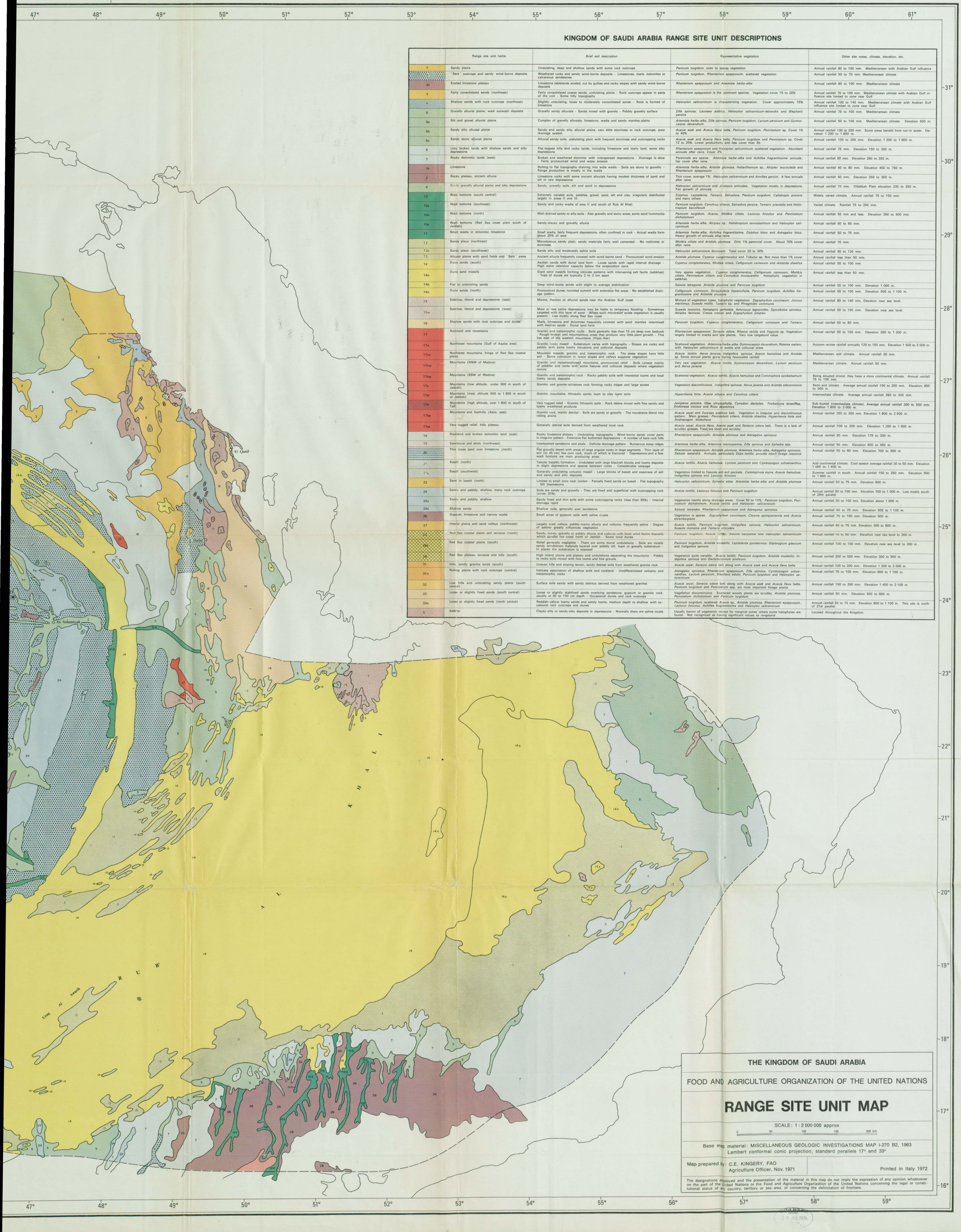


R E D S E A
Al Aqabah
Tabuk
Sakakah
Al Jawf
Ha'il
Buraydah
Unayzah
Al Madinah
AR RIYAD
As Salamiyah
Jiddah
MAKKAH
Al Qunfudhah
Abha
Jizan
FARASAN'S
Uruq Al Awarik



KINGDOM OF SAUDI ARABIA RANGE SITE UNIT DESCRIPTIONS

	Range site unit name	Brief soil description	Representative vegetation	Other site notes, climate, elevation, etc.
