The geography of Argiculture in irrigated areas of the middle Euphrates valley

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The Geography of Agriculture in Irrigated Areas
of
The Middle Euphrates Valley

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PREFACE

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PREFACE

Research Methods

The thesis attempts to analyse the regional diversity of life in the Middle Euphrates Valley, the most important agricultural region in Iraq. The irrigated agriculture of this region sheds light on the future development of other regions in the country.

Consideration is in two major divisions, the physical and the agricultural. The physical aspects studied include the geology, physiography, soils, climate and water resources of the area. The second major part of the approach investigates irrigation, the agriculture, rural settlement, and farming development, along with a comparison between the Middle Euphrates scene and similar areas in other countries.

The physical section is based in large part on published or otherwise written material, including:

(a) Older, pre-1939 material, of some value, and

(b) Recent reports, articles and other official statements appearing within the past few years. The agricultural section, on the other hand, is the result of personal field research in the area. It is at once extensive, in that a total coverage of the area was made, and intensive, where small sample areas were selected for detailed study on the basis of their representative regional characteristics.

The initial difficulty at all stages of the field work was transport. This took three very different forms. A large part of the area was surveyed by motor vehicle where such was available. In marshy areas a small boat (mashhoof) is the sole means of transport, while other areas far into the Jezireh were reached on horse-back. Moreover progress was made no easier by difficulties of finding accommodation in the rural areas nor by the ignorance of many people approached and the refusal of others to co-operate.

The sources contacted during the field research were:

(a) Government Offices, which provided reports, articles and other official information and statistics. Prior to as late as 1957 relevant statistics were singularly limited as well as inaccurate.

(b) Land-owners, including sheikhs, landlords living in the towns, and the pump-owners. It was often difficult to get such individuals to comprehend the purpose of the enquiries.

(c) Fellahin, who were often too ignorant or too frightened of their landlords to give the required information.

(d) Financiers, who lend the cultivators necessary capital, were another important source. Being more educated these people were able to provide accurate supplementary information.

The field work was begun in 1954 and extended over the following four years. Apart from the general traverses of the whole area a large number of farms in the regions were selected for detailed survey. In these cases an effort was made to contact all responsible individuals such as farmers, tenants, and land-owners as local government officers.

Acknowledgments

This thesis has been prepared during the past three years for submission for the Degree of Doctor of Philosophy in the University of Durham.

It concerns an analysis of the problems associated with the development of the Middle Euphrates Valley. Studying these problems has involved, in turn, an evaluation of the physical, demographic and agricultural aspects of the region. This however was not thought sufficient and a detailed attempt has been made to synthesise all factors affecting agricultural development in this part of Iraq. Irrigation is of major importance and therefore a large part of this thesis has been devoted to its study.

Many were those who helped me in so many ways. My grateful acknowledgments are rendered to Professor W.B. Fisher, who accepted me as a postgraduate research student in his department and through his kind encouragement made the work possible. He was always helpful and patient. I would also like to thank the large number of individuals and institutions who helped by providing statistics and maps.

PART I

THE ENVIRONMENT

CHAPTER I

Introduction
(Map I)

The country of Iraq lies between longitudes 38°42 E and 48°23 E and latitude 29°27 N and 37°23 N, mainly along a vast depression which runs down in a N.W. - S.E. direction from the Turkish highlands to Persian Gulf with the plateau of Arabian and Syrian desert on one side and the mountain wall of Iran (Persia) on the other. The floor of this depression is the flood plain of the rivers Tigris and Euphrates which flow from the north-west to the south-east respectively. This alluvial plain is almost flat, having an average altitude of not more than 15-30 metres above sea level.

Iraq forms a triangular area of approximately 181,400,000 mesharas (453,500 sq. kms. or 180,000 sq. miles) with the base of the triangle running northwest to southeast and the apex terminating at the Persian Gulf. This measures over 960 Kms. at its greatest width. It is bounded on the west by the Syrian desert which separates it from Syria (United Arab Republic) to the north and Jordan to the south-west, on the south by the desert of Arabia (Arabian Massif), on the south-east by the shore of the Persian Gulf, on the east and north-east by the Zagros mountains and on the north by the mountains of the Turkish-Iraq border area where the Khabur tributary of the Tigris rises.

(1) Topography

Iraq may be subdivided into the following physiographic regions:

(1) The folded mountain zone.

(2) The steppes of the northern Jezireh (Jezireh High Plain).

(3) The western desert plateau.

(4) The alluvial lowland.

The Folded Zone This folded zone lies in the N.E. and includes two different sections; the Kurdish high mountains further north and the foothill areas to the south. These merge to form a Zone, topographically indistinct but marked by a line of settlements which includes Fish-Khabur, Al-Qosh, Agra, Koi Sanjak, Chemchemal and Kasir-Shiren, which is N. of Khanagin just over the Persian border.

To the N.E. the country is of a mountainous character, varying from 450 to 750 metres in the lowest valleys to 1,800 - 3,600 metres in the highest mountain summits. The highest peak in Iraq is that of Ari Gird Dagh (Alt. 3,660 metres), situated on the Persian border north-east of Rowanduz. Beyond the Turkish border to the north even greater altitudes are reached. Many deep limestone gorges characterise this region, separating mountain chains which trend generally either from north-west to south-east or from east to west. While the upper mountain slopes are often bare and rocky, extensive oak forests occur up to a height of about 1,800 metres. This area contains many well watered valleys, sometimes opening out into high rolling plains. The inhabitants practise a certain amount of cultivation in the valleys where their villages are situated. They practise transhumance taking their flocks in summer to the high mountain pastures. The mountain passes are blocked in winter with snow for several months on end and, on the higher summits, small patches of snow can generally be found throughout the summer.

The foothill zone area is situated directly south of this high mountain belt, stretching south-westwards as far as the Jabal Hamrin. It is an undulating area, broken here and there by hills and hill ranges, which increase in altitude from about 600 to 1,500 feet, the land sloping gradually towards the north-east. The extreme south of this area near the Jabal Hamrin is semi-desert, arid and unfit for cultivation, while to the east, close to the high mountain belt, the rainfall increases rapidly and the character of the land changes.

The Jabal Hamrin, which represents the south-west border of this area, is a low range of dry hills starting from a point some 96 km. north-east of Baghdad and running up in a north-westerly direction. It forms an abrupt wall at the upper limit of its range. The height of the Jabal Hamrin varies from 150 to 210 metres. West of the Tigris it is continued as the Jabal Makhul, a considerably higher range running in a more northerly direction. The Tigris river pierces the Makhul-Hamrin range by the Fattah Gorge.

<u>The steppes of the Jezireh High Plain</u> The tract of country which lies between the Upper Tigris and the Euphrates north of a line between Baghdad and Ramadi is known as Al-Jezireh ("the island"). The Jezireh is bounded on two sides by the rivers, and on the north by the fold ranges of Asia Minor. Beyond the upper limit of the alluvial plain the land begins to slope more rapidly to the north, rising to an altitude of 270-300 metres above sea level at the foot of Jabal Sinjar, a distance of about 400 km. from Baghdad (alt. 34.5 metres). For the most part, the Jezireh consists of an undulating plain or low plateau, lying at an altutide of 150-300 metres above sea level, with a number of small closed basins from which there is no drainage outlet. The largest of these basins is a long narrow trench cut deeply into the plateau and known as the Wadi Al-Tharthar. The Wadi Al-Tharthar is a large water course which begins near the eastern end of Jabal Sinjar and ends in a large saline depression (Sabka Um Rahal) 32-48 km. north of Ramadi on the Euphrates. It may be a tectonic feature, or even an old river valley now dried out except in the winter season. It is now used only for grazing by the nomads, but in the past it provided a north-south route-way. Since 1956, Al-Tharthar depression (Sabka Um Rahal) has been used as a reservoir which is connected to the Tigris at Samarrah through a channel which discharges into the depression.

The Jezireh is traversed by several chains of low hills, the highest range being Jabal Sinjar which lies to the north-west of the Wadi Al Tharthar. The upper slopes, around the 900 metres level, have a heavier rainfall, and some settled cultivation is therefore possible. The Yezidi, who inhabit the Jabal, practise mixed arable and pastoral farming. The Jezireh, south of the Jabal Sinjar is uninhabited, but in spring and early summer large flocks of sheep and herds of camels occupy the Bedouin pastures, for, in spite of the aridity of this region it contains numerous wells and springs which can be tapped at that time of the year.

The region on the eastern bank of the Tigris is known as Assyria. Here the land rises in steps from the Tigris towards the north-east, each step being marked by increasingly prominent ridges that are aligned generally from north-west to south-east. The first of these ranges is the Jabal Hamrin which fronts the Tigris along a part of its course. Numerous tributaries of the Tigris have broken through the ridges, forming gaps or gorges, so that the whole region of Assyria has been dissected, giving on the south-west a fairly broad open plain with occasional higher ridges. This passes towards the north-east into an increasingly broken sub-mountainous country with scattered lowland basins shut in by hills.

<u>The western desert plateau</u> This region, an extensive plain rising from the western side of the Euphrates Valley, culminates in the Jabal Aineza, near the Iraq-Transjordan-Arabian border, at an elevation of about 990 metres. The gradient in all

directions from this summit is gentle, some 5 metres to the Km. A few wadis (water courses) dissect its surface, an example being the Wadi Hauran, which runs from the summit of Jabal Aineza for some 480 Km. to the Euphrates, being in places a Km. wide and attaining depths of 60 metres. The monotony of the plain is occasionally broken by low hills of volcanic origin.(1)

The western desert may be divided into two sections, north and south. The northern half slopes gradually up to form the plateau of the Syrian Desert, an immense tract of infertile country separating Iraq from Syria and Jordan. The general surface of land is more or less level or slightly undulating with scattered low barren hill ranges. It is a great, open, and somewhat stony waste traversed by wadis which are dry for the greater part of the year. Only the routes from Baghdad to Damascus and Amman through Ramadi city, (a distance of 800-960 Km) are at all frequented. The rest of the area is entirely desolate and uninhabited except by the Bedouin who bring their flocks and camels there to pasture at certain seasons of the year. From Ramadi westward the plateau gradually rises until it attains a height of 750 - 900 metres. In spring, if the rains have been sufficient, it is clothed with short green pasture in many places, but by early summer all this has been burnt up by the sun and no vegetation except the perennial bushes remains.

The southern half of the desert is bounded on the east by the lower reaches of the alluvial plain of the Euphrates, stretching to the boundaries of Nejd and Kuwait. This is the

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(1) Hot A.L: "The future of the North Arabia Desert", Geog. Jour. Vol. LXII, October, 1923, p.262-3.

northern limit of the Arabian desert, an extremely dry and inaccessible region. Only the fringe of this, in the locality of Zubair village near Basra, has been visited by the author. It is an arid pebbly plain in which there are some ranges of low rocky hills. Jabal Sannam (alt. 138 metres) is the highest point in this region; it lies south of Zubair on the border of Kuwait.

The alluvial lowland. The boundary of this zone starts from the settlement of Mandeli (to the east of the Tigris) passing the town of Khalis, and stretches to a point 64 km. north of Baghdad, and then goes west to Al-Aswad, 26 kilometres north-west of Ramadi, on the eastern bank of the Euphrates. Here a drop of 6 - 15 metres is stated by some authors to mark the ancient coastline of the Persian Gulf suggesting that the plain represents the ancient delta of the rivers Tigris and Euphrates, which for many centuries have been advancing into the Persian Gulf. It should be noted however that this view is not universally accepted, and while detailed consideration of this, and of alternative theories of formation is deferred for the time being, it may be stated that this opinion is shared by the present writer. It is almost level, the land falling only about 35 m. in the 560 km. from Baghdad to the sea. The remains of ancient canals and the mounds of buried cities alone break the monotonous flatness, "tels" or eminences of 6 - 9 metres being marked as hills on the map. The rainfall is low and except where irrigation is available it is an arid waste, only clothed with a sparse green covering in spring for a short period following the winter rains. By May this ephemeral vegetation has gone. At other times of the year only the perennial bushes are found. The cultivated areas of the alluvial plain consist principally of a narrow strip along the river's edge where water is available. In addition, in the Middle Euphrates valley, there are considerable areas between Hilla and Samawa irrigated by canals which draw their water from the Hindiya barrage. Similar irrigation systems from the Diyala (a tributary of the Tigris) have been built in the neighbourhood of the settlements of Khalis, Baqubah, Balad-Ruz and Shahraban.

The important feature to be noticed is the variation in level between the main streams of the Tigris and Euphrates. From Aziziyah Nahiya, a point mid-way between Baghdad and Kut, to Qurna, the bed of the Tigris lies at a slightly higher altitude than that of the Euphrates, allowing the easy construction of free-flowing irrigation channels. In the region situated between Aziziyah and Baghdad on the Tigris, the position is reversed, with the Euphrates lying higher than the Tigris. This circumstance has for centuries been utilized with much effect for irrigation.

The area of swamps is shaped like a triangle with its apex of Basra and base between Amara and Nasiriya. The area is liable to inundation due to the annual flood of the Tigris and

Euphrates, and is much flatter and lower than the zone to the north. As a result, much of the region is undisturbed swamp, are parts are still entirely uninhabited and unsurveyed. The greater part of the area between Amara and Nasiriya is permanent marsh. Other permanent marshes occur to the south of Kut and to the east of the Tigris between Amara and Qurna. The inhabitants live in reed huts along the waters edge and ply their trade in boats. Deltas are continually pushing out southwards into the marsh with each successive deposition of silt, so that what was good rice land at one time is soon afterwards cultivated for wheat and barley. Water-buffalo are almost the only animals kept.

The Shatt Al Arab, formed by the confluence of the Tigris and Euphrates, is a broad navigable waterway, fringed by a belt of palms, two km. or four wide, behind which occur masses of tall reeds, sometimes more than 6 metres tall.

Finally, the south-east coastline is the only area of Iraq which lies on the Persian Gulf. It extends some 40 km. from the mouth of the Shatt Al Arab to the boundary of Kuwait. It is low alluvial land intersected by numerous irrigation creeks from the river. In some places it is bare mud, in others it is covered with grasses and reeds and ultimately merges with the desert behind. It has no beaches. At certain points the sea runs inland for several km. at high tide forming a large area of shallow water.

(ii) Structure

In order to understand the main structural outlines of Iraq it is necessary first to consider tectonic disturbances which have affected neighbouring regions.

In the Pliocene age great earth waves originated in the north-east of Iraq and in the areas beyond, and they took a south-westerly direction towards the rigid mass of Arabia. Accordingly the structural contrast of the land between the Iraq mountain front and that of the Arabian foreland is reflected in the physical geography.

From north-east to south-west altitude decreases, from the mountain summits to the foothills bordering the Jezireh High Plain. The latter occupies the upper part of the geosynclinal valley above the Plain, regarded as the lower part of it. This is a common feature of the land lying between the Alpine system of the Zagros mountains in the north-east and the foreland of Arabia in the south-west.

While the dominant feature in this area is simplicity the compressional movements of the Pliocene directed from the thrust fronts of Central Persia towards the Arabian Massif produced a strong local pattern of compressions and faults. Several anticlines have lengths of 320 to 400 kms. and many 160 to 320 kms. The straightness of these great fold lines indicates an unusual regularity and constancy of the compressive force. The mountain anticlines mostly expose Cretaceous and Jurassic limestones, but towards the south-west the structural elevation of the anticlines decreases and in the foot-hill zone to the south-east the Cretaceous limestones still have a cover of softer and plastic strata of the Miocene and Pliocene. This zone contains the oilfields of Iraq which stretch from the Turkish frontier north of Mosul down through Kirkuk oilfield in the centre to the Naft Khaneh at the Iraqi-Persian border. Their width includes the land between the high mountains in the north-east and the Jezireh high plain in the south-west.

In the light of this discussion it is possible to divide Iraq structurally into three divisions:-

(1) The folded Zone.

(2) The geosynclinal plain.

(3) The foreland of western desert.

<u>The folded Zone</u> Events in the geological history of Iraq indicate in the region south-west of the Euphrates and possibly part of the south-western Jezireh high plain the influence of the Arabian basement. Beyond this basement, both north and north-east of the Delta lands, the sedimentary strata thicken until they reach a depth of 45 metres which is more than ten times greater than that in the south-west (desert). These beds of oceanic deposits have been bent during the tectonic disturbances into a folded mountain system. The outermost folds rise from the plains as gentle and regular features. Many of them north-west of the Diyala river are similar, but some are higher and steeper than others. Towards the Persian

frontier in Kurdistan the regular folds are replaced by numerous disturbances in the nature of these faults which have produced beds of tilted strata, packed like tiles on a house roof, each bed dipping north-eastwards and with its south-western edge resting on it's neighbour. This present position is the result of more complex processes, the rock sheets having been forced in from outside of Iraq.

As to the simpler folds of the foothills nearer the plains, many can be traced north-westwards of the Diyala (Map 1) for long distances, even beyond the Upper Zab (a tributary of the Tigris), where folding remains generally of a simple type. West of the Tigris, north and south of Mosul, some folds can be traced far into the Jezireh as low ranges separated by many kilometres of plain. One such fold, the Jabal Sinjar, is situated west of Mosul in the Upper Jesireh plain.

These outer folds are arranged in four parallel chains running approximately from south-east to north-west, and finally north of Mosul they begin to swing from east to west.

The belt of country for nearly 32 km. to the north is only warped, then folds again become numerous. These mountain chains are less easy to describe from end to end, because they are closer together and the rivers have cut deeply into them. Between the Upper Diyala and the Lower Zab (a tributary of the Tigris) there are three parallel chains forming the broad swelling elevations near to the settlement of Chemchemal. To the north-east of this chain there is Pir-i-Mukurun which forms a fourth one which is a marked feature in this part of the area. North-east of it from two to five others can be traced in the Sulaimaniya territory.

Between the two Zabs, in continuation of this group, there are several closely packed parallel folds. Sefin Dagh[1] is an outstanding feature which acts as a formidable barrier between the Erbil Plain to the west and the settlement of Rowanduz to the east. West of the Upper Zab four folds rise from the plain 32 and 48 km. north-east of Mosul. The folds are mostly broad and rather gentle, though they are deeply cut by gorges. The topography of these four latter folds is less regular and not so easily related to the structural foundation as that of the folds in the foothills area to the south.

<u>The geosynclinal plain</u> This area may be divided lithologically and topographically into upper and lower divisions, the former called the Jezireh High Plain and the latter the Alluvial Plain.

The Jezireh High Plain lies along the axis of a north-west trending geosyncline which occupies the central portion of Iraq and plunges to the east-south-east. This geosyncline is a broad structural depression of down-folded sedimentary formations. In the Plain to the south of the degraded cliff line of the Quaternary Persian Gulf, the basin is filling with materials carried down from the upland areas mainly by the streams of the Tigris and Euphrates and to a much lesser extent by the winds.

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(1) Dagh means a mountain in Kurdish language.

The alluvial, lacustrine and aeolian deposits of Pleistocene and Recent age are underlain by older folded formations that outcrop on either side of the great basin in Iraq. These are the Euphrates formations, the Fars series, and the Bakhtiari formation. North of the alluvial plain in the Jezireh high plain, , the geosyncline is devoid of any extensive alluvial cover over these older strata, with the exception of minor amounts of Older alluvium.

The formations exposed in the area on the west limb of the geosyncline are the Lower Bakhtiari and the Upper Fars formations. These formations outcrop on the eastern side of the Wadi-Al-Tharthar and dip very gently to the north-east. The limit of the geosyncline is stated by the 1955 report of the Parsons Company to lie approximately 32 kilometres south-west of the base of the Jabal Hamrin. The formations exposed on the eastern limb of the geosyncline are the Fars series, and the Lower Bakhtiari formations which outcrop on the south-west flank of Jabal Hamrin and Jabal Makhul.

The anticlinal folds in the area represented by Jabal Sinjar in the farther north, Jabal Hamrin and its north-westerly extension Jabal Makhul (see p. 3). There are small synclines to the west flank of Hamrin and it is possible that several minor flexures also occur to the south-west of the area.

Faults which occur on Jabal Hamrin and Makhul are believed to result from tectonic disturbances. There is another remarkable feature which is represented by the depressions of Al-Tharthar and Shari Lake. Rees Williams, a government geologist, believes that these depressions are attributed to down faulting.

The Plain which now forms the lowlands of Iraq consists of the lower part of the geosyncline which has subsequently been filled with deposits of silt. During the evolution of the eastern mountains and the western plateau to their present condition, the space between them had remained submerged throughout the earth movements. This plain is restricted by the proposed prehistoric head of the Persian Gulf extending far to the north-west about 64 kms. north of Baghdad. Its head then lay south-west of the settlement of Tikrit, and the Euphrates and Tigris entered it separately.. No permanent streams reached it from the western plateau of Arabia, while below the Tigris mouth along the north-east coast of the Gulf there entered a number of small rivers and two large ones, the Karkheh and the Karun (Persian rivers). Especially during their flood periods each year all streams carried a great quantity of sediment which they deposited in the Gulf.

The deltas of the Tigris and the Euphrates merged as a result of the normal operation of the sea current in removing and distributing the invading silt which was provided by action of the Karun-Karkheh on the one hand and the deposits which were brought down by transaction of the Twin Rivers and their tributaries on the other. The delta of Karun-Karkheh which grew more quickly than those of Tigris and Euphrates enclosed a long sheet of water north-west of it. This basin due to the Karun-Karkheh delta process formed a barrier which aided the formation of the Tigris-Euphrates delta.

<u>Foreland of West Desert</u> The rigid block of western desert is regarded as a part of the ancient African continent which ends just west of the Euphrates. It has formed a resistant foundation covered by sedimentary layers, thin on the west but thickening as the river is approached.

The structure of this region is composed of a succession of layers deposited on the rigid continental block and on its gentle eastern slope during the following geological stages. Sometimes this block has been above sea-level and subject to the desert conditions but always the sea lapped its edge, advancing and retreating over its surface, because of changes in the relative level of land and sea. This ancient basement also has an irregular surface of depressions due to warping and differential fault movements. Thus, there are remarkable features of these deformations and faults represented by many depressions and springs. The depressions which stretch along the areas bordering the geosynclinal belt are from the north to the south, Habbaniya depression, Abu-Dibis depression and Bahr Najaf, while the springs include the Kubaisa, Rahalia, Shithatha and Tujagana.

(iii) <u>The regime of the Euphrates and Tigris</u>

Both the Euphrates and Tigris rise in the Armenian mountains of Turkey being fed by melting snow and rainfall. They flow south-east until their confluence at Qurna where they form Shatt Al-Arab which discharges into the Persian Gulf.

The Euphrates after leaving Turkey has an arc-shaped course flowing through north-east and entering Iraq south of the Albu Kamal 8 kms. north of the boundary. Hence the river is confined between the fairly high parallel rocky ridges of the Syrian desert to the west bank and the Jezireh plateau to the east bank as far south as Al-Aswad which stands at the head of the alluvial plain.

Throughout this section the river flows swiftly in in a narrow, deeply incised valley and flows therefore much more quickly than in either the upper or lower courses in Syria or in the alluvial plain area. Furthermore, there is a remarkable feature, composed of a successive series of water-falls which dominates this part of the river course. These water-falls, constructed of limestones by local inhabitants, turn the water wheels to lift water from the stream for irrigation. South of Al-Aswad the river flows south-easterly in the alluvial plain until it joins the Tigris at Qurna (see pp.93-97).

The Tigris rises in the Armenian mountains north of Diarbeker settlement within Turkey. It receives many tributaries throughout its course from the sources in the north to mouth on the Persian Gulf in the south. The main tributaries which flow in Iraq and discharge their water into Tigris from the north to the south are Khabur, Upper Zab, Lower Zab and Diyala.

The Khabur river forms the most north boundary between Iraq and Turkey. It rises in the mountains north of Zakho, where it flows for the most part through narrow gorges and joins the Tigris at Fish Khabur. The Upper Zab has its origin in the mountains of Hakiari in Turkey and joins the Tigris 43 kms. below Mosul. In the Kurdish hills the Upper Zab is deeply incised flowing between banks which in places such as the Rowanduz, are cut down sheer in the limestone to over a depth of 450 metres. The Lower Zab is fed by headwaters in both the Qandil range of mountains east of Rowanduz and in the Persian Zagros and joins the Tigris about 44 kms. above the Fattha gorge. The source of the Diyala is in Iran where it is called the Sirwan river which crosses the Iraq frontier near the settlement of Halabja to flow south into the alluvial plain not far from the town of Shahraban joining in the Tigris about 32 kms. below Baghdad by river.

The volume of water which is brought down into the Tigris through these tributaries greatly influences the rising water level in the Tigris particularly during rainy season. As a result of this, a sudden flood of the Tigris at this time is a common feature.

The Euphrates has no tributaries in Iraq and much of its flood water is derived from rainfall and melting snow in its upper reaches. Thus, the volume of water in its middle and lower courses does not fluctuate as npidly as that of the Tigris.

The Tigris enters Iraq at a place called Maghara (37°07 , 42°23), at its confluence with the Khabur. The current is strong and carries a great load of sediment from the Kurdish tributaries. Fish Khabur which stands 5 kms. south of Maghara is 348 metres above sea level. From this point to Mosul the Tigris forces a passage gradually through the low folded foothills of the Kurdish mountains, flowing alternately south-eastwards in broad synclinal valleys, and south through narrow, winding gorges, breaching the intervening anticlinal folds. Below Mosul the characteristics of the bed and course are broadly similar to those above, but the hills are much lower, and there is more open steppe. Passing through the anticlinal ridge of Jebal Hamrin in the gorge of Al-Fattha the Tigris enters its alluvial plain at Tikrit. From this point southwards to Balad the Tigris flows between high conglomerate banks, affording a high degree of protection from floods. Between Baghdad and Kut the river course is extremely tortuous. Some of the bends are so acute that river-boats on their passage down stream have difficulty in rounding them when the current is strong. Some of the meanders have been cut off forming 'ox-bow' depressions. South of Kut as far as its confluence with the Euphrates at Qurna, the river is less winding than between Baghdad and Kut, and its gradient much less - 1 in 29,000 compared with 1 in 15,000[1] respectively. At Ali-Al-Gharbi village south of Kut the Tigris begins to disperse through several channels exhibiting a braided condition and forming

(1) Naval Intelligence Division: "Iraq and the Persian Gulf". 1944, p.51.

extensive areas of marsh and marsh land conditions not unsuited to the cultivation of rice.

Annual regime Both rivers are at their lowest in September and while a slight but visible rise occurs in the Euphrates during November, this feature does not exist in the Tigris, but the consequences of the first sign of winter rainfall are apparent more rapidly in the Tigris. From December onwards, both rivers begin to rise considerably, because of heavier rainfall over the whole region. In spite of that a difference once again becomes obvious in later spring. The maximum flood of the Tigris takes place during April, but owing to slower melting, and the result of percolation, high water in the Euphrates does not occur until May. It is also important to compare the volume of the two rivers. At Hit, the normal difference between high and low levels is about 3.24 metres, and the normal discharge varies between 259 cubic metres per second in September and 1,880 cubic metres per second in May. At Baghdad the Tigris discharges a minimum of 346 cubic metres per second in September, and a maximum of 310 cubic metres in April, with a rise in level of 5.4 metres partly due to the fact that the Tigris at Baghdad is narrower than the Euphrates at Hit. The greatest rise in the Tigris which was ever recorded in 24 hours is 2.8 metres; this has occurred once in November and once in January; both were caused by heavy rains.

(iv) Climate

Some insight into the nature of the climate of Iraq can be given by review of the topography of the conntries on its borders

To the south-east lies the Persian Gulf, a low-lying area greatly influenced by an extension of the low-pressure over north-western India. To the north and north-east lie the mountains of Iraq, Turkey and Persia. Beyond these are situated the high-pressure areas of the Anatolian and Persian plateaux. To the west are the arid Arabian and Syrian deserts beyond which lies the Mediterranean sea. All these geographical factors influence the climate of Iraq both in general and also locally.

The land lying south of the Jezireh high plain as far as the shore of the Persian Gulf is in summer the hottest and most oppressive part of Iraq. In winter the country is cooler than is normal for the latitude. The prevailing winds throughout the year are northerly in origin. They blow from the southward extension of the Eurasian high-pressure system and strengthen over Anatolia in winter, and towards the low pressure system of north-west India in summer. They become north-westerly in Iraq because that is the trend of the Persian mountain barrier. They are predominantlyy constant and dry in summer. This dryness is due to the fact that the winds pass through arid lands in which they can not pick up any moisture except from the marshes in southern Iraq. They become hotter as they pass over the country especially over the alluvial plain. In general, they are interrupted in winter by depressions travelling eastwards from the Mediterranean, and during the passage of these depressions there falls almost the only rain that the country receives.

On the basis of the geographical situation, altitude and latitude, it is possible to classify Iraq climatically as follows:-

(1) The Mediterranean type.

(2) The low latitude desert type.

The Mediterranean climate dominates in the foothill areas and the Kurdistan highlands where it is more temperate. Although the annual and diurnal ranges of temperature are still considerable the mean temperature is lower, the humidity and rainfall are greater and the rate of evaporation is less than in the desert type.

The desert type prevails in the lower Jezireh high plain, the alluvial plain and the western desert of Iraq. The climate in these areas is hot and dry in summer. This is due partly to its situation close to the Persian coast and partly to a large evaporation rate which generally exceeds the annual rainfall by 20 - 40 times. With the exception of the ephemeral growth of the spring, which dries up and disappears early in summer, the land is quite bear of vegetation.

The year in the whole country is divided into two well marked seasons with short transition periods between the long, hot, rainless summer extending from May to October, and the comparatively short, cool winter extending from December to February. In the mountain and sub-mountain areas where the first type of climate dominates the summer is rather shorter and the winter considerably longer than on the plains and the desert to the south and south-west of the country. Spring and Autumn are less well marked on the plains and desert than in the highlands, but are nevertheless distinguishable from both winter and summer. The spring months are March and April and the month of November or at any rate its earlier part, may be said to correspond to a short autumnal phase.

Unfortunately, there are no available records for the Kurdish highlands, all the observations having been made on the plains. The coldest month in the year in all parts of the country is January during which the mean daily temperature on the plains ranges from about 35° - 60° F. with recorded minima of 19° F. at Baghdad and 12° F at Mosul. The hottest months in the year are July and August during which the mean daily temperature ranges from about 75°-110°F with recorded maximum of 120°F. at Baghdad and 122°F. at Basra.

The prevailing wind in all months is N.W. but during the winter months depressions pass eastward across the country from the eastern Mediterranean. They are accompanied by unsettled weather, strong south-easterly winds often of gale force, rain, and dust storms. Mist at night and in the early morning sometimes succeeds the rain in winter, but is usually local and rarely outlasts sunrise by more than a few hours. During March and April, rainfall tends to be associated with thunderstorms and squalls. Dust storms often accompany thunderstorms in Iraq but may also occur during most months of the year. Their greatest frequency is during the hot weather in June, July and August. In the mountain ranges of southern Kurdistan there is sometimes a strong, very gusty N.E. wind known locally as the "ghashaba".

In summer it is a dry, rather hot wind raising dust, in winter a dry bitterly cold wind.

The rainfall is low in the plains of central and southern Iraq, averaging less than 150 mm (6") per annum. It is also extremely variable. At Baghdad, over 17" of rain were recorded in 1889-90 and only 2" in 1908-09. On the foothill Zone the rainfall is more than double (350 - 400 mm. or 14" - 16"), while in the mountains it is undoubtedly still higher. Very little rain falls in summer (May - October) and rarely any at all during the months of June, July and August. The bulk of the rain falls during the winter months. During this period the mountain passes are blocked with snow, while at the height of winter frost frequently occurs on the surrounding plains. The months of December and February are slightly milder than January. During March the temperature begins to rise markedly, continuing its rapid rise in April and May. Even in winter the unsettled weather which accompanies rain is usually of brief duration and occurs at widely spaced intervals, so that on the majority of days the sky is clear and the sun shining. Low cloud is most frequent from November to April, but in the plains of Central and Southern Iraq the sky is on the average less than half covered with cloud. The amount of cloud is practically negligible from May to October when it rarely covers more than 3/10 of sky. During this period the air is extremely dry and the temperature high. By comparison with the days the nights are cool, for example, the daily range of temperature at Baghdad from July to Septemberis 13 - 35°F.

(v) The People

The history of Iraq shows that the country has been subjected to periodic invasion and settlement by the peoples of Anatolia, The Iranian plateau and the Arabian peninsula throughout the past 3,000 years. The main features of the two racial groups from which these invading peoples had sprung are still apparent in the people of today.

There is evidence of the settlement of lower Iraq in early times by broad-headed Sumerian peoples from the Elam mountains. Today however the bulk of the population is descended from later waves of Mediterranean stock notably the Akkad and the Semitic Arabs. The Arabs element predominates in central and lower Iraq. In the mountainous north however broad-headed peoples of Kurdish and associated racial stocks, such as Yezidi and Athorian, frm the great majority. There are also small scattered Turkoman groups, remnants of Turkish invasion and settlement, in the Erbil and Kirkuk liwas in Northern and Central Iraq.

From the religious point of view 93 per cent of the people in the country are Moslems. Within the small non-Moslem minority the greatest single group are Jews and Christians and there is a strange pagan community of Yezidis who live in the Jabal Sinjar and the Mosul from Jabal Maglub north-west to the foothills around Duhuk settlement.

The Sabians mainly live in Baghdad City, Nasiriya and Amara liwas, whilst Jews are confined to the three cities of Mosul, Baghdad and Basra.

Christians chiefly live in the Mosul liwa, and in Baghdad City and there is a large urban population of them scattered in Northern and Southern Iraq.

Distribution. The best available picture of the population of Iraq is provided by the second population Census of 1957. A total of 6,538,109 individuals were enumerated, including 3,294,036 males and 3,244,036 females. If the estimate of 250,000 fully nomadic Bedouin is added, the total population would stand at 6,788,109.