1	Sandy plains	Undulating, deep and shallow sands with some rock outcrops	*Panicum turgidum*, even to sparse vegetation	Annual rainfall 80 to 100 mm. Mediterranean with Arabian Gulf influence
2	'Serir' outcrops and sandy wind-borne deposits	Weathered rocks and sandy wind-borne deposits - Limestones, marls, dolomites or calcareous sandstones	*Panicum turgidum*, *Rhanterium epapposum*, scattered vegetation	Annual rainfall 50 to 70 mm. Mediterranean climate
2a	Eroded limestone plateau	Limestone tablelands eroded, cut by gullies and rocky slopes with sandy wind-borne deposits	*Rhanterium epapposum* and *Artemisia herba-alba*	Annual rainfall 80 to 100 mm. Mediterranean climate
3	Fairly consolidated sands (northeast)	Fairly consolidated coarse sands, undulating plains - Rock outcrops appear in parts of the unit - Some hilly topography	*Rhanterium epapposum* is the dominant species. Vegetation cover 15 to 20%	Annual rainfall 75 to 100 mm. Mediterranean climate with Arabian Gulf influence site limited to zone near Gulf
4	Shallow sands with rock outcrops (northeast)	Slightly undulating, loose to moderately consolidated sands - Rock is formed of limestone	*Haloxylon salicornicum* is characterizing vegetation. Cover approximately 15%	Annual rainfall 100 to 140 mm. Mediterranean climate with Arabian Gulf influence site limited to zone near Gulf
5	Gravelly alluvial plains, wadi outwash deposits	Gravelly sandy alluvials - Sands mixed with gravels - Pebbly gravelly surface	*Zilla spinosa*, *Launaea arabica*, *Haloxylon salicornicum-tetrandra* and *Blepharis persica*	Annual rainfall 75 to 100 mm. Mediterranean climate
5a	Silt and gravel alluvial plains	Complex of gravelly alluvials, limestone, wadis and sandy mantles-plains	*Artemisia herba-alba*, *Zilla spinosa*, *Panicum turgidum*, *Lycium persicum* and *Gymnocarpos decandrum*	Annual rainfall 50 to 100 mm. Mediterranean climate. Elevation 500 m.
5b	Sandy silty alluvial plains	Sandy and sandy silty alluvial plains, very little stoniness or rock outcrops, poor drainage system	*Acacia asak* and *Acacia flava* belts, *Panicum turgidum*, *Pennisetum* sp. Cover 15 to 40%	Annual rainfall 100 to 200 mm. Some areas benefit from run-in water. Elevation 1 200 to 1 800 m.
5c	Sandy stony alluvial plains	Alluvial sandy soils, undulating plain with frequent stoniness and outcropping rocks	*Acacia asak* and *Acacia flava* belts, *Panicum turgidum* and *Pennisetum* sp. Cover 12 to 25%. Lower productivity and less cover than 5b	Annual rainfall 100 to 200 mm. Elevation 1 200 to 1 800 m.
6	Limy broken lands with shallow sands and silty depressions	Flat-topped hills and rocky lands, including limestone and marly land, some silty depressions	*Rhanterium epapposum* and *Haloxylon salicornicum*, scattered vegetation. Abundant annuals after rains. Cover 2%	Annual rainfall 75 mm. Elevation 150 to 250 m.
7	Rocky dolomitic lands (east)	Broken and weathered dolomite with interspersed depressions - Drainage is slow - Fairly pronounced wind and water erosion	Perennials are sparse. *Artemisia herba-alba* and *Achillea fragrantissima* annuals; fair cover after rains	Annual rainfall 50 mm. Elevation 250 to 350 m.
7a	Limestone	Rolling to flat topography draining into wide wadis - Soils are stony to gravelly - Range production is mostly in the wadis	*Artemisia herba-alba*, *Aristida plumosa*, *Helianthemum* sp., *Atriplex leucoclada* and *Rhanterium epapposum*	Annual rainfall 40 to 80 mm. Elevation 450 to 750 m.
8	Rocky plateau, ancient alluvia	Limestone rocks with some ancient alluvials having modest thickness of sand and silt in rare depressions	Thin cover, average 1%. *Haloxylon salicornicum* and *Anvillea garcini*. A few annuals after rains	Annual rainfall 50 mm. Elevation 250 to 350 m.