The population was distributed over the fourteen liwas (counties) with an average density of 27 persons per sq. km.(1)

Approximately 70 per cent of the population was living in the irrigated areas of the Tigris and Euphrates and on the surroun ing canals system. Over two-thirds of the people lived outside of municipalities, in villages and Bedouin camps, and only in the Baghdad liwa did more than half of the population live in the municipalities. Baghdad City alone contains about 14 per cent of Iraq's population and 35 per cent of its urban population.

(1) Only 14 liwas were included in the density figures; they include 53% of the total area of Iraq. The desert, assumed to be uninhabited, includes the remaining 47% of Iraq. The Bedouin were assigned to the liwas where they camp in summer.

<u>Migration</u> The data on internal migration presents a striking picture of destinations and origins of the majority of migrants from rural areas. There appear from the data two liwas of sizeable net immigration, Baghdad and Basra; 22 per cent of Baghdad liwa's population and 17 per cent of Basra's were born outside of their liwas of residence, while the former had sent out only 7 and the latter only 4 per cent of people born therein. One liwa stood out above all others as a source of migrants. About 396,722 persons living elsewhere in Iraq were born originally in Amara liwa. Most of these migrants made their way to Baghdad and Basra. The attraction of Baghdad City can be explained by its glamour as well as its rapid recent growth of industry. Migration to Basra City can be accounted for by its proximity to Amara, with the seasonal needs of its date industry, the presence of the port, and its recent growth of industry.

The driving factor of the migration is difficult of explanation in the absence of more detailed information. For example, it may be that the semi-feudal system of land tenure which is operated by a few sheikhs, is responsible for the exodus of the fellahin from Amara. The Agricultural and Livestock Census of 1952-3 disclosed the average size of agricultural holding in that liwa to be 755,833 mesharas (4,260 acres), as compared to an average of 210 mesharas (126 acres) for the country as a whole. In addition, it is known that living conditions of the fellahin there are among the worst in the country.

Population prospect in an expanding economy

In more densely peopled countries such as India and Egypt the resources available to support any increase in population are very much more limited than in Iraq where the potential of exploitation is, in contrast, high enough to support a much greater population than at present. Such an increase would seem probable in view of the present high fertility and falling mortality rate(1) in the country.

The resources of Iraq which future developments could be based include a large area of undeveloped land, the waters of the two rivers, and oil.

As economic development proceeds, thereby lowering death rates and accelerating natural increase, the increased numbers can be put to work both on agricultural land newly brought under cultivation and in newly created industries. Furthermore, a large source of foreign exchange in the form of oil revenues, with which Iraq may purchase the capital goods and technical assistance necessary for economic development.

Other neighbouring countries in the Middle East have one or two of these attributes, but no other has all three. For example, Iran has oil revenues but lacks the unused land and water resources possessed by Iraq. Syria has unused land and water and a comparatively

(1) According to the Ministry of Health, by taking the population in 1947 to be 5 million and in 1957, from the Census, to be 6.8 million, the crude death rate is assumed to be 30 per thousand and the crude birth rate 50 to 55 per thousand. Thus the crude rate of natural increase is 20 to 25 per thousand, or 2 to 2.5 per cent per annum.

sparse population but encounters the usual problems of capital formation and foreign exchange shortage faced by underdeveloped countries. Jordan has a sparse population but few undeveloped resources of any kind and no large source of capital. Egypt's problems are not only the lack of a continuing source of foreign exchange but also a dense population whose rate of growth has tended to outstrip the maximum possible rate of development of unused resources. Iraq's resources, properly developed, are fully capable of supporting a growing population at a rising level of income.

Ultimately, by encouraging the rapid exploitation of oil resources, thereby enlarging present National income at the expense of potential future revenues from oil, Iraq is attempting to attain in a generation the economic development achieved over a much greater period by countries now industrialized. It may be that rapid development is the only way to obtain the stability of the economic situation of the country.

(vi) General Human and Economic background

Iraq possesses impressive potentialities for economic development. The country's twin river system - the Tigris and Euphrates can provide large amounts of water for irrigation. Much of its soil is inherently fertile and with considerable water, manpower and implements, the area under cultivation might be almost tripled. From its oil Iraq possesses not only a source of foreign exchange but also a cheap source of power and raw materials essential to the development of industry, agriculture and transportation. Iraq may have other mineral resources capable of commercial exploitation.

At the present situation the economic potential is in sharp contrast to the poverty prevailing in Iraq especially in the rural community. The standard of living of the people is extremely low. Income per head is probably at most ID29[1]. Almost 90 per cent of the population is illiterate and many people are subject to diseases such as malaria and bilharzia. Housing and health are for the most part primitive particularly in the rural areas. The fundamental reasons for these conditions are low output and low productivity. Most of the manpower on the land is underemployed for a large part of the year, and considerable unemployment exists in the major cities and big towns.

Agriculture in Iraq is devoted largely to the cultivation of winter crops. Because of the lack of rain in the summer, crops can be grown during that season only with help of irrigation. In the rain fed zone of the North, summer crops can be grown on a moderate scale in small irrigated areas. Barley and wheat are the only significant winter crops, while rice and, more recently, cotton are the principal summer crops. The area sown with subordinate grains is comparatively insignificant. Tobacco assumes some importance in the mountain areas of the North.

(1) One Iraqi dinar equals £1.

Fruit and vegetables are quite important. Iraq is the world's principal producer and exporter of dates.

Crop yields are generally low as the water supply is frequently inadequate. Agricultural methods have on the whole remained unchanged for centuries. Crop rotation is wholly inefficient and makes little change to the fertility of the soil. Salinity, attributed to poor drainage, has materially lowered the productivity of land in the irrigated areas.

As the ownership of cultivated lands is largely in the hands of sheikhs and urban landowners who entrust the actual cultivation in small portions to the fellahin, under the share cropping system the landowners enjoy a large share of the crop with the expenditure of little effort on their part, while the fellahin get a low share according to the old agreement between the two sides. From these considerations of the fellah's status there is a great danger of a continued flight of labour from the land, impairing the country's agricultural production.

<u>Occupation</u> The data on occupation is badly obscured by a definitional confusion of occupation and industry and by the difficulty of determining who is economically active, particularly among females and children engaged in agriculture. However, certain generalizations can be drawn from the data which has been obtained from the Ministry of Social Affairs. According to this Ministry, nearly two thirds of the working people who live in the rural communities are engaged in agricultural and postoral production. As handicrafts are rarely found in the villages

and only few people are absorbed, it may be said that 85 to 90 percent of the rural population lives directly off the land.

Many of the dwellers of the smaller and even some of the larger towns are also engaged in agriculture. In the large cities, there is a small population of fellahin employed in agriculture, particularly on small holdings producing vegetables, dates and other fruits or raising livestock for the city market.

After agriculture, commerce is certainly the most important occupational group. The census records showed nearly 55,000 people in the four largest cities, Baghdad, Mosul, Basra and Kirkuk alone were in this category. There is about the same number in the rest of the country, since one of the main functions of the smaller towns is to give retail trade to the surrounding countryside and as collection centres for its produce.

Industry is as yet little developed in Iraq. It is largely confined to the processing of agricultural products, the production of building materials such as cement and bricks, and the manufacture of consumer goods like textiles, soaps, matches, cigarettes, shoes and beverages. In oil and natural gas the country possesses a cheap source of power and fuel as well as an important source of raw materials as mentioned before. The industrial development in the immediate future will depend very largely upon the financial assistance of the Government. Due to the recent increase in Government revenues from oil it is now possible for it to undertake a large scale programme for the development of the country. According to the agreement reached in August 1951 with oil companies Iraq's share amounted to 30 million tons by the end of 1955. On the basis of that agreement it is anticipated that, by the end of the next five years, the Government may receive net revenues amounting to as much as 214 million dinars from oil alone. In consideration of this the industrial development can in many ways effectively complement agriculture. For example, the proposed chemical plant at Kirkuk, supplemented by electrical plants, could provide the cheap fertilizers needed to raise the productivity of agriculture. Expansion of cotton textile and vegetable oil extraction capacity would capitalize on the growing output of cotton.

The future prospects of Iraq are brighter than those of most other countries of the Arab world. Like Saudi Arabia and Kuwait Iraq behefits from the exploitation of her oil reserves but is also rich in cultivable land and water supplies, both lacking in her two neighbours. Syria, Lebanon and Jorden do possess agricultural land and water but have no oil reserves which support developments of these assets. Iraq has, therefore, both land and water but also has the oil revenues necessary for their exploitation, which promises to increase the total national income and to bring a much higher standard of living to al. Moreover, unlike Egypt, Iraq is not faced with a problem of surplus population.

CHAPTER II

THE PHYSICAL ENVIRONMENT
(Maps 2 - 7: Diagram 1)

A. Definition of the Middle Euphrates Valley

The Middle Euphrates region occupies the western portion of the alluvial plain of the Lower Iraq of the Twin Rivers. Situated between longitudes 45°35 E and 43°E, and latitudes 31°20 N, and 33°20 N, the region lies mainly on the left side of the Euphrates with desert plateau on the west and the natural drainage of the Tigris - Euphrates outfall on the east. It is bounded in the north-west by the rocky ridge of Spur Al-Aswad, 26 km. to the north-west of Ramadi, and, in the south, by the village of Al-Khidhir (mid-way between Samawa and Nasiriya). The area thus enclosed is a roughly rectangular unit, the main axis of which lies north-west to south-east. The length of the rectangle is approximately 367 km. while its breadth, though variable, does not exceed 125 km. It is much narrower in the upper part of the valley, where the river flows in a succession of wadis. The approximate area of the valley delta amounts to about 9,206,400 mesharas (1) or 23,016 sq. km.

To the west is desert upland corresponding approximately to part of the Arabian Massif while the administrative boundary of Diwaniya-Nasiriya-Kut liwas (2) lies to the south and south-east

(1) One meshara (one donum) = 0.611976 acre.

(2) Liwa - Administrative division (county).

On the eastern side is the Tigris-Euphrates outfall with its natural drainage starting at the Aqarquf depression further north, (a little west of Baghdad) (Map 3). The Jezireh high plain is to the north. This runs south-east and south parallel to the Tigris, through the Interfluvial Zone (Map 3, IVA and IVB) to the Haur Dilmaj which occupies the area situated between the three administrative borders of Diwaniya-Nasiriya-Kut liwas. This marsh filled depression stretches from a point south of Naamaniya Nahiya on the right bank of the Tigris and takes a more southerly direction as far as the boundary of the region under consideration. On the north, the boundary follows a head-land or ridge (see p.7) running between the alluvial plain of the region and the Jezireh high plain; this ridge stretches roughly from the eastern bank of the Euphrates, some 26 kms. north-west of Ramadi, and takes a more easterly direction, almost parallel to the Saqlawiya canal to the north, as far as the Aqarquf depression just a few kilometres west of Baghdad. The ridge rises about 6 - 15 metres (1) above the alluvial plain to the south and 145 metres (2) above sea level and has been interpreted in various ways (see pp.41-43).

The ridge marks a significant change in topography. To the south is the plain of the Middle Euphrates; to the north is the plateau of the Jezireh High Plain.

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(1) This figure has been quoted from the Directorate-General of the Geological Department of the Government of Iraq.
(2) "Iraq and the Persian Gulf". Geographical Handbook Series, N.I.D., 1944 p.28.

The greatest width of the region from west to east is about 125 km . between the furthest point of Bahr Al-Najaf and a point on the administrative boundary of Diwaniya - Nasiriyia - Kut liwas. The shortest width, about 10 km . across the head of the river delta, is between Ramadi and the prehistoric coastline, the average width of the region being about 75 km .

The alignment of the topographic cross-section (fig. 1), representing 327 km . shows the various land levels from Ramadi through Mahmudiya, Yusifiya, Babil, Hilla, Haur Ibn-Najim, Shamiya, Ghammas, Shinafiya, Samawa, and Nasiriya, beyond the southern bounday.

The plain of the river Euphrates which flows from the north-west to south-east is a level alluvial plain at an average altitude of some 25 metres above sea level. This plain begins to widen close to Ramadi, in a south-easterly direction, until it reaches Haur Dilmaj. To the south lies the Shatt Al-Gharaf marshes which are fed by the Tigris river. This low lying marshland zone is regarded as the northern extension of the recent Basra-Amara-Nasiriya Delta.

The Unity of the Area

The Middle Euphrates valley is a single physical unit on the basis of its central feature, the river Euphrates, as well as its situation, geological structure, geomorphology, relief and soils.

The Euphrates, which provides a routeway from north to south, is a natural artery for movement between Basra on the Persian Gulf and the north, as far as the Syrian - Iraq boundary.

The two most important centres are Basra itself and Hit. The latter is at the upper limit of high water of the Euphrates so that heavy river traffic is limited to the stretch below Hit, whilst light cargo can continue as far as the Syrian boundary. Hit, as an inland port, is a link between lower Iraq and the Upper Euphrates areas and Syria. Basra, with its deep-water harbour at Maqil (the interchange point for ocean-going vessels and river craft), has rail and motor links with Persia, and desert connections with Kuwait and Arabia.

Situation The area chosen is, within Iraq, the link between Basra on the Persian coast and the Baghdad - Mosul territories to the north. It is moreover located south of the main road Baghdad - Damascus - Beirut through the towns of Ramadi and Falluja. The region under consideration lies between the desert to the west and the Tigris river to the east. The network of routes through the Euphrates Valley links it with the neighbouring districts of central and lower Iraq. The movement of trade between Baghdad and Basra corresponds to the geographical and agricultural situation of the Valley. This agricultural area, therefore, in relation to the south, north and east is important both because of its position in the heart of lower Iraq, and because it links the Basra-Kuwait areas on the one hand with the northern and eastern parts of Iraq on the other. Moreover, the region, with its fertile soils and irrigation system, is the basis of the agricultural economy of Iraq. It is also the earliest-settled agricultural area in Iraq (and possibly in the whole world), having been developed in ancient times by the Sumerians and semitic Akkadians who were attracted by the potentially fertile soils and the large delta valley with its Euphrates water supply.

B. Geology (Maps 6, 7).

Geological History

The Middle Euphrates valley forms the north-west quarter of the alluvial plain of Iraq and the south-western part of the Iraq geosyncline (p. 13). It is a broad structural depression that has been filled by fluvial, lacustrine, and aeolian deposits. Aggradation in the geosyncline has formed an extensive alluvial plain with a gentle south-easterly gradient.

From the agricultural point of view the geological history is important chiefly from the Miocene period to the Recent, and the earlier history will be mentioned only briefly.

Pre-Cambrian and successive periods as far as Eocene are unknown in the Middle Euphrates valley, but these formations, folded in the western desert, and intruded by igneous rocks in Pre-Cambrian times, have formed a stable massif. The western edge of this stable block which lies to the west of the Euphrates has been transgressed by shallow seas in Jurassic, Cretaceous and Eocene times. The total thickness of the sediments overlying the Pre-Cambrian crystalline rocks is probably only a few thousand feet. The most widely marked Cretaceous advance of the sea was when a southern sea crept northwards until it covered not only the Middle Euphrates, but the whole of Iraq. This is evident from the Upper Cretaceous limestone at Anah about 285 km. north of Ramadi on the right bank of the Euphrates.

The Euphrates geosyncline sedimentation commenced with the Cretaceous, which contains reef limestone formations, and bathyal sediments such as globgerinal marls. Lying over these are the Tertiary (Miocene and Pliocene) deposits which consist of gravel, sandstone, siltstone, gypsum and shale. The thickness of these is not less than 110,000 metres as is recorded in the following table on page 53. Upon these the Old and Younger formations have been formed through the aggradation of the Euphrates since late Tertiary times. These recent deposits are typical flood-plain, lacustrine and paludal deposits. The maximum thickness measured up to the present, for these deposits, is about 45 metres (1). Underneath these recent deposits lie Tertiary bed which outcrops in the border ranges of Persia to the east. To the south-west of the Euphrates geosyncline upon the stable block, the Lower Cretaceous seas deposited the Ratba sands across eroded beds of Jurassic and Triassic Age.

Compressive stresses associated with southward movement towards the Arabian Massif began in Upper Cretaceous times, the Middle Euphrates geosynclinal trough, already having been filled last with coarse detrital sediments. The cycle of movements which formed the first trough continued progressively throughout subsequent

(1) R.C. Mitchell: "Notes on the geology of Western Iraq and Northern Saudi Arabia". Geologische Rundschau International Zeitschrift, 1957.

geological periods. Since this tectonic sequence started from Upper Cretaceous to late Miocene times, marine transgressions in the area have been particularly marked in the Cretaceous and Eocene periods. The Upper Eocene and the Oligocene were periods of varying tectonic movements with erosion and sedimentation continuing in the valley trough where the Middle Euphrates plain now is.

During the early part of the Miocene period, the marine area became more and more restricted, and finally, only brackish waters, with very small or no connection with the open sea, covered half the area. During the latter half of the Miocene, and in the Pliocene periods, the region was above sea level and was covered with broad alluvial fans, which are the deposits of detrital materials, also encountered in the Upper Fars formations.