9	Sandy gravelly alluvial plains and silty depressions	Sandy, gravelly soils, silt and sand in depressions	*Haloxylon salicornicum* and *Anabasis articulata*. Vegetation mostly in depressions. Fair growth of annuals	Annual rainfall 70 mm. Dibdibah Plain elevation 230 to 250 m.
10	Wadi bottoms (south central)	Extremely variable soils, pebbles, gravel, sand, silt and clay, irregularly distributed largely in areas II and III	*Ziziphus*, *Leptadenia*, *Tamarix*, *Salvadora*, *Panicum turgidum*, *Caliotropis procera* and many others	Widely varied climate. Annual rainfall 75 to 150 mm.
10e	Wadi bottoms (southeast)	Sandy and rocky wadis of area II and south of Rub Al Khali	*Panicum turgidum*, *Cenchrus ciliarus*, *Salvadora persica*, *Tamarix orientalis* and *Heliotropium bacciferum*	Varied climate. Rainfall 75 to 250 mm.
10n	Wadi bottoms (north)	Well-drained sandy to silty soils - Also gravelly and stony areas, some sand hummocks	*Panicum turgidum*, *Acacia*, *Moltkia ciliata*, *Lasiurus hirsutus* and *Pennisetum dichotomum*	Annual rainfall 50 mm and less. Elevation 350 to 500 mm.
10s	Wadi bottoms (Red Sea coast plain south of Jeddah)	Sandy-clayey and gravelly alluvia	*Artemisia herba-alba*, *Atriplex* sp., *Heliotropium ramosissimum* and *Haloxylon salicornicum*	Annual rainfall 60 to 80 mm.
11	Small wadis in dolomitic limestone	Small wadis, fairly frequent depressions, often confined in rock - Actual wadis form about 25% of area	*Artemisia herba-alba*, *Achillea fragrantissima*, *Ziziphus lotus* and *Astragalus lotus*. Heavy growth of annuals after rains	Annual rainfall 50 to 75 mm.
12	Sandy playa (northeast)	Monotonous sandy plain, sandy materials fairly well cemented - No rockiness or stoniness	*Moltkia ciliata* and *Aristida plumosa*. Only 1% perennial cover. About 70% cover after rains	Annual rainfall 70 mm.
12s	Sandy playa (southwest)	Sandy silty and moderately saline soils	*Haloxylon salicornicum* dominant. Total cover 20 to 30%	Annual rainfall 50 to 120 mm.
13	Alluvial plains with sand fields and 'Serir' areas	Ancient alluvia frequently covered with wind-borne sand - Pronounced wind erosion	*Aristida plumosa*, *Cyperus conglomeratus* and *Tribulus* sp. Not more than 1% cover	Annual rainfall less than 50 mm.
14	Dune sands (south)	Aeolian sands with dunal land form - Loose sands with rapid internal drainage - High water retention capacity below the evaporation zone	*Cyperus conglomeratus*, *Moltkia ciliata*, *Calligonum comosum* and *Artistida shaelica*	Annual rainfall 50 to 100 mm.
14a	Dune sand massifs	Giant sand massifs forming intricate patterns with intervening salt faults (sabkhas) - Tops of dunes are typically 2 to 3 km apart	Very sparse vegetation. *Cyperus conglomeratus*, *Calligonum comosum*, *Moltkia ciliata*, *Pennisetum ciliaris* and *Cornulaca monacantha*. Halophytic vegetation in sabkhas	Annual rainfall less than 50 mm.
14b	Flat to undulating sands	Deep wind-borne sands with slight to average stabilization	*Salsola tetragona*, *Aristida plumosa* and *Panicum turgidum*	Annual rainfall 50 to 100 mm. Elevation 1 000 m.
14n	Dune sands (north)	Pronounced dunes, rounded summit with extensive flat areas - No established drainage pattern	*Calligonum comosum*, *Scrophularia hypericifolia*, *Panicum turgidum*, *Achillea fragrantissima* and *Artistida plumosa*	Annual rainfall 50 to 100 mm. Elevation 500 to 1 100 m.
15	Sabkhas, littoral and depressions (east)	Marine, Aeolian or alluvial sands near the Arabian Gulf coast	Mixture of vegetation types, halophytic vegetation. *Zygophyllum coccineum*, *Juncus maritimus*, *Suaeda mollis*, *Tamarix* sp. and *Phragmites communis*	Annual rainfall 80 to 140 mm. Elevation near sea level.