During the Upper Pleistocene[1] the region and surrounding regions enjoyed considerably greater precipitation than today. Immense masses of material were transported by wadis, streams of the west desert; at present these formations are shown upon the lower plateaux (Al Haswa and Al-Megass Plateaux) and on various points on the left and right side of the Euphrates. The Persian Gulf, at that time, stretched as far as the northern end of the Saqlawiya canal, to leave present evidence of that prehistoric coastline. Since that time, the Gulf has been gradually filled up with the formation of the plain. The Euphrates stream has repeatedly changed its course, and thus greatly contributed to the

(1) The Flora of Iraq and its Physiogeographical Subdivisions, Bulletin. 1952. pp.8-10.

rejuvenation of soil profiles in the plain.

It is usually assumed by archaeologists and classical geographers that the plain of the Euphrates has been built up gradually on account of the retreat of the Persian Gulf, and due to the normal processes of delta formation. The geat amount of deposits carried down by the Euphrates river are supposed to have filled the Gulf gradually. Seton Lloyd, for instance, shows the head of the Gulf before 4,000 B.C. at a position which today represents the physical border between the Jezireh High Plain and the alluvial plain of the Euphrates; and, in Chaladian times (696 B.C.) it is shown to have been in the neighbourhood of Al-Warka mound.

Sir Leonard Woolley[1] during his excavations south of this region at Ur and Al-Warka (1926-1929) described an 8-foot bed of clean clay of Sumerian age, from the relics of an older period. This bed of clay was correlated by Woolley with the flood and normal deposits of the Euphrates. The opinion of de Morgan[2] was based on normal delta-forming processes, and on two principal assumptions. The first is that the ancient Sumerians cities, Eridu, Ur, Larsa and Lagash, whose sites have been discovered and surveyed, were founded near what was the head of the Gulf about 3,000 B.C. but now lie some 248 km . inland (see map 6). The second point was that there were changes in the drainage pattern of the river course during historical times, as shown on map 5. These will be discussed in a consideration of the Euphrates' river

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(1) L. Woolley: "Ur of the Chaldees", Pelican Books, 1938, pp.18-21.

(2) De Morgan: "Mission Scientfique en Perse" Vol. II. pp.283-299.

course. De Morgan believed that the characteristic instability of river course throughout a plain aggradation is well evidenced at a point just north of Musayib. This drainage evolution of the river course, he said, was due to the accumulation of river deposits which blocked the stream. He correlated this phenomenon, with the recession of the head of the Gulf when the Karun - Kerkha delta formed a barrier enclosing the water of the river.

Lloyd, in the "Twin Rivers",(1) suggests that the alignment of this ridge, which roughly forms a tongue on a head-land, reveals the line of the ancient Persian Gulf coast in this area. This theory is based on the events in the recession of the head of the Gulf, some 4,000 years B.C. when the Karun-Kerkha delta reached the Arabian shore and formed a barrier in the sea enclosing the waters of the Euphrates and Tigris. He suggested that similar conditions may have prevailed when the upper plain was occupied by an extension of the Gulf leaving the evidence of the ridge mentioned (see p. 7).

Lees and Falcon have criticised the suggestions of de Morgan and the archaeologists who approved this assumption. They say that the theory of the persistent forward building of the land at the head of the prolonged Persian Gulf by river sediments depends on an assumption of static conditions in the rock floor of the zone of depression. If subsidence is still active, they say the advance or retreat of the sea must depend on which factor is the more active, sedimentation or sinking, and only firm and positive evidence can

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(1) S. Lloyd: "Twin Rivers" London. 1950. p.150.

decide this point. Lees and Falcon claim that the Classical Arab and other earlier geographers were not sufficiently precise in their descriptions. A further problem arises from the assumption that because a city has been described as a seaport, it was necessarily on the coast; in reality, this may mean only that it had river access to the sea.

In addition to the considerations above quoted, Lees and Falcon go on to say that the Euphrates has an average silt content at Ramadi (at a point near the surface of the stream at the centre of the river) of 553[1] dry grammes per cubic metre and the average discharge of the Euphrates at Hit, just north of Ramadi, throughout the year is 710 cubic metres per second. The river brings annually 76.2 million cubic feet of silt. This silt spread over the Middle Euphrates Valley which is 23,016 square kilometres in area makes a layer 0.000 003 672 inches thick. As the silt content in other parts of the river would be considerably greater than at the centre of its surface (average figures are being used for flow), this rate of accumulation can be regarded as a minimum. However, if the amount of silt carried to the sea during the early times was the same as at the present, the Delta under consideration could not possibly be formed under these conditions.

The author cannot accept the conclusions of Lees and Falcon, and adopts the views of the archaeologists and the classical geographers such as de Morgan that the Delta is geologically recent

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(1) Lees and Falcon: (The Geographical History of Mesopotamia Plains) Geog. Journal. Vo. cxiii. 1952.

and was once all covered by the sea. The sea has left abundant evidence of its presence by the organic remains which have been left behind which will be considered later (see pp. 45).

The Middle Euphrates lowland is in origin deltaic, formed by fluvial deposits laid down in a tidal sea. As a result of delta extension and the adoption of a braided condition by the streams aggradation has produced an alluvial lowland possessing a high degree of flatness. Its surface is broken only by the occurrence of island-like masses of older transported detritus to the level of which the alluvium has not reached, such as the low desert plateaux of Al-Haswa and Dahr-Al-Megass.

The action of a tidal sea would cause the accumulation of silt in a bar, which, at the period of the first gain of the land in the pre-Babylonian[1] era, and in the inter-riverine zone above the site of the present Babil, would be in advance of the mouth of the river. This is the case with the actual bar of the present day. It would have produced the high and sandy downs to the south of Babil. Present evidence of this process is abundant in the lower part of this region.

The barrier enclosed saline waters which would, with further accumulation of land, and the process of evaporation, become brackish and then fresh. Owing, however, to the presence of the Euphrates and its annual flooding, the area became marshy and known in early times as the Paludes Babyloniae, in the Middle Ages Al-Batiah and in the 19th century as the marshes of Lamlum. In the

(1) Ainsworth: "Research in Babylonia and Chaldea" London, 1938. pp.43, 142.

present day the remnants of these marshes still exist in the eastern portion of the Shamiya branch (map 4).

The alluvium deposited by the Euphrates river advanced into the Persian Gulf forming the Middle Euphrates plain. The location of the prehistoric coastline of the Middle Euphrates area may be established by the use of historical evidence. As already pointed out, about 3,000 B.C. Eridu, Ur and Lagash were situated relatively near the sea, just a few km. south of the Middle Euphrates boundary. Further, it may be maintained that the present landscape to the south of these cities came into existence late, in that it is an area of unbroken flatness. Thus the whole physiognomy of the Middle Euphrates from prehistoric times up to now has been formed from the deposit of the river, and we may add that the process has taken place rapidly even when measured by millenia. Eridu, the oldest port known to us is now 248 km. from the sea. We may deduce therefore that the deposits from the river push the coastline in the Gulf some 29 metres seaward every year, or about 3 km. per century as stated by S.A. Pallis (1).

Lower Fars

The Lower Fars marine limestone represents the deposits of the last invasion of the sea in this area. It is generally between 100 - 300 metres thick, and extends beneath the recent deposits. The Lower Fars formation is composed, mainly, of shale, gypsum,

(1) S.A. Pallis: "The Antiquity of Iraq. 1956. p.15.

green marl, thin limestone and salt beds. The Lower Fars is generally an impervious formation and springs issue from its contact with the Upper Fars. It is of hydrological interest, chiefly because of its evaporate beds of gypsum and salt which cause the ground water which passes through them to become highly mineralised(1). Furthermore, both detrital and re-precipitated gypsum from the Lower Fars have found their way into the alluvial formations derived from these older evaporate beds. The shale beds are relatively impermeable and serve as confining beds for water. Map 7 shows these formations stretch southwards along the right bank of the Euphrates from Bahr Najaf and Abu Skhair to a point 24 km. south east of Samawa.

Upper Miocene

The Upper Miocene is represented by the Upper Fars and Bakhtiari series. These formations are restricted to the west belt of the Euphrates course starting from Abu-Skhair and stretching northward, including the area to the east of the Bahr Najaf depression, to Kufa village. Hence, this belt proceeds in a northern direction, passing Karbala, at the head of Abu Ghraib canal, until it approaches the river course north of Falluja. It then follows the narrow flood plain on both sides of the river as far as the spur of Al-Aswad, at the northern edge of the area. In addition, it includes the low plateaux of Al-Haswa and Dahr Al-Megass, which are located to the left side of the river, inside the plain, and occupy the belt which stretches to the west and south of Samawa on the right side of the river.

Upper Fars

The Upper Fars formation consists of sandstone with

(1) (e.g.) Shithatha and Rahhaliga artesian (springs)

interbedded siltstone and mudstone. It is generally reddish or brown in colour and grades upward into the coarser Bakhtiari formation and downward into the shale and gypsum beds of the Lower Fars formation. The lowest pebbly sandstone is generally considered to be the base of the Bakhtiari formation, and the uppermost bed of gypsum to be the top of the Lower Fars formation. The Upper Fars is several metres thick in the fold mountains in the north of Iraq, but thins rapidly south-westward between the right bank of the Euphrates (from Al-Aswad to Abu-Skhair) and the desert. It therefore underlies the Bakhtiari formation of the plain of the Middle Euphrates where its thickness amounts to about 120 metres.

Pliocene

The Pliocene epoch is represented by the Bakhtiari formations which are chiefly discontinuous gravel bed outcrops, stretching from the north-west to the south-west, on both sides of the Euphrates and inter-bedded with siltstone and mudstone. It is often indistinguishable from the underlying Upper Fars formation since the contact is gradational. The sediments are generally yellow or brownish in colour and poorly sorted. The fine-grained pebbles consist largely or exclusively, of hard siliceous rocks, such as jasper, flint, chert, quartzite, etc. The formation attains a thickness of about 2,310 metres. This gravel in the southern part of the region, to the west of Samawa on the right bank of the Euphrates is probably derived from the south-west, and is known as the Dibdiba beds[1]. The upper parts of these beds are of the same period as the Bakhtiari beds, although derived from a different source. The Dibdiba beds interdigitate basinward with marine limestone of the Euphrates formation, and the lower beds are therefore much older than the Bakhtiari formation.

The Bakhtiari series is exposed in the low plateaux in the north-west of the region, and along both sides of the Euphrates. It presumably underlies the plain of the Middle Euphrates but its extent, character and depth beneath the surface remain as yet undetermined in full. In this area its potential yield of water has not been investigated but there seem to be distinct possibilities for development.

<u>Pleistocene and Recent</u>

These periods are represented by what are distinguished as the Older and Younger alluvial formations. These cover most of the surface of the plain of the Middle Euphrates.

<u>The Older Alluvium</u> was deposited after the mountains were folded in the north zone. It is made up of locally derived rocks and, because many lime-stone fold-ranges are exposed in the north where the Euphrates rises, frequently contains many limestone pebbles. The Bakhtiari gravel-beds are of the same formation. Therefore the Older Alluvium consists of silicious pebbles from the Bakhtiari with some pebbles of gypsum, limestone and hard shale. Much more work needs to be done on the characteristics, history and correlation of this formation.

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(1) Ainsworth refuted that the original rocks to which the various pebbles belong were a chain of Taurus. pp.93.

It seems likely that the O.A. is the result of intense erosion and deposition during Pleistocene Pluvial periods and it may therefore be considered Pleistocene in age. Its extent and character beneath the plain of the Middle Euphrates, has not been determined. The wells in the area of this region may derive their water from this formation. At Najaf, the sacred shrine of Sheikh Mohammed, the depression of the edge of Bahr Najaf, and the cutting of a new canal, exposed a horizontal section of about 15 metres through beds of:

1. A very fine white quartz-gravel, imbedded in friable, reddish, calcareous marl 3.5 metres high.
2. Similar quartz-gravel, in friable calcareous earth sixty four km.(1) long lying between Musayib and Karbala.

It is in the form of a slight rise in the surface of the ground and is a bed of loosely-cemented fine gravel, resting on gypsum, and contains crystals of selenite. The road passes for half a km. over the south-eastern extremity of the bed, which extends in a low undulation towards the north-west. The components of this gravel are precisely similar to that at the Dahr Al-Megass low-plateau, which will be discussed in the physiographical section (pp. 71-72). On the road between Baghdad and Babil gypsum again appears, and causes a remarkable ridge on the otherwise level desert. It is first met with half a km. to the north of the Iskandriya village, and runs in a general direction N.N.W. - S.S.E. to the south of the Iskandriya, and is about 1.5 km. broad. It

(1) Loftus: ("On the geology of the Turks-Persian Frontier, and the district adjoining). Quat.Jour.Geol.Soc.vol.XL.pp.250.

sinks into the alluvial plain on the other side, but re-appears near Mizerakji Khan, about three km. to the west, whence another ridge breaks away to the N.N.W. However, the gypsum protrudes in small masses visible and irregular, in some places hard, and closely packed together, similar to a tessellated pavement. In both varieties small pebbles are observed which do not exceed a quarter of an inch in diameter. The pebbles associated with the gypsum deposits are here quarried to a depth of three or four feet. In some localities of the region discussed above, the gravel is wholly composed of white quartz, and at others of coloured cherts.

Younger Alluvium The younger alluvium consists of flood plain river silt and clay, lacustrine clay and silt, wind deposited silt and clay, and stream gravel and sand. The greatest thickness is probably in the plain under consideration where the subsiding parts of the valley have been filled with sediments brought into them by the river, and by the wind. The thickness of this alluvium is most important from the agricultural point of view and must be determined from geological data and test holes. In the desert upland, just to the west of the river, the younger alluvium is generally thin or absent in the wadis.

The Younger alluvium is not generally an important water-bearing formation. Wells dug in the areas of water tables may derive their water from this formation, but in many cases they extend throughout into Older Alluvium or older formations.

According to Loftus the alluvial deposits which have chiefly been derived from the Euphrates denudation consist partly of clay and partly of sand. He divides the clays into two divisions, the freshwater (fluviatile) and marine.

The fluviatile alluvium, now in process of downwarping, is limited to the banks of the river and the adjoining marshes and canals. It consists of a stiff blue, or fine arenaceous grey clay, and fine sand or gravel. These deposits are dried and cracked in every direction by the intense heat of the sun, but afford a rich and fertile soil for the cultivation of crops, and frequently contain imbedded shells of extinct species.

The marine beds of the recent alluvium are much more extensive than the fluviatile, and consist of dark grey or reddish yellow loose sands and sandy marls. These are usually dominant in the southern region, but are, of course, mixed with other recent formations This formation appears clearly in the desert at some distance from the river, such as at the Abu-Dibis depression (see map 31), and, where it is otherwise not easily distinguished from the beds of the underlying rocks, it is to be recognized by the growth of saline plants, and by dark wet patches, produced by the presence of sodium chloride. It is sometimes fossiliferous.

Loftus[1], referring to the Upper area at about latitude 32°10 N said that "I picked up numerous pieces of silicified shell - conglomerates". Probably belonging to a pre-Pleistocene formation these fragments are presumably from the immediate locality, although the outcrops and positions of the beds with relation to the older and newer deposits are not precisely known since they are entirely concealed beneath the drifting sands of the desert.

From the considerations above it seems to the author that the examination of the fossils of these marine deposits proves that, at a comparatively recent date, the margin of the Persian Gulf extended certainly 240 km. beyond the junction of the Tigris and Euphrates rivers at Qurna.

As a result the geology of the region shows a variety of types of deposit and in the following table an attempt has been made to indicate the conditions under which these deposits were laid down.

GEOLOGIC FORMATIONS OF THE MIDDLE EUPHRATES

Period	Formation	Thickness (metres)	Description	Conditions and events
Recent	Younger Alluvium	30 - 100 perhaps thicker	River silt, lacustrine clay, sand dunes, stream gravel	Not yet distinguished from Older Alluvium in this region.

(1) (op. cit. p.49).

GEOLOGIC FORMATIONS OF THE MIDDLE EUPHRATES (cont'd)

Period	Formation	Thickness (metres)	Description	Conditions and events.
Pleistocene	Older alluvium	60 - 100	Coarse, locally derived (generally) gravel, lacustrine clay andsilt.	The source of water in many dug-wells and in some irrigation wells. Sometimes difficult to distinguish from younger alluvium in wells derived Bakhtiari gravel.
Pliocene	Bakhtiari	0 - 2,310	Conglomerate and Gravel, sandstone inter-bedded with silt stone, mudstone and clay, pebbles.	Source water in wells, artesian aquifer, it is a period of erosion
Miocene	Upper Fars	0 - 120	Interbedded mudstone and sandstone, silt stone. Generally red or brown in colour, thin gypsum veinlets.	A period of earth movement.
	Lower Fars	90 - 300	Marine limestone, gypsum, grey shale, local salt beds, marls.	Generally yields highly mineralised water, a period of earth movement.
	Euphrates limestone (Asmari)	0 - 180	Reef limestone passing basinward into anhydrite and shale	Source of springs in West desert, possible source of artesian wells

Source: (1) Fao Report, No. 189, Investigation and Development of ground water resources Rome, 1953.

(2) "Report on the Ground-Water Resources of Iraq" Ministry of Development of Iraq, June 1955.