15w	Sabkhas, littoral and depressions (west)	More or less saline depressions may be liable to temporary flooding - Sometimes carpeted with thin layer of sand - Where such microrelief exists vegetation is usually present - Lies mostly along Red Sea coast	*Suaeda monoica*, *Halopeplis perfoliata*, *Aeluropus lagopoides*, *Sporobolus spicatus*, *Atriplex farinosa*, *Cressa cretica* and *Zygophyllum simplex*	Annual rainfall 50 to 150 mm. Elevation near sea level.
16	Shallow sands with rock outcrops and dunes	Marls, limestone and dolomites frequently covered with sand mantles intermixed with Aeolian sands - Dunal land form	*Panicum turgidum*, *Cyperus conglomeratus*, *Calligonum comosum* and *Tamarix*	Annual rainfall 50 to 80 mm.
17	Rockland and mountains	Granitic and metamorphic rocks - Soils generally less than 15 cm deep over bedrock - Rough broken and mountainous areas that produce very little plant growth - This lies east of the western mountains (Hijaz-Asir)	*Rhanterium epapposum*, *Senecio odora*, *Rhazya stricta* and *Fagonia* sp. Vegetation largely limited to cracks and low places. Very low rangeland value	Annual rainfall 50 to 100 mm. Elevation 300 to 1 300 m.
17n	Northwest mountains (Gulf of Aqaba area)	Granitic rocky massif - Substratum varies with topography - Slopes are rocky and pebbly with some loamy intrusions and colluvial deposits	Scattered vegetation. *Artemisia herba-alba*, *Gymnocarpos decandrum*, *Retama raetam*, with *Haloxylon salicornicum* in wadis and colluvial areas	Autumn-winter rainfall annually 120 to 150 mm. Elevation 1 500 to 2 000 m.
17nc	Northwest mountains, fringe of Red Sea coastal plains	Mountain massifs, granitic and metamorphic rock - The steep slopes have little soil - Some colluvium in lower slopes and valleys supports vegetation	*Acacia tortilis*, *Aerva javania*, *Indigofera spinosa*, *Acacia hamulosa* and *Aristida* sp. Some annual plants grow during favourable rainfall	Mediterranean arid climate. Annual rainfall 30 mm.
17nw	Mountains (NNW of Medina)	Granitic and metamorphosed mountains, pronounced relief - Soils consist mainly of pebbles and rocks with some fissures and colluvial deposits where vegetation occurs	Very rare vegetation. *Acacia tortilis*, *Gymnocarpos decandrum*, *Lycium persicum* and *Aerva javania*	Mediterranean climate. Annual rainfall 50 mm.
17sw	Mountains (SSW of Medina)	Granitic and metamorphic rock - Rocky pebbly soils with interstitial loams and local loamy sandy deposits	Scattered vegetation. *Acacia tortilis*, *Acacia hamulosa* and *Commiphora opobalsamum*	Being situated inland, they have a more continental climate. Annual rainfall 75 to 100 mm.
17s	Mountains (low altitude, under 900 m south of Jeddah)	Granitic and granite-schistose rock forming rocky ridges and large screes	Vegetation discontinuous. *Indigofera spinosa*, *Aerva javania* and *Aristida adscensionis*	Semi-arid climate. Average annual rainfall 100 to 250 mm. Elevation 800 to 900 m.
17sl	Mountains (med. altitude 900 to 1 800 m south of Jeddah)	Granitic mountains, lithosolic sandy loam to clay loam soils	*Hyparrhenia hirta*, *Acacia etbaica* and *Cenchrus ciliaris*	Intermediate climate. Average annual rainfall 280 to 300 mm.
17h	Mountains (high altitude, over 1 800 m south of Taif)	Very rugged relief - Granitic lithosolic soils - Rock debris mixed with fine sandy and loamy weathered products	*Juniperus procera*, *Olea chrysophylla*, *Cynodon dactylon*, *Tricholaena teneriffae*, *Dodonaea viscosa* and *Rosa abyssinica*	Sub-humid (intermediate climate). Average annual rainfall 300 to 500 mm. Elevation 1 800 to 3 000 m.