C. Geomorphology

The broad relationship between physiography and geology will be first outlined, followed by a systematic examination of the range of strata and deposits found in the plain of the Middle Euphrates basin. Particular attention is paid to the lithology of the rocks, as the basis for extractive agriculture, and evidence from borings is assessed from the point of view of its usefulness in ground-water development, soil parent material, the drainage characteristics, and the agricultural possibilities of the area. Finally, the contribution of the flood matter to the physical landscape together with the drainage evolution of the Middle Euphrates system will be considered.

Relation to physiography

The relation of physiography to geological structure is well marked and gives a framework to the relief of the region. The evolution of the landscape, during successive cycles of erosion may be determined from the evidence of summit-levels and the land-forms associated with the advance and retreat of the pre-Persian Gulf. But, in general, in appears, though no systematic study has yet been made, that the effects of these changes by successive cycles are of a minor order in comparison with the creation of the main outlines of relief by weathering of rock strata and the deposition of material from the Euphrates during the flood seasons.

Strata of formations

Stratigraphy

The Euphrates plain is a basin-shaped structure, the oldest rocks outcropping on the west border and dipping under successively younger formations towards the east of the plain (seepp.13-14). The Mesozoic and older Tertiary rocks rise in the west side of the basin, producing gradually rising limestone country To the east, most of the area is covered by rocks of alluvial or lacustrine origin. These formations include the Pliocene, Pleistocene and Recent Age (but not Miocene).

The Miocene however is represented by the Euphrates formation (Asmari) and the Lower Fars formations. These are restricted to the western edge of the Euphrates river, stretching from Abu Skhair village southward to Samawa, along the right bank of the Hindiya channel, extending westward to the desert.

This is of massive reef limestone, passing into brecciated and fragmental limestone. It is about 180 metres thick (See table on p.53), but is resistant to erosion, and probably the source of the famous 'line of springs' of the desert. West of the Euphrates, as was previously mentioned, is a broad area extending out into the Syrian desert; it also enters the Jezireh high plain east of the Euphrates; and north of the plain of the Middle Euphrates.

Lithology, or the physical and chemical properties of rock types, thus has a great importance for the correlation of the type of soil with structure. In the south-west, in the desert, the Cretaceous and Eocene limestones dip gently underneath the sediments of the plain of the Middle Euphrates. They re-appear as a uniform surface in the mountain zone to the north-east. The spring-line may indicate a fault, or series of fault-systems which releases artesian water from the Euphrates limestone or other permeable limestones, as shown by alignment of the depressions to the west of the Euphrates, along the east margin of the desert from Hit as far as Karbala (p. 16).

According to the Fao Report No.189[1], a considerable succession of interrupted periods of erosion followed the folding of the Lower Fars (Miocene), exposing beds along the crests of some of the folds in northern Iraq. Within the plain under consideration this interrupted erosion has truncated the spurs of the desert periphery and has removed much of the alluvial deposits found in some localities between the spurs. This is seen in the extending tongues of the western desert within the plain such as Dhiban ridge to the east of Habbaniya lake and the western edges of the plateaux of Al-Haswa and Dahr Al-Megass.

Evidence as to the detailed nature of the movements which produced the regional depression is limited. The diagrams by Loftus[2] show the suddenness of the descent from the Persian plateau to the Tigris-Euphrates plains. They also show the Persian border country as faulted and disturbed. The successive

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(1) "Fao Report No. 189". The investigation and development of ground water resources, 1953.
(2) Loftus: "On the Geology of the Turkish-Persian Frontier, and district adjoining". Quat.Jour.Geol. Soc.Vol.XL.pp.250.

terraces might be explained as due to faulting. On the Arabian desert side to the west of the Euphrates a similar straight line indicated on Blanckenhorn's[1] diagram suggests that the separation of the tectonic subsidence zone of the Euphrates from the Arabian desert is along a fault or a straight sharp monoclinal fold.

The Middle Euphrates valley is a geosynclinal subsidence area with very gentle dips to the south-west. It appears along the Jabal Hamrin at the foot-hill zone. The steep dips along the latter front probably flatten rapidly south-westwards on crossing the Middle Euphrates area.

The characteristic movements are quite clear throughout the delta area, if one bears in mind the crumpling, faulting and shearing area, which characterises the landscape of the Nappe zone of north Iraq. The great earth movements, which determined the present structure, came mainly after the deposition of the Bakhtiari gravels (Pliocene). The thrust was due to forces acting from the north-east, and caused the strata to be folded along north-westerly lines in Iraq and to be faulted along the eastern margin of the Arabian desert.

Accordingly, the Middle Euphrates plain and Persian Gulf occupy a zone in which gradual subsidence has been taking place during the settled episode of the mountain building movement, as described above. Since then the Middle Euphrates delta has

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(1) M. Blanckenhorn. "Syrian, Arabian and Mesopotamian" Geol. vol. V. part IV, 1914.

gradually advanced into the Persian Gulf. It now has probably attained its senile phase in a rather shorter time than in the case of most other deltas. This senility is demonstrated by the relatively higher level of the land at the delta apex, the more pronounced gradient of the surface, and the small extent of marsh. The relative stability of its level with the predominance of silt accumulation has contributed to this rapid building up of the delta to senility, although its development has been influenced by the changes in the regime and load of the Euphrates as well as by the earth movements already mentioned.

Its development has involved two processes, deposition and aggradation. The northern most portion of the delta demonstrates mature characteristics not only because it was deposited in earlier times but also because it was less subjected to the changes of the river drainage. The rate of deposition varied in time and place with the result that the northern parts a t the apex have a greater depth of recent alluvium than do the southern.

The deltaic deposits of clay, silt and sand present not only a horizon of marked lateral discontinuity but also show wide variations in texture. They tend to become finer in later times with a predominance of lime constituents; they also become more friable in the southern part of the region, especially in the marsh zone. The outer fringes to the north-west and the flank of the gypsum deposits of Miocene to the right bank of the Euphrates are inundated by the admixture of blown sands from the desert. The plateaux of Al-Haswa and Dahr Al-Megass covered by patches of sand, flints, gravels and fragments of gypsum represent the sources of coarse non-deltaic materials that occur amid the deltaic tracts. Variable conditions of deposition have been the outstanding factor leading to the variability in the texture both vertically and laterally.

In this respect man's activities have also been felt. Modification in the flow of the river by reinforcing natural embankments or constructing dykes has interfered with the expected sequence of beds as well as with their nature. The impounding of water in certain sectionsof the Euphrates branches, upstream from the barrages of Hindiya and Ramadi, and the planned control of water resources have introduced new factors that influence the structure of deltaic deposits(1). On the whole, the lower deposits which attain a considerable thickness are superimposed upon earlier beds that thin out in the north-western and western fringes of the plain.

D. <u>General Physiography</u> (Maps 2, 3).

In general terms, the Middle Euphrates valley is a plain of aggradation extending between the Arabian block on the west and the Tigris-Euphrates natural outfall on the east. Through this runs a regular valley, traversed by the giant banks of the ancient canals.

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(1) W.A. Macfadyen: "Water supplies in Iraq" publication No. 1, Geological Department, Baghdad. 1938.

It begins at a point marked on the left bank by the rocks of the Spur of Al-Aswad and on the right bank by the rocks of Al-Okoba. Beyond Al-Aswad the alluvial plain is intersected by numerous ditches. For some distance south of Al-Aswad there is a depression, Al-Karma, which is about six km. wide, and a natural branch of the Euphrates. South of this depression there rises another upland area which is rather difficult to irrigate, while the narrow belt of plain still further to the south extends as far as the head of the Saqlawiya canal. On the right bank of the river the plain is restricted by the desert escarpment. It is dissected by small wadis and ditches which sometimes reach the river. The narrow plain extends as far south as a point opposite the southern end of the Dahr Al-Megass Plateau.

South-east of a line from the Habbaniya lake crossing the Dhiban ridge and the head of the Saqlawiya canal to the Jezireh High Plain on the north, the plain opens into a fertile irrigated area. The landscape is generally flat though tilted and the greatest height (at Ramadi) is more than 50 metres above sea level while the lowest point (at Al-Khidher) is about 7.6 metres above sea level. These points are separated by a distance of 404 km. (Diag. I).

The transverse gradient dips from the foreland of the Arabian block going eastward throughout the plain until it reaches the Tigris-Euphrates outfall drain. Here, it is noted that the ground-level at Falluja is about 45 metres above sea level while that of the Aqarquf area, at the head of the Tigris-Euphrates outfall, is 32 metres. As a measurement of this gradient, the landscape falls about 13 metres in every 45 km. . This is so gentle that the whole area to the east of the river is inundated during the flooding season. This phenomenon dominates not only this part of the country but the south too. At Abu-Skhair which stands 200 kms. to the south of Falluja, the land-level falls to 26 metres above sea level. From this point the slope falls gently eastwards until it reaches a height of about 14 metres at the west bank of haur Dilmaj, a distance of 115 kms. as the crow flies.

In consideration of this it appears that the gradient of land in both directions is a marked feature, with the northern slope having the steeper slopes. The direction of the irrigation canals is invariably aligned directly down the prevailing gradients in the different areas. For example in the north region the irrigation canals are aligned west to east and in the south region from north to south. This is an obvious reflection of the riverine landscape which has already been described.

Worthy of note is the fact that the Euphrates, by depositing silt in its bed, flows on levels which become higher as time progresses. Thus the land surface slopes gently away from the river course, a condition which accounts for the annual flooding of the neighbouring areas at the time of high water. According to Willcocks(1) the transverse slopes away from the Euphrates

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(1) W. Willcocks: "Irrigation of Mesopotamia". 1911. p.13.

are five times as steep as those of the Nile. If the Nile breaches its banks in flood it can be brought back after the flood to its old channel without any serious difficulty. But a very severe breach on the Euphrates bank is followed by the river completely leaving its channel and forming a new one some kilometres away and flooding the whole area. Therefore the plain was protected in early times by artificial embankments, 31 metres wide. Hundreds of km. of their remains can still be seen.

The broad plain is a structural depression filled irregularly by fluvial, lacustrine and aeolian deposits. It begins 26 km. north-west of Ramadi with the delta first consisting of a bare plain of clay crossed by the silt banks of countless canals. Also it can be noted, that in the upper part of the region, as far as Babil, great stretches of salt-flats are interspersed with bare plain and low sand-drifts. All this land is capable of easy levelling. This type of landscape is seen not far away from the giant banks of old canals and the ruins of ancient towns. As one goes south the salt-flats increase in area, and then the marshes begin with their stretches of rice cultivation.

In spite of the problem of salinity the soil is mainly an argilaceous, calcareous loam of great fertility. Pockets of stiff clay or pebbles, more or less sandy patches, and areas of saline efflorescene occur here and there on the left side of the river. The opposite margin (the Shamiya[1]) is dissected

(1) Shamiya - the land which is stretched along the right bank of the Euphrates.

by wadis and soil erosion during the rainy winter season.

The dominant feature in the Shamiya margin is the Miocene gypsum which is covered by sandy gypsiferous soil. This narrow belt is a very undulating gypsum landscape, with broad undeveloped drainage facilities.

There are two main distinctive features of this Middle Euphrates region; high and low lands. The high lands could be divided as follows:-

(a) Low arid desert plateaux (Al Haswa and Dahr Al-Megass).

(b) Mounds (tels).

(c) Old irrigation canals.

(d) Sand spots (dunes).

The low land may be classified into two belts:-

(a) Longitudinal belt.

(b) Transverse belt.

The low arid desert plateaux are a remarkable feature of the landscape and cover a considerable area through the western part of the upper region. They consist of two distinct blocks which rise between 6 and 9 metres above the surrounding alluvial plain. The western edges of the two plateaux overlook the Euphrates stream, while the eastern escarpment is covered by deposits of the flood plain (see map 2).

The other noticeable elevations on this very flat plain are man-made and consist of tels (mounds), which are the sites of ancient towns and villages, 6 - 9 metres in height (marked on the map 5). They follow the line of an ancient course of the

Euphrates and its canals which carried water for irrigation from the river to the neighbouring fields.

Another outstanding feature is the scattered old irrigation canals which rise about five metres above the neighbouring areas. Old irrigation canals are distributed over all the country but are concentrated more in the Northern Babylonian region to the east of the Dahr Al-Megass plateau and in the lower region to the east of Hashimiya (map 2), because the old irrigation systems were centred there. They run, predominantly, in a west-east direction through the upper and middle region, but the trend in the lower region is in a north-southerly direction, except for a few in the south-east.

Significant features in the westerly prolongation of alluvial formations in the lower region are the sand dunes. It is quite easy to distinguish a line of sand which stretches beyond Rumaitha village or Bahr Najaf (to which, according to tradition, the sea once extended), just a little to the west of the Shatt Al-Atshan, and the Samawa branch of Euphrates. Some areas are occupied by hills or dunes of marine sands and of transported pebbles with sandy deposits which rise in the neighbourhood of al Mushkab. They stretch along the Shinafiya swamps on the right bank of the Euphrates as far as Samawa. These sandy deposits include both marine and desert sands carried by winds from the Arabian desert. Sand dunes are also important in the area some twenty km. beyond the south-eastern quarter of ancient Babil.

The low-land areas dominate the flood plain. They comprise haurs (permanent swamps) within the plain mainly south and east of the valley, marshes (seasonal swamps), and arid low lands on the one hand, and lakes, depressions and arid channels or the other. The latter group of features form a succession of low basin lands on the western limits of the region.

Two principal groups of lowlands may be distinguished, a longitudinal and what may be called a transverse belt. The first includes two parallel branches, one eastern and the other western. The Aqarquf depression represents the head of the eastern longitudinal belt which starts from this point and follows the line of the Tigris-Euphrates natural outfall, passing many separated marshes and depressions before it reaches the Haur Dilmaj.

Habbaniya lake stands at the head of the western longitudinal strip. This extends more or less as a straight arm from the Upper region, southwards, partly through the eastern fringe of the desert and partly parallel to the right bank of the Euphrates. It follows the Mujara Channel which connects the lake Habbaniya to the north with Abu-Dibis depression to the south. South of this it extends as a long, dry valley, following for much of its route the base of a prominent cliff, varying in height from 30 to 60 metres, called locally the Tar as Sayyid (see map 2). This dry valley stretches below Abu-Dibis towards the south, then at a point mid-way slopes down south-eastwards to a mean level of about 46 metres at the shallow, brackish depression of Bahr-Najaf.

The greatest breadth of this valley is about 1 km. and typical fluvial deposits on its floor are stated by Mitchell [1] to reach a depth of 15 metres. It seems that this dry valley was once the course of a major river which probably reached the modern Euphrates valley east of Najaf city.

From Bahr Najaf the longitudinal belt continues southwards parallel to the Euphrates, passing the Abu-Skhair marshes, as far as Haur Sulaib.

The transverse belt is not a series of low lands but divided by the Jezireh territory into two main groups of basins, the western and eastern. The western part extends from Kifl village as far south as a point mid-way between Shinafiya and Samawa. On the west it adjoins the marshes of the western longitudinal belt which are themselves confined in a narrow region by the desert escarpment. To the east it is limited by the Jezireh Zone. The second group occupies the eastern portion of the Valley and consists of small and scattered marsh areas. Dilmaj is the largest marsh in this group, which also includes the marshes scattered to the south of the Dagharra Canal distributaries.

It is noted that these two groups of the transverse belt are now gradually drying up, due, not only to high temperatures, but also to the recent flood control measures. Previously the waters gradually drained into wide inundations, in which, because they have no adequate outlet, the waters might remain standing for some years. Many of them were salt or brakkish before they

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(1) R.C. Mitchell: "The Recent Tectonic movement in the Mesopotamic Plain". Geog. Journ. Vol

disappeared.

In the light of the above discussion it can be seen that the marsh lands are concentrated in limited parts of the country, because of the difference in land height both between the upper and lower areas, and the west and the east.

The drainage map 2 shows that the land to the north of the Euphrates is higher than the Tigris - Euphrates outfall drain; thus swamps and depressions are concentrated near the latter. In the south the relative height of the two rivers changes; the east side of the lower region, just at the latitude of Kut city on the Tigris river, is higher than the Euphrates side. Here there is a general downwards slope towards the latter and consequently marshes have been formed near the course of the Euphrates channels.

There are several possibilities to account for the development of the low areas in the upper region:-

(a) The tectonic movements during the Tertiary times.

(b) Aeolian denudation. (This seems feasible in the case of the Aqarquf depression).

or (c) Chemical dissolution. (This last possibility would account for the Habbaniya lake built up in the limestone hilly area).

E. Physical Regions (Map 3).

In the previous section consideration was given to the general morphological characteristics of the area as a whole. This is followed by a more detailed examination of the features of minor physiographic regions within the whole.

On the basis of relief features, physical evolution, soils and types of vegetation and crops the valley can be subdivided as follows:-

(1) The Levee Zone (riverline deposition).

(2) The Upper Miocene Desert Plateaux.

(3) The Marshes Zone (Rice areas).

(4) Interfluvial Zone (Northern Babylonia and Jezireh).

(1) Levee Zone

This zone stretches along the banks of the Euphrates and its two branches of Hindiya and Hilla Channels. Therefore it is possible to draw a line bounding the area from the north and south as well as to the west and east so that the territory is composed of a narrow belt on both sides of the river and its channels (mentioned above). In the north it is quite broad but gradually becomes narrower to the south, especially along the Hilla canal. In addition, the Hilla belt is shorter in length than the Hindiya levee belt. The former terminates near the settlement of Hashimiya while the latter extends as far as Kifl village. The territory is bounded on the east and south by the Interfluvial Zone whilst on the west mainly by desert.

The Euphrates carries in winter and especially during flood season in spring a great quantity of silt. The available data show that the maximum flood discharge of 2733 cubic metres per second at Hit amounts to 682 million kgm. a day. This is enough to cover 1,000 mesharas (600 acres) of land with a layer of silt 0.025 cm. thick. This phenomenon explains how the river has gradually formed the successive layers of its Levee zone along its two banks. In this connection it is worth while to state that the highest proportion of silt is deposited during the period of flooding. This has an important bearing on the land formation in the borderland through which the river passes. In the upper reaches, when the river overflows its banks at the peak of the floods, it carries its maximum of silt, and deposits enormous quantities on the adjacent land, which is consequently raised. In the lower reaches the flood has often begun to subside below the banks before the maximum charge of silt arrives, and the rate of bank formation is consequently much slower, the silt being confined to the channels of Hindiya and Hilla and the rest deposited in lakes and swamps of the Shamiya marsh zone. The riverline deposition which is accumulated yearly during flooding season explains why the elevation of the young alluvial bankland is higher than the river level on the one hand and the back slope of the interfluvial land on the other.

This Levee belt starts from the head of the plain on the north, running parallel to the river course. In some localities it forms a broad basin of alluvium while in other places it becomes a narrow strip. This physical characteristic is due in each case either to one or both of the following factors. The extension of the desert escarpment towards the river course and the position of the land-level adjacent to the river stream as well as the alignment of the artificial embankment along the side of the river are considered the main criteria in the delimitation of the Levee Zone. The part of this zone with greatest width extends from the north (Spur Al-Aswad) to as far south as the southern end of Al-Haswa plateau. The largest breadth of this part of the area stretches along a line some 8 km. in extent from the north of Habhaniya lake to a point north-east of Ramadi. This wide open space has a level below that of the flood waters in the river, so that flows which had taken place before the construction of Ramadi barrage in 1956 covered the whole area with layers of silt (map 3). Map 3 shows that to the south of this division the riverline area follows its way south-eastwards until it touches the desert edge at a point where the river makes a marked meander towards the desert escarpment. From this point the Levee belt runs parallel to the west bank of the river as far south as the Hindiya Barrage. In this later part the belt is in general narrow but varies in width from one locality to another because of the extent of the desert edge on the one hand and the position of the river course on the other. The narrowest place in this part which lies to the west of Dahr Al-Megass Plateau measures about 3 km. in breadth. To the left side of the river the breadth of the Levee area is limited by the artificial embankment which usually runs parallel to the river side. South of the Hindiya Barrage it is divided into two strips as was mentioned before. These two belts of the Hindiya and Hilla Channels which stretch southwards throughout the Intefflwial Zone are also confined by artificial embankments. They form roughly regular riverline belts (compare the main one to the north of Hindiya Barrage) but become narrower. The average width of the Zone as a whole from the north to the south is 5 km.

From the head of the river the banks are fairly high and well drained.

The soil of the territory has been deposited largely by the main river and the Hindiya and Hilla streams in the past and this process is still continuing. Therefore this zone has been built up of a considerable proportion of well-drained piedpont alluvium which consists of a fine and silty soil but it is liable to flooding when waters rise above the channel banks, because the level of the Levee zone is much lower than the level of the water streams during the flood (see diagram 1).

(2) <u>The Upper Miocene Desert Plateuax Zone</u>.

Two isolated low plateaux rise, like islands out of a sea, between 6 and 9 metres above the level of the surrounding plain. These plateaux are found to consist of transported materials, chiefly flints, pebbles, fragments of gypsum and also gypsiferous sandstone and the western desert. Only this and fragmented alluvial material is found on the plateau surface which suggest that during much of the period of the post-Miocene marine incursions, the plateaux themselves projected above sea level. <u>Al-Haswa Plateau</u> is the larger, occupying twice the area of the southern plateau. It occupies about a hundred and seventy-six sq. km. and forms a tongue of some 40 km. in length. Falluja town stands on the western edge which terminates to the left side of the Euphrates stream. It is restricted in the south-east by the alluvial tracts, in the north by the Saqlawiya canal, in the south by the Abu-Ghraib canal (see map 3).

Dahr Al-Megass Plateau stretches for 24 km. --an area more than half that of Al-Haswa plateau. It forms a roughly longitudinal shape and stretches westwards as far as the river and eastwards to the alluvial plain. It is separated from the Al-Haswa plateau by a considerable stretch of agricultural land. It runs in a north-west - south-east direction parallel to the Latifiya and Iskandariya canals to the north and south respectively.

Since these plateaux are higher than the surrounding flood plain as well as being bare of soil with the exception of the sand dunes, gravels, and some fragments of alluvial materials, this zone is not irrigated. The chief natural vegetation is thorn, camel thorn and poop, during spring time.

From the point of view of structure, topography and lithology these plateaux are similar to the Turtle-Backs which dominate the eastern part of the flat alluvial area of the Nile Delta. The elevation of the Turtle-Backs above the general level corresponds to the elevation of the low plateaux of the Middle Euphrates plain. Moreover, like the Turtle-Backs low plateaux of Al-Haswa and Dahr Al-Megass are insular patches of coarse material, exposed through "windows" in much more recent alluvial coverings.

(3) Marshes Zone (map 4).

This district of both permanent and seasonal swamps has been derived from the ancient lagoons which were succeeded by the old Babylonian marshes. These, later called the "Paludes Babylonial" by Roman Historians, occupied a larger water area than the present Shamiya swamps. They developed and expanded even more in the southern part of the country in 629 A.D. when the Euphrates flooded to the highest level ever known. Shortly afterwards these marshes were called "Al-Batiah" by Arab geographers. According to Ibn Serapion in his book "Description of Mesopatamia and Baghdad",[1] Al-Batiah in the 7th century A.D. was a most remarkable feature, enclosed by a latitude through Kifl-Diwaniya on the north and haur Al-Hammar to the south of the Middle Euphrates boundary. Chesney, who visited the area in 1836, described in his book "The expedition of the Rivers Tigris and Euphrates", how the "Al-Batiah" (the Lemlum marshes) were dried up except for the northern part where the Shamiya swamps exist to the present day.

The Shamiya marshes follow an approximate line from a point just south of Kifl village, southwards, to eight kms. above Samawa. From 60 kms. downstream of the Hindiya barrage the river maintains its single course, but divides at Kifl into two branches, namely the Shamiya branch to the east, taking just over half the water, and the Kufa branch to the west. Soon after this bifurcation numerous channels lead away from each branch and flow over extensive rice-fields. These channels, divided by stages into smaller and smaller streams, are finally lost in two main drainage lakes (haurs). The eastern one is called Haur Ibn Najun (photo 1) and is considered the largest swamp. That to the south is called Haur Abu Hajar (photo 2) and covers a considerable area. Between

(1) Ibn Serapion; "Description of Mesopotamia and Baghdad". A.D. 900.

(2) F.R. Chesney; "The Expedition to the rivers Euphrates and Tigris", vol. II, London 1850.

the Shamiya branch to the east and the Kalbbi drainage channel to the west are the Kalbhi marshes. The Abu Skhair marshes occupy the area south of the village of that name, following the Kufa branch as far as Shinafiya. Each main branch of the river dwindle continuously as it pursues its southward journey, until it is finally dispersed entirely into the marshes and ceases to exist as a branch of the river. Between the settlements of Abu Skhair and Ghammas and Shinafiya to the south the marsh lands are only about 17 metres above sea level. By contrast the land at Abu Skhair is 26 metres high. In the flooded season land between the two branches and on either side for about 41 metres south of Kifl village is completely inundated, the water persisting for some time after the flood. In the low water months the marsh drains out into separate expanses of flood water and the drainage channel to Shamiya and Shinafiya becomes distinct.

It is noticeable that there is an additional feature of the greatest importance which was absent from the other parts of the valley of the Middle Euphrates. This phenomenon, which dominates especially the southern portion, is the "Nuggara" feature (see map 4). At low water there is a large drop of level between the water in the irrigation canals in the rice area between the latitudes of Abu Skhair in the north and Shinafiya in the south. This drop is taken up by numerous falls into the lower level channels which converge to form three main drainage channels leading out from the marshes into the river some 20 kms. to the north of Shinafiya. In these three drainage channels are more falls. These falls, locally called "Nuggaras", ane obliterated under flood conditions. However, while the levels in the drainage channels are low, the water may fall as much as 5 metres over a sudden drop in the friable alluvium of this part of the region.

To understand this marked feature dominating the area one should note the position of the water level in the river at Kifl, where the Shamiya and Kufa channels bifurcate, and at Shinafiya.

As the Hindiya branch drew off the flood waters and filled the depressions (haurs and marshes) to the south of Kifl, the time came when the Shatt Al-Shinafiya was unable to discharge the excess water without enlargement. This enlargement is brought about by natural forces. The erosive action of the flowing water scours out the bed of the river and in places produces falls. These falls are themselves eroded by the water and cut backwards up the channel at a rate depending on the nature of the local alluvium. The rate of this action varies from a few metres to about one kilometre per annum.

This cutting back has far-reaching consequences. For instance, an irrigation canal, dug out from either the Shamiya or Kufa branches to flood the rice crops, ends in several smaller drains which remove the excess water and spill it over falls into the main drainage channel. This in turn discharges into the Shatt Al-Shinafiya. In the main drainage channel the main fall receding upstream, passes the end of the smaller drains, whereupon the fall, now greatly increased, begins to travel rapidly up the irrigation canals themselves towards the main branch of the Shamiya and Kufa.

This must be prevented. The falls are too high to be permanently held by the crude methods of the local people who strive to raise the bed-level of the main branch of the river (for irrigation) despite the natural tendency to lower it. They build low dams of reeds and earth to pound up water in the low season. Under the regime in which they had established their system the water-level in their canals was controlled by the level of the haur, which in turn, was affected by the continual down-cutting in the Shatt Al-Shinafiya. Because of the lowering of the water in the drainage channels and in the haurs due to the scouring action, the people were forced to turn to artificial means for keeping up the summer low levels in their canals. The old system of the entire river flooding over the rice-fields which had for centuries been maintained was reversed in the Abu Skhair - Shamiya marshes where there was an extension of the rice area into the marshes. Here in the Shamiya the drop between the levels in the canals and the haurs created falls in the irrigation channels themselves eating back into the recently developed rice-fields. Thus instead of expanding, the area diminished, at least on its southern fringes, and as it did so, the menace of the falls was magnified, for they were cutting back into higher land and becoming more difficult to control and driving the cultivators higher and higher up onto the ridge which they had themselves encouraged the river to form. When they realised the erosion problem in the Shamiya area the Irrigation Department planned to construct concrete weirs, by which it is hoped to hold up the travel of the nuggara falls in the main drainage channels. But, it seems that the construction of weirs can be no more than a temporary remedy. The entire silt load of the river will be deposited year after year in the same place and there will be a steady rise until the weirs are no longer able to hold up the water to a sufficient level. Then the trouble will recur. The area can be permanently safeguarded only by providing barrages on the two river channels to serve main canals supplying the rice-fields. Accordingly there would be development of the branches by halting of the scouring action till they become capable of carrying off the excess flood waters.

(4) Interfluvial Zone (Northern Babylonia and Jezireh).

The boundaries of this zone are, in the north, the head-land of the Jezireh High Plain, in the east, the Tigris-Euphrates outfall, and in the west, the Levee Zone ending at Kifl village. To the south of this point are the Shamiya marshes stretching down to a point forty km. north of Samawa. From Kifl towards the north as far as the opposite side of Dahr Al-Megass Plateau, the limit lies westward across the Hindiya branch of the river. This territory extends northwest-southeast until it reaches the south-east border of the country.

From consideration of its topography, soils and types of vegetation and crops the interfluvial zone can be sub-divided as follows into Northern Babylonia and Jezireh:

(4a) Northern Babylonia.

The zone of northern Babylonia covers the considerable area bounded on the north by the prehistoric coastline, on the west by the Levee Zone, on the east by the Aqarquf depression and the northern part of the Tigris - Euphrates outfall drain, and on the south by the Musayib canal.

The physical characters of the district below the Saqlawiya canal are best studied from north to south, as the valley opens out. In the upper territory at the Prehistoric coastline there is localised sinking above Falluja and near Aqarquf. The territory here undulates a little in the centre, and then drops gradually towards the south. The height of the land at Ramadi is about fifty matres above sea-level. Falluja, at the head of the Abu Ghraib canal, a short distance south, stands at about forty-three metres. Further south, Mahmudiya village, at the east of this portion, is thirty-eight metres, and Iskandariya village, to the south, close to the boundary of the territory, thirty-one metres above sea-level.

First to consider the case of the eastern slope; the land level at the head of the Abu Ghraib canal is forty-three metres, as previously stated, but a little further eastwards, from Abu Ghraib village the land remains at about thirty-two metres for about 40 kilometres. Thus the level falls nineteen metres over 112 kilometres ground distance in the former while it falls eleven metres over 40 kilometres in the latter; slopes of 1 in 5842 and 1 in 3908 respectively. Accordingly, the danger of flooding in this territory is evident during the season in which the river rises.

Another remarkable phenomenon is the extent to which the plain is marked by man-made features. Mounds rise from an otherwise flat surface; walls, mud ramparts and dykes intersect one another; elevated masses of friable soil and clay are succeeded by low plains, which were previously inundated during a great part of the year; and the ancient beds of canals are visible in every direction.

In addition to this, there are the old canals which have been filled in from their embankments and left standing, and new canals dug alongside. The old canals have been found also on the right bank of the Euphrates, e.g. Bitra canal on the opposite side of Al-Megass low plateau.(1) This canal issued from the river at the fields round Bitra, and was dug in a natural depression in the Tertiary upland formation. It ran south-southeast of the ancient town of Parsipa (see map 5). In the most northerly territory, the soil is slightly pebbly, the pebbles consisting almost solely of various coloured flints and occasional small fragments of gypsum. This is followed by a continuous formation of clay soil, in part humus, in part argillaceous and argille-calcareous, but covered with mould, dust or sands, or the tenacious clay of frequent inundations.

It is rare that pebbly deposits show themselves south of a line from Fallūja to Aqarquf; but small circumscribed transported deposits are occasionally met with. These form islands in the course of the vast tracts of alluvium, as at Iskandariya village to the south, and other places.

Another curious feature is the recent accumulation of soil

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(1) A. Musil; "The Middle Euphrates", New York. 1927, p.222.

in this zone. This soil, found to be a result of the annual inundations, is still very extensive. Canals, such as the Isa (now called Saqlawiya), canal north of Falluja, which in the past and at the present time carry water from the Euphrates to the Tigris, previously flooded the area about Aqarquf for six months of the year. Other irrigation canals to the south were, and still are, drawn from the same source, (e.g. the Abu-Ghraib, Latifiya, Yousufiya and Iskandariya), which in the flood period, inundate most of the north plain and the lands through this district.

The quantity of recent mud deposited even at the mouth of these canals is considerable, and is found in strata by the canal sides, covered by alluvium, 1.5 metres above the neighbouring land. The alluvium brought down by canals and riverlets and deposited at their mouths and on their banks is of a fine clay character.

The depressions which occupy a considerable area of low land through the northern portion of this district are the Habbaniya lake on the western side and the Quarquf depression on the eastern side.

The Habbaniya lake covers an area of 240 sq. km. and is some 8 metres deep, in flood. At its northern extremity is a low-lying belt of abrupt desert mounds, the formations of which can be seen today surmounted by thorn. It has a basin which contains a lake about 85 sq. km. in area, and this lake joins the right bank of the Euphrates by a cut which leads to the Habbaniya depression. This contains a sheet of slightly saline water at about 43 metres above sea level, separated from the river by the Asib and Dhiban ridges 40 metres higher, and surrounded on other sides by sandy hills. Since 1956 it has been utilized as a reservoir in periods of dangerously high water by means of a new cut, the Warrar inlet canal, which stretches for six kilometres between the lake and the source where the Ramadi Barrage is situated. Another cut called the Dhiban outlet canal is nine kilometres long and is used for feeding the Euphrates at low water. Besides the Mujara escape surplus water is taken, during dangerous flood, from the Habbaniya lake southwards into the Abu-Dibis depression and so prevents excessive flooding in the north country. Abu-Dibis is situated south of Habbaniya and covers about 760 sq.km. It is 6 metres deep so that the level of the water would naturally flow back into the Euphrates valley near Karbala (see map 31). These basins are very important from the point of view of the extension of irrigation projects.

The Aqarquf depression is bounded on the north by the Jezireh high plain and on the south by Abu-Ghraib agricultural areas. It has been derived from the old Babylonian reservoir. It is more intersected by old channels and irrigation cuts than any other part of this district. The depression covers an area of 600 square kilometres at extreme low water, and 408 sq.km.,[1] when full. It contains about 0.646[2] milliard cubic metres of

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(1) W. Willcocks: "Irrigation of Mesopotamia". 1917. London. p.11.13.