17he	Mountains and foothills (Asirs, east)	Granitic rock, mainly detrital - Soils are sandy or gravelly - The mountains blend into rolling plains	*Acacia seyal* and *Euryops arabicus* belt. Vegetation in irregular and discontinuous pattern. Main grasses: *Pennisetum ciliaris*, *Aristida shaelica*, *Hyparrhenia hirta* and *Andropogon distachyus*	Annual rainfall 250 to 300 mm. Elevation 1 800 to 2 500 m.
17se	Very rugged relief, hilly plateau	Generally detrital soils derived from weathered local rock	*Acacia seyal*, *Acacia flava*, *Acacia asak* and *Senecio odora* belt. There is a lack of scrubby grasses. Trees are short and scrubby	Annual rainfall 100 to 200 mm. Elevation 1 200 to 1 900 m.
18	Rockland and broken dolomitic land (east)	Rocky limestone plateau - Undulating topography - Wind-borne sands cover parts in irregular pattern - Extensive flat-bottomed depressions - A number of bare rock hills	*Rhanterium epapposum*, *Aristida plumosa* and *Astragalus spinosus*	Annual rainfall 50 mm. Elevation 175 to 300 m.
19	Sandstone and shale (northwest)	Interbedded sandstone and shale - Definite drainage pattern - Numerous steep ridges	*Artemisia herba-alba*, *Artemisia monosperma*, *Zilla spinosa* and *Ephedra* spp.	Annual rainfall 50 mm. Elevation 600 to 950 m.
20	Thin loose sand over limestone (north)	Flat gravelly desert with areas of large angular rocks in large segments - Thin layer of soil (to 45 cm) lies over rock, much of which is fractured - Depressions and a few wadi bottoms are main producing areas	*Rhanterium epapposum*, *Artistida plumosa*, *Artemisia herba-alba*, *Astragalus spinosus*, *Salsola tetrandra*. Annuals, particularly *Stipa tortilis*, provide much forage resource	Annual rainfall 50 to 80 mm. Elevation 700 to 900 m.
21	Basalt (north)	Tabular basaltic formation - Undulated with large blackish blocks and loamy deposits in slight depressions and spaces between rocks - Considerable seepage	*Acacia tortilis*, *Acacia hamulosa*, *Lycium persicum* and *Cymbopogon schoenanthus*	Arid continental climate. Cool season average rainfall 30 to 50 mm. Elevation 1 000 to 1 400 m.
21s	Basalt (southwest)	Generally undulating volcanic massif - Large blocks of basalt and expanses of ash and sandy and silty deposits	Vegetation limited to fissures and soil pockets. *Commiphora myrra*, *Acacia hamulosa*, *Indigofera spinosa* and *Lasiurus hirsutus*	Summer rainfall in south. Annual rainfall 150 to 250 mm. Elevation 900 to 1 800 m.
22	Sand in basalt (north)	Limited to small zone near Jordan - Partially fixed sands on basalt - Flat topography - Silt depressions	*Haloxylon salicornicum*, *Ephedra alata*, *Artemisia herba-alba* and *Aristida plumosa*	Annual rainfall 50 to 75 mm. Elevation 600 m.
24	Sandy and pebbly, shallow, many rock outcrops	Soils are sandy and gravelly - They are fixed and superficial with outcropping rock (cover 35%)	*Acacia tortilis*, *Lasiurus hirsutus* and *Panicum turgidum*	Annual rainfall 50 to 100 mm. Elevation 700 to 1 000 m. Lies mostly south of 26th parallel
24a	Sandy and pebbly, shallow	Sandy fixed and thin soils with some outcropping rocks (less than 35%) - Internal drainage rapid	Vegetation mainly along drainage areas. Cover 50 to 10%. *Panicum turgidum*, *Pennisetum dichotomum*, *Acacia tortilis* and *Haloxylon salicornicum*	Annual rainfall 50 to 100 mm. Elevation about 1 000 m.
24n	Shallow sands	Shallow soils, generally over sandstone	*Salsola tetrandra*, *Rhanterium epapposum* and *Astragalus spinosus*	Annual rainfall 50 to 75 mm. Elevation 600 to 1 100 m.
26	Gypsum, limestone and narrow wadis	Small areas of gypsum soils with saline crusts	Vegetation is sparse. *Zygophyllum coccineum*, *Cleome quinquenervia* and *Acacia ehrenbergiana*	Annual rainfall 75 to 100 mm. Elevation 500 m.