(2) A. Sousa: "The Euphrates Valley and Hindiya Barrage" (Arabic) Baghdad, 1945. p.6.

water. Its bed-level is 10 metres below the Tigris. The deepest point inside the depression is about 31 metres above sea level. Into this depression runs the Saqlawiya canal of the Euphrates, which splits up into about twenty smallcanals as it enters the western side of the depression.

The Directorate General of Irrigation of the Iraqi Government has already planned to drain the collected waters of this depression by the Tigris - Euphrates outfall. This drain will be given a width of twenty metres along its entire length so that it can discharge fifty cubic metres per second after the flood, and help the valuable rice crop.

(4B) Jezireh

The Jezireh area which represents the southern part of the InterfluvialZone extends from the southern border of the Great Musayib Canal between the southern part of the Levee Zone and Shamiya swamps to the west and the southern part of the line of natural drainage of the Tigris - Euphrates outfall. It is orientated in a north-western to south-eastern direction. On the eastern border it follows an old irrigation canal passing Tel Ibrahim (Kutha) (map 5) and a series of longitudinal low hills of which the average height is no more than five metres above the surrounding land level. After this it runs concurrently with the western banks of the haur Shuke and haur Dilmaj until it reaches a point just south of the Kut-Nasiriya boundary. From this point the direction turns to south and southwest passing Qala Ratha which is situated at Shatt Al Khar, tel Al-Warka (map 5) and going as far as Al-Khidher village on the Euphrates.

The unique feature of Jezireh is its general slope level towards the south. The elevation of the land-level at a point on the southern bank of haur Hillala is 25 metres above sea level. To the south of this point the land-level slopes gradually for about 8 km. towards the latitude of Diwaniya - Al-Budair where it is 17 metres above sea level, i.e. a slope of 1 in 10,000. To the south of this line the land-level declines fairly steeply until it reaches a height of 8 metres at Al-Warka latitude in a distance of 63 km. (a slope of 1 in 7,000). The pattern of irrigation drainage is very much controlled by this general slope of land-level. This topographical character is different from what has been shown in the Northern Babylonia division. The sloping land-level of the latter coincides with the eastern direction whilst in Jezireh it descends to the south.

The other marked physical characteristics which dominate the area are haurs, arid depressions, ancient irrigation canals which have been derived from the Chaldeans time in 39 B.C., and the extensive growth of sand-dunes.

The haurs and arid depressions which are mainly contained in a longitudinal belt from the haur Hillala on the north to Niffur depression to the south form a remarkable feature in the eastern part of the Jezireh. These low lying lands have been derived from the ancient lagoons which were succeeded by the permanent and seasonal marshes fed by the Tigris during flood seasons. Thus it was found that the type of soil which characterises these localities is the clay loam of the pinkish-grey colour of the Tigris series. This soil differs from the greyish-brown Euphrates soil series (see chapter on soils). The haurs and marshes under consideration have been described earlier in this section (see pp.72-77). The major important depression in this group is Niffur. It lies between the settlements of Ifaq and Al-Budair to the east and the uninhabited sand-dunes area to the south. The depression covers an area of not less than six hundred sq.km. Its land-level is about 14 metres above sea level whilst the deepest point inside the depression is approximately six metres below the surrounding land-level. Into its eastern margin runs the Dagharra canal of the Hilla Branch. All of these low lying tracts of haurs and depressions are considered the main areas of rice growing, whilst the remaining areas except the irrigated divisions are used as grazing land especially during the rainy period.

The sand-dunes which characterise the Jezireh are regarded as a remarkable feature. There are three main groups found in different localities. In the north part, between the west bank of haur Shuke on the one side and Hilla on the other there is a small group of sand-dunes. The second one which has a high elevation and a dense accumulation of sands is located close to the western shore of haur Dilmaj. The third group is scattered among Diwaniya, Rumaitha and Al-Budair, respectively, as shown on map 2. It is noted in the Jezireh that these dunes occur where sand and dust storms are often severe. Thus, in the eastern Jezireh, most dunes accumulate near to the shores of the marshes and swamps. All of these dunes are active at present and do not give the impression of great antiquity. The northern part of the dunes, which appear formless and widespread, may have originated as littoral dunes upon which recent active ones have been superimposed. In the east, close to the haur Dilmaj, the accumulation of sand-dunes is noticeable whilst in the case of the uninhabited dunes-area the sands are sparsely scattered. This may be due, in the former case, to the moisture and, in the latter, to the drier land.

The soil in this territory is composed of wind borne material and river overflow deposits, haur sediments, or a combination of these. There are large salt and silt drifts of deep blue colour which are very uniform in character (Map 19).

This Zone consists of a vast open plain when compared with other sub-regions mentioned before. It includes large undeveloped areas, with the exception of the Dagharra-Ifaq and Rumaitha districts (Map 29). This undeveloped land has been put on the Development Programme for establishing new irrigation projects similar to those of the Great Musayib and Babil. It is an area with considerable cultivation potential and is considered a suitable district for the introduction of modern agricultural and irrigation projects.

F. THE DRAINAGE EVOLUTION OF THE EUPHRATES COURSE (Map 5)

(i) Drainage Evolution

The stages of the evolution of the Middle Euphrates basin will now be considered. A theory to explain the direction and flow of the river has been based on the archaeological evidence and the physical characteristics of the land. Thus the original drainage of the river between the head of the delta and the head of the Persian Gulf at Warka, Eridu , Ur and Lagash shoreline (see p.45 and maps 5,6) has changed during historical time.

The landscape of the Middle Euphrates region became influenced by successive cycles of inundations during the evolution of the drainage pattern. The changing of the river courses throughout this area was due to blockage by accumulated river sediment, and the lower section has itself acquired three distinct channels since earliest times. A basic distinction is to be made between the upper and lower courses of the Euphrates.

<u>The Upper Course</u> - In ancient times the upper part of the Middle Euphrates course flowed in the present channel, through the upper valley from the Spur of Al-Aswad, running south of Falluja until it reached the ruins of Sippar (called locally Abu-Habba) about 12 kilometres east of the present Euphrates channel. Musil (1) believed that the Upper Euphrates channel has probably occupied its present course since earliest times. This part of the Valley (called "the Garden of Eden" by Musil and Willcocks) was watered by the upper river and extended as far south as the Sippar. Below Sippar the course of the Euphrates bifurcated. The upper valley (the "Garden of Eden" district) consists of a narrow plain.

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(1) A. Musil: "The Middle Euphrates" New York. 1927. pp.20.

The Euphrates first filled in the embayment at Spur Al-Aswad and Al-Okoba in the Tertiary uplands about 26 kilometres north-west of Ramadi. That region is regarded as the oldest part of the Middle Euphrates plain, and here man could have settled in earliest times. The river here flows in a plain which averages fifteen kilometres in width from north to south, about 65 kilometres in length from east to west and enclosed on all sides by Tertiary uplands until it opens in the south-east into the interior of the broad plain.

<u>The Lower Course</u> - The lower course had three previous positions; firstly, Kutha, which was the chief channel of the Euphrates to the east of the present river bed; secondly, the Babylonian channel (Hilla canal) in the middle; and thirdly, the Pallacopas channel (Hindiya branch) to the west.

<u>The Kutha river</u> represented the principal ancient bed of the Euphrates of Sumerian and Akkad times, between three and two thousand years B.C.(1). That course was probably in being during earlier periods and the main body of water passed into the Gulf. The Kutha river(2) started at a point about half-way between the head of the Latifiya Canal and Falluja passing Sippar (mound) to the southeast and thereafter running parallel to the Tigris river on the east. The position of its original bed is indicated by the mounds covering the sites of early cities, which extend through the country from north to south (map 5).

(1) Dr.Sousa: "The Euphrates Valley and Hindiya barrage" Baghdad, 1945.

(2) Lenard W. King: "History of Sumer and Akkad", 1923, pp.8-9.

The mounds of Abu-Habba, tel Ibrahim, Al-Ahemir and Niffer on the north, mask the sites of the important cities of Sippar, Kutha, Jemdt Nassir, Kish and Nippur, the last two mounds being situated on the ancient bed of the Shatt Al-Nil(1). Similarly, the course of the Shatt Al-Khar, which formed an extension of the Shatt Al-Nil below Ifaq village passes the mounds of Abu-Hatab, Fara and Warka (Erech) which stand on a further continuation of the Shatt Al-Nil representing the tail of Kutha river. The exact course of the Kutha south of Nippur during the earliest period reached the Persian Gulf head in two or three mouths.

The Kutha at that time was of sufficient breadth and depth to be navigable for merchant vessels, so it is not surprising that some historians and geographers have considered it as the ancient bed of the Euphrates.

About the last quarter of the third century and at the beginning of the second century before Christ, the Kutha stream entered a period in which the general fall of land, east to west, so dominated the creation of successive new post-flood courses as to form the general alignment westward. So it broke away westward, and the last branch of the stream still further to the west, left the river above Babylon and Mussibab during the last stage of the river cycle, as will be discussed later. In addition to the considerations mentioned above there are some other noteworthy reasons which played a great part in changing the river course. Firstly the river bed became higher than before with the

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(1) Shatt = Nahr = river.

accumulation of the river deposits brought into the river bed, especially in the tail of the stream. Secondly, as was referred to by Sousa (1), a high inundation at that time forced the river to take a new course to the west. Thirdly, the Euphrates with its low banks tends, during high water, to spread itself over the surrounding country.

The Babylonian River (present Hilla Canal)

The Babil river probably originated during the last dynasty of Sumer and Akkad (2) and continued from 2,000 B.C. to the sixth century A.D.

The stream was diverted to the west and drained into Pallocopas channel (present Hindiya branch) at a later stage. The Babil river started from a point about half-way between Musayib and Falluja to the west of the old city of Sippar, and this was the main course of the Euphrates during that period, as shown by the ruined cities located alongside the river bed (such as the mounds of Babil, Parsipa and Marda).

Evidence of a once flourishing irrigated agriculture is afforded by the remnants of ancient irrigation projects throughout the region. The river flowed, as it does still in the present straight Babil or Hilla canal line, passing the twn of Musayib, and proceeding through the ruins of Babil. Soon after passing the latter site the river begins to assume that appearance which may have caused Herodotus (3) to say that it differs from all other

(1) Dr. Sousa: "The Euphrates Valley and Chaldaea" London, 1939. pp.164-5.

(2) Ainsworth: "Assyria, Babylonia and Chaldaea" London, 1939. pp.164-5.

(3) Col.Chesney: "Expedition to the Euphrates and Tigris"Vol.2. London, 1850.p.57.

great streams by becoming smaller towards the lower, rather than in the higher part of its course. Numerous canals extend from each side to irrigate the fields. It continued past the location of the present Diwaniya city, to the old town of Lamlum and passes to the east of the present Samawa until it rejoined the remnant of the old Kutha stream which came from the east passing Warka or Erck before it drained into the Persian Gulf at Ur.

At the final stage the channel of the Babil river has altered its direction towards the west as a consequence of the general level of the low-lying lands and because of a high inundation which took place in 629 A.D.(1) when the Euphrates rose, causing flooding on a scale not seen previously.

Owing to the flood the river course was changed above Babil, at Musayib, and formed the most western branch which was marked by the Pallacopas channel during Greek times.

Pallacopas Channel (present Hindiya) - Willcocks referred in "Irrigation of Mesopotamia" to the low-lying Pallacopas as the chief branch of the Euphrates which broke off above Babil and discharged the waters of the river into the Babylonian marshes. The first public work which Alexander the Great undertook in Babylon was the excavation of a new head on solid ground for the Pallacopas, known some years ago as the Hindiya Branch. This is, today, the main stream of the Euphrates, and is immediately closed after the flood to keep the main stream full of water past Babil.

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(1) Le Strange: "The lands of the Eastern Chaliphate" Cambridge, 1930, p.27.

Since that time a change has occurred in the river course. During the Middle Ages, great floods occurred covering an area (Al Batiah) (see pp. 72-73) of 80 km. across and very nearly 320 km. in length - extending as far down as the immediate neighbourhood of Basra and to within a few km. of Kufa. The main channel of the Euphrates was, in those days, the Pallacopas, while the Babil arm became only a great irrigation canal, called the Nahr Sura.(1) Along the northern edge of the lower part of the Great Swamps, a line of lagoons connected by open channels made navigation possible, as evidenced by the old cities which stand along the course or close to it. The city of Kufa, founded immediately after the Moslem conquest of Iraq, about A.D. 638, is slightly to the north of the old Persian City of Al Hirah which had been a great city under the Sassanian. Nearby stood the famous towns of As-Sadir and Al-Khawarnak, the latter having been built up by Naman, Prince of Hirah. On the actual desert border to the west of Kufa stands the ruin of Al-Khadisiyia, while Najaf lies about four km. westward of Kufa, and has remained a populous town to the present day.

The positions of these cities are at present marked by mounds along the right bank of the old stream, and almost definitely indicate that this was the main course of the Euphrates at that time.

The Pallacopas course, was later (in the 14th century)

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(1) Dr. Sousa: "The Euphrates Valley and Hindiya barrage" (Arabic) Baghdad, 1945, p.241.

superseded by the Babil river bed, owing to the Mongol devastation of the 13th century. It gradually decayed during the last three hundred years of the Ottoman Empire. Owing to the anarchy and neglect in the country the irrigation projects were destroyed, and the accumulation of the river deposits made the river bed higher than before. Therefore the river stream changed its direction to the Babil again. Thereafter the Babil channel became the chief course of the Euphrates for another six centuries. At the beginning of the 19th century the latter stream gradually started to leave its bed to the west, towards the Pallacopas. The principal cause of this was the digging of a new canal by Asif(1), the Governor of Iraq, under the Ottoman Empire, to divert the body of water to the holy city of Najaf, when the Pallacopas stream turned towards the Babil stream. In addition to this, there had been deposition throughout the lower course, especially in the Haurs of Lamlum area, so that the stream began to search for another suitable passage, especially during the flood seasons. Another remarkable reason was that Midhat Pasha closed the head of the Saqlawiya canal of the Euphrates, north of Falluja, without making any provision for the heavy discharge of some 750 cubic metres per second which for 500 years had escaped down its canal. This large volume of water, added to the natural discharge of the Euphrates was diverted to save Baghdad and the west side of the Tigris tracts which used to be flooded by the Saqlawiya, playing

(1) Dr. Sousa; "The Euphrates Valley and Hindiya barrage" 1945. Baghdad, p.245.

havoc with the country downstream from Falluja. The high-lying Hilla branch was quite incapable of carrying this extra supply, which, finding its way into the low-lying Hindiya branch, swept away the temporary earthen dams across its channel, scoured out its bed, and permanently lowered the level of water at the bifurcation. The Hilla branch immediately began to silt up and the Government were forced to construct the present Hindiya barrage. As the silting up of the Hilla branch steadily advanced, less water went down its channel and more down the Hindiya branch. In the flood of 1909 the Hilla stream was discharging 300 cubic metres per second, as against 2,500 cubic metres per second going down the Hindiya branch. During 1913[1], the barrage was completed and the water body of the river has since that time discharged evenly through both branches, Hilla and Hindiya, though the latter is still the main channel of the Euphrates.

(ii) Present Conditions

The Euphrates rises in the mountains of Armenia, flows by a circuitous route through northern Syria and enters Iraq near Abu-Kamal, 1200 km. above its confluence with the Tigris at Qurna. It reaches the alluvial plain of the old delta of the Middle Euphrates at the spur of Al-Aswad, about twenty six kilometres north-west of Ramadi. South of Falluja it converges to within forty-two kilometres of the Tigris. Below the Hindiya barrage it divides into two main branches, which join again just north of Samawa. From Kifl village on the Hindiya

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(1) Willcocks: "Irrigation of Mesopotamia" 1917, p.5.

branch, southwards, the river begins to divide into two other branches and some of their waters drain into marshes, while to the south of the marshes area it preserves its character as one river and near Samawa has an average width of 190 - 315 metres (photo. 4(a)). The average depth of the river below Al-Aswad varies from 2.7 to 3.2 metres with shoals at many points, and the current varies, according to place and season, from one to four knots. The Euphrates receives no tributaries in the plain of the river basin.

<u>From Al-Aswad-Falluja</u> Below a spur of Al-Aswad, the Euphrates enters its plain at a height of about 52 metres above sea-level (in September). However, at this point, the river bed is still rocky in character and this factor limits navigation. But hereafter the river flows unimpeded between its own well defined banks.

The river takes a more easterly direction as though to join the Tigris south of Falluja, and passes through a flat scrub-covered plain, about 18 km . wide, to Ramadi. The Ramadi areas are assumed to be the prehistoric river-mouth of the Euphrates, with escarpments on both sides. For the first time, the Euphrates, here at about 45 metres above sea-level (September) begins to dissipate its waters. A cut on the right bank leads to the Habbaniya depression, which contains a sheet of slightly saline water at about 42 metres above sea-level, separated from the river by the Asibi and Dhiban ridges 39 metres higher. It is at present used to take the high flood of the Euphrates.

(1) Dr. Sousa; "The Euphrates Valley and Hindiya Barrage, 1945. p.298.

Between Ramadi and Falluja the first of the modern, controlled distributaries leaves the left bank of the Euphrates. This is the Saqlawiya canal. Thereafter the Euphrates approaches closer to the Tigris. A few kms. further down there is the hard strip of the Al Haswa low plateau, starting south of Saqlawiye canal and extending along the bank of the Euphrates south of Falluja. At this point the river changes its course to the southwest (map 31 and photo. 4(b)). 10 km. below Falluja to Musayib the river takes a straight course in a more southerly direction, proceeding through the date-groves (photo. 5). There are many islands scattered through the river, some of them jungle-covered. In addition the meanders are the unique physical characteristics of this part as compared with other portions of the river course. The river here in September, under the regime(1) of the Euphrates drops to between 39 metres above sea-level (at Falluja) and 42 metres (at Musayib). Its breadth in the low-water season varies from 136 to 270 metres, when the current is only 3 km. an hour and the depth between 3.5 and 2.7 metres. However, the flood waters may rise as much as 5.4 metres, so that the natural banks, rarely more than 4.5 metres high, have to be raised by continuous artificial embankments over long stretches. Four controlled perennial canals, were remodelled by the National Government, to distribute the water at various points along the course into the Abu-Ghraib, Al-Yusufiya, and Latifiya and the

(1) Admiralty: "Iraq and the Persian Gulf". N.I.D. 1944. p.32.

Iskandariya canals.

Land is cultivated on both sides of the river, down-stream of the Abu-Ghraib canal head; water-wheels, pumps, and levers (Shaduf) being used to lift water into the smaller irrigation canals.

Ten km. below Musayib, at the Hindiya barrage, the Euphrates divides into two branches, the Hindiya branch to the west and Hilla canal to the east. The western arm (Hindiya branch) is now considered the main channel of the river. This branch takes a south-westerly direction, following a single course as far as Kifl. Between the Hindiya barrage and Kifl village the river reaches a width of 180 metres. Permanent creeks enclose Kifl on three sides, so that at the flood time the village is surrounded by water and can only be reached by a winding embankment The river is divided into channels below Kifl. The eastern or shatt Al-Shamiya channel carrying half the water, varies between 45 and 135 metres wide. The western or Kufa channel (photo. 6) passes close to Najaf, but below Kufa runs in a southerly direction until it joins many creeks and the Nuggara canals ((map 4) which come from the lower course of Shamiya and join the channel just north of Shinafiya.

The meanders winding along this division of the river are not a very remarkable physical feature when compared with the division above the Hindiya barrage.

Both channel banks south of Kifl are low so the water is dissipated into marshes which are considered the principal rice cultivation areas in the whole of the Shamiya-Abu Skhair zone. The marshes are mostly drained by three channels into a single bed at Shinafiya (map 4) but about 18 km. lower down, two new courses are formed, the Shatt as-Sabil and the Shatt Al-Atshan, which unite about 8 km. above Samawa. It may be noted that a few km. above Shinafiya along the western channel, the river bed turns inland to the west forming a curved course nearby as far as Samawa. Below the latter town, the Euphrates flows in a single channel in a south-easterly direction to Al-Khidher. It drains the land irrigated by the Hilla canal, the water entering the river from small creeks from the Haur Lofta (map 2) about 18 km. below Samawa. The river's (1) width averages between 135 - 180 metres so that it is fairly easy to navigate.

Hilla branch - The Hilla canal which represents the eastern channel of the Euphrates is clean-cut and well graded, and passes Babylon, (photo. 7) Hilla, Diwaniya (photo. 8) and Rumaitha. Following a south-easterly direction as far as Rumaitha, it is there divided by a regulator (photo. 9) into several small branches each of which goes its separate way through the fields until they are gathered into haur Lofta, forming a new course which joins the Euphrates at the south of Samawa.

The banks of the canal are fairly high and well-maintained and the land on either side is comparatively well drained and affords a good route for roads and railways. About 32 km. above Diwaniya, the Daghghara barrage controls water in an

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(1) Numbers recorded above have been taken from the Surveying Department in Baghdad, 1957.

intricate network of small inundation canals, in the eastern Diwaniya district, but still runs below Diwaniya, its waters being gradually dissipated by irrigation. Only a very small proportion of the volume is taken by the tail of this canal as has been previously mentioned.

(ii) <u>Places for Development</u>

Water policy is concerned with the integrated development of major reservoirs, barrages, regulators, inlets, outlets and irrigation canals in the area. The sites of the major projects have been located in areas where the scope for water collection and storage is greatest, and where most effective use can be made of the potential irrigation waters. Thus a project for the regulated diversion of the waters of the Euphrates into lake Habbaniya has been under construction since 1956. This involves the construction of an inlet along Warrar channel from the Euphrates near Ramadi to the Lake, as well as an outlet through the Dhiban channel for the later release of the stored water. This outlet discharges into the Euphrates during the period of low water level of the river. Ramadi barrage which is built across the Euphrates raises the water level and thus permits an increase in the capacity of the lake reservoir. The project will extend the storage capacity by draining the water of Lake Habbaniya into the nearby depression of Abu-Dibis through the discharge channel of Mujara. The water in Abu-Dibis reservoir will be drained by means of outlet called the Abu-Dibis channel which in turn will discharge into Hindiya branch south of Hindiya barrage when the water level is lower in the river (map 31). In addition to this the construction of a barrage below Kifl is planned on a branch of the Kufa Channel which would govern, on the right bank, a new canal intended to serve the Bahr-Najaf project area. There would also be, on the left bank, the Shamiya branch which would extend irrigation to the southern Jezireh project areas (map 28).

The storage waters of these irrigation projects have been planned to expand and develop the underdeveloped lands of the Middle Euphrates Valley, especially the Jezireh Zone. Jezireh consists of a vast open plain when compared to the other sub-regions which have already been considered. It includes large undeveloped areas so that most of it has been put on the Development Board's Scheme for establishing new project areas (e.g. the extensions of Musayib, Babil, Eastern Jezireh, Dagharra, Southern Jezireh (Khar and Fawar projects), and the area between Shamiya - Diwaniya). Apart from this, other extensions have been designed, such as the Iskandariya, Latifiya extensions to the north in the Northern Babylonia district, the Bahr-Najaf extension located to the west, and the Shamiya extension to the east of Kifl barrage respectively (map 29). Future irrigation projects will be considered in detail in the irrigation chapter.

G. <u>CLIMATE</u> (Maps 8-18; Diagrams 2-4; tables 1-5).

The climate of the Middle Euphrates plain is of the semi-arid type, or "continental, sub-tropical". The main characteristics are (a) a high mean annual air temperature (due to the latitude), (b) a large difference in temperature between day and night and between winter and summer (i.e. large diurnal and annual ranges of temperature), (c) low humidity of the atmosphere, and (d) scanty rainfall.

The small latitudinal extent of the region under consideration (little over 2^{o}), would lead one to expect hardly any difference between the climate and vegetation of the north and of the south. This small natural differenceis further negated by an increase in altitude as one proceeds from north to south. Maritime influences are slight and mainly felt in the north, and not, as might be expected, in the south. For, although the short sea coast of Iraq is situated in its south-eastern corner, along the shore of the Persian Gulf, a glance at map 1 shows that the Gulf is only a narrow land-locked arm of the Arabian Sea, cut off from the open ocean by the whole width of the arid desert peninsula of Sothern Arabia. Beyond the mountains of Kurdistan and Armenia lie the Black Sea, at a great distance to the north, and the Caspian to the east; while to the west beyond the Syrian Desert is the Mediterranean. Accordingly, the climatic conditions of such a country as this are affected by its situation in relation to the seas mentioned.

The prevailing wind throughout the year is north-westerly owing to the situation of the basin on the fringe of the great high-pressure zone of Anatolia and Central Asia. In summer the ruling factor is the low pressure area over the Persian Gulf. There is thus, in this season a steep gradient of pressure from the high-pressure zone of Anatolia towards the Gulf area. In winter a projection of the anticyclone system which lies over Central Asia stretches over Iraq extending to the south-west towards the Arabian desert. Atmospheric pressure, therefore, is comparatively high, and falls away with a slight gradient to the south and west throughout the Middle Euphrates Valley, so that winds, though variable in direction, are mainly from the north and west. Alternating with this temporary high pressure, during the winter months of December, January and February, depressions may pass over the Mediterranean Sea from the west to east, through lower Iraq, leading to a change in the direction of the wind from the prevailing north-west round to the south-east, accompanied by a rise in temperature and often by gales and dust-storms in the Middle Euphrates Valley. In the unsettled weather which follows, rain frequently falls.

As the season progresses, the high-pressure centre over Central Asia recedes northwards, while the low-pressure over north-western India advances westwards towards the Persian Gulf. As a result, the predominance of the northerly and north-westerly winds in the basin increases, and is accompanied by an increase in the wind speed. By June the low-pressure area has its centre over south-eastern Iran, and over the Euphrates basin the gradient is very steep. For this and the two succeeding months conditions are very steady. Northerly winds, of steady velocity, dry and comparatively cool, sweep down from the hills of the folded zone.

In September, October and November, the low-pressure area returns eastwards to the north-western part of India, and the Central Asian high-pressure area returns southwards. Unsettled weather, following the passage of depressions from the Mediterranean Sea, begins, bringing the first rains of the season along with an increase in the incidence of southerly winds. The steady wind, producing a high average speed without gales, which characterises June, July and August, gives place to more frequent calms and a lower mean wind speed, but with gales of short duration.

Throughout the country the year is divided into two well-marked seasons, with short transition periods in between - the long, hot, rainless summer extending from May to October and the comparatively short, cool winter from December to February. The transitional periods, spring and autumn, are less well-marked on the plain of the Middle Euphrates than either winter or summer.

Winter In the winter, the atmospheric pressure is comparatively high over northern Syria and extends towards the Euphrates Valley, since these areas are on the outskirts of the great high-pressure system of Central Asia. The north-west wind prevails throughout the region at this time of year but tends to be more variable in direction than in other seasons. Rain occurs during the passage of cyclonic depressions, some of which come from the eastern Medittéranean Basin, and others probably pass across Asia Minor. At other times, however, those from the north arrive at the low-lying Jezireh as dry and comparatively warm winds.

Winter usually comes suddenly, after the short season of Autumn and lasts from December to February. North-west winds still prevail, as mentioned, but they are weaker and are frequently interrupted by depressions from the Mediterranean. With the south-east winds (Shargi) which blow in front of them, come cloudy skies, rain and a drop in temperature. In the region, winter rainfall is about 125 mm. on the average, but in some winters this figure is greatly exceeded. The rain is often heavy and unpleasant while it lasts, and it quickly turns the deltaic alluvium into a morass of sticky mud, in which all forms of transport become bogged down. The temperature falls gradually during the night, so that the relative humidity rises. Frosts may occur in any of the five months November to March throughout the region. These frosts, coming after rain, accompany the cold north-west winds which follow in the wake of the depressions.

Spring which occurs during April, is almost as fleeting as autumn. It lasts for a month and is noticeable for a slight rainfall, generally accompanied by thunder, and for a change in the land colouring, a faint tinge of green, marking a transition from the brown of winter to the dust of summer.

Summer In summer the region is influenced by a low depression which is concentrated all over the country, so that the north-westerly winds are the prevailing winds. These winds are warmed by their descent from the plateau, and, in their passage to lower latitudes, sweep over the valley of the Euphrates as hot, dry winds, which blow fairly continuously from May until October. At this season, the great low pressure area of the Persian Gulf which is in fact an extension of the low pressure system over the north-west of India. Accordingly the pressure gradient, which exists from the eastern Mediterranean to the Persian Gulf, maintains a flow of air over the Euphrates Valley throughout these months, as shown from the frequency and direction of wind (map 13).

Summer begins in May and lasts until October. The heat is intense, the sky cloudless, the atmosphere dry, and rain extremely rare. The prevailing north-west wind (the shamal) is strong by day but decreases to a breeze at night. Though a hot wind, it is notable for its dryness. At Habbaniya station, in the upper region, the temperature rises to about 111°.2 F or 44°C. every day in July and August, but the nights are comparatively cool (mean daily minimum July and August 78°F or 25.8°C.[1]

Generally, the sky pales with the dust in the atmosphere and mirages after 9 a.m. reduce visibility to a few hundred yards. Finally, it is clear that the land in this region has to depend on the waters of the Euphrates river since the rainfall alone is insufficient to maintain vegetation throughout the summer.

Air masses movements.

Climatic conditions of the Middle Euphrates valley are influenced by a series of air masses both maritime and continental. These air masses may be classified according to their

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(1) "Monthly Weather Report of Iraq" Meteorological Department Baghdad, 1956.

respective areas of origin as —

Monsoon Air. Monsoon air affects the Middle Euphrates only in the summer months. This air mass originates over the Indian ocean extending towards the interior of the sub-continent from June onwards. A projection from the air mass is drawn towards the Middle Euphrates by the development of low pressure associated with the high temperature over Lower Iraq. Though initially moist, the passage of the air current over North West India, Pakistan and Iran reduces its humidity. This loss is, however, partially compensated for by the damp area of the Persian Gulf. The flow of the monsoonal air into the Middle Euphrates persists until the end of September and the associated wind system influences not only the Euphrates area but the whole of Lower Iraq. The air itself is relatively stable but in transit over the hot continental areas it expands with consequent reduction in density. This factor, combined with the higher humidity of the Monsoon current, exerts a significant physiological influence on the inhabitants, especially in the lower part of this region.

The advance of Monsoonal low pressure conditions into Iraq results in air being drawn in from the north-west (i.e. the Continental High Pressure Zone of Anatolia). The resulting air currents are called the Shamal. This wind is an almost uninterrupted feature of the summer months, the associated weather being cloudless, dry and hot.

Maritime Air. Maritime air is associated with the Atlantic Air Masses. The westerly air stream with associated depressions occasionally penetrates to the Eastern Mediterranean, and some re-generated cyclones reach the Middle Euphrates. These depressions are stable, with only slow changes in temperature and humidity.

The inflow of maritime air is limited to the period between October and May, being interrupted from time to time by inflow into the Euphrates of tropical continental and polar continental air.

Tropical Continental Air. A feature of the contiguous Arabian and Syrian desert regions is the development of zones of hot and dry high pressure air masses. The passage of cyclones through the Euphrates area produces alternations in the pressure gradient resulting in the inflow of this tropical continental air. This leads to the development of the dust storms noted below.

Polar Continental Air. This air is associated with the intensely cold winter high pressure zones of Central Asia and Anatolia. At certain times a current from these masses is drawn towards the Mediterranean, via the Euphrates. The result is a general lowering of temperatures in the valley. Occasionally, further currents of the Polar Continental air are attracted into the advancing maritime depressions. The admixture of cold and warm air re-generates instability within the cyclone. This leads to the development of clouds and sometimes to heavy showers.

Winds and Dust Storms. In winter the high-pressure system of Central Asia extends southwards into Persia, and the gradient is south-westwards to eastern Iraq until it reaches the Euphrates Valley. This produces a general flow of air from the north-east, towards Arabia, through the Euphrates area, thus reinforcing the theoretical trade-wind circulation. But the gradient is broken by the Persian Gulf, and air is drawn from the moving mass down the Euphrates trough, thus causing a cold north-westerly wind, in winter, over the country. The Middle Euphrates valley is affected by the cold air from local high pressure concentrated over the Syrian desert and Arabia contributing predominantly westerly low level air masses which blow towards the valley area. Figures 10 and 11 show the distribution of mean monthly pressure for January and July. Map 10 reveals that the mean daily pressure for January decreases from north-west to south-east whilst map 11, for July, illustrates the pressure gradient changes. In the north, pressure falls from south-west to south-east, but in the Lower Euphrates Valley and the Persian Gulf, the gradient is influenced by the extensive low pressure centre over north-west India, as shown by the southerly sweep of the isobars. These conditions bring a mass of air from the north-west, guided by the relief and uninterrupted by outside disturbance. The wind-roses indicate the preponderance of westerlies throughout the year.

The change of gradient brings a marked increase both in the frequency and the strength of the north-west wind during the summer. It then receives the special name of Shamal, the Arabic word for north. The Shamal normally begins in June, quite suddenly, bringing considerable relief, not only by lowering the air temperature, but by increasing the rate of evaporation from the skin. The change is very noticeable in this region and is strongly reflected in meteorological records.

Figures 12 and 13 show the average frequency and wind direction at Habbaniya and Diwaniya for January and July. Map 12 shows that the average frequency of north-west winds at Habbaniya in January amounts to 9 days whilst at Diwaniya that figure decreases to 3 days. On the other hand the frequency of westerly winds at Diwaniya exceeds that at Habbaniya. For July map 13 shows a striking predominance of north-west winds at Habbaniya which occur on 20 days whilst at Diwaniya the average frequency of this wind direction decreases to 13 days. Again westerly winds in this month at Diwaniya exceed by three times those at Habbaniya.

The general character of the air circulation throughout the year is a prevailing current from the north-west sweeping over the region from the hilly country in the north to the south. This air has for the most part descended from altitudes of 1,200 metres on the plateau of Asia Minor and Kurdistan, and therefore reaches the northern part of the upper region of the Euphrates Valley as a dry wind passing southwards and entering the warmer area of the plain. As was mentioned before, the frequent occurence of easterly winds throughout the northern part of upper Mesopotamia during winter and spring, is probably connected