27	Interior plains and sand valleys (northwest)	Largely wadi valleys, pebbly-loamy alluvia and colluvia, frequently saline - Degree of salinity greatly influences vegetation	*Acacia tortilis*, *Panicum turgidum*, *Indigofera spinosa*, *Haloxylon salicornicum*, *Suaeda monoica* and *Tamarix articulata*	Annual rainfall 40 to 75 mm. Elevation 300 to 800 m.
28	Red Sea coastal plains and terraces (north)	Sandy, loamy, gravelly or pebbly alluvia and colluvia with local wind-borne deposits which parallel the coast north of Jeddah - Some local dunes	*Panicum turgidum*, *Acacia* [illegible], *Salsola baryosma* and *Haloxylon salicornicum*	Annual rainfall 10 to 50 mm. Elevation near sea level to 300 m.
28s	Red Sea coastal plains (south)	Relief generally negligible - There are some dunal undulations - Soils are mostly sandy windblown materials layered over pebbly silt, loam or gravelly substratum - In places the substratum is exposed	*Panicum turgidum*, *Aristida mutabilis*, *Leptadenia pyrotecnica*, *Dipterygium glaucum* and *Indigofera spinosa*	Annual rainfall 100 to 150 mm. Elevation near sea level to 300 m.
29	Red Sea plateau, terraces and hills (south)	High inland plains and plateau and undulations separating the mountains - Pebbly to rocky soils mixed with fine loams and fine gravels	Vegetation quite variable. *Acacia tortilis*, *Panicum turgidum*, *Aristida mutabilis*, *Indigofera spinosa* and *Dactyloctenium sindicum*	Annual rainfall 200 to 500 mm. Elevation 300 to 900 m.
31	Hilly, sandy, granitic lands (south)	Uneven hills and sloping terrain, sandy detrital soils from weathered granite rock	*Acacia seyal*, *Senecio odora* belt along with *Acacia asak* and *Acacia flava* belts	Annual rainfall 100 to 200 mm. Elevation 1 200 to 2 000 m.
31n	Rolling plains with rock outcrops (central)	Intricate association of shallow soils and rockland - Undifferentiated volcanic and metamorphic rocks	*Astragalus spinosus*, *Rhanterium epapposum*, *Zilla spinosa*, *Cymbopogon schoenanthus*, *Lycium persicum*, *Blepharis edulis*, *Panicum turgidum* and *Haloxylon salicornicum*	Annual rainfall 75 to 100 mm. Elevation 800 to 1 100 m.
32	Low hills and undulating sandy plains (south central)	Surface soils sandy with sandy detritus derived from weathered granites	*Acacia seyal*, *Senecio odora* belt along with *Acacia asak* and *Acacia flava* belts. *Panicum turgidum* and *Pennisetum* spp. are most important forage plants	Annual rainfall 150 to 250 mm. Elevation 1 400 to 2 100 m.
33	Loose or slightly fixed sands (south central)	Loose or slightly stabilized sands overlying sandstone, gypsum or granitic rock, usually at 30 to 100 cm depth - Occasional dunes and rock outcrops	Vegetation discontinuous. Scattered woody plants are scrubby. *Aristida plumosa*, *Pennisetum dichotomum* and *Panicum turgidum*	Annual rainfall 50 mm. Elevation 500 to 800 m.
33n	Loose or slightly fixed sands (north central)	Reddish-yellow loamy sands and sandy loams, medium depth to shallow with occasional rock outcrops and dunes	*Panicum turgidum*, scattered *Acacia* sp., *Aristida plumosa*, *Rhanterium epapposum*, *Lasiurus hirsutus*, *Achillea fragrantissima* and *Haloxylon salicornicum*	Annual rainfall 50 to 75 mm. Elevation 800 to 1 100 m. This site is north of 21st parallel
S	Sabkha	Clayey-silty or sandy-silty deposits in depressions - Normally there are saline crusts	Usually barren of vegetation except for marginal zones where some halophytes are found. Not recognized as having significant values as rangeland	Located throughout the Kingdom.

THE KINGDOM OF SAUDI ARABIA

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RANGE SITE UNIT MAP

SCALE: 1 : 2 000 000 approx

0 50 100 150 200 km

Base map material: MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-270 B2, 1963
Lambert conformal conic projection; standard parallels 17° and 33°

Map prepared by: C.E. KINGERY, FAO
Agriculture Officer, Nov. 1971

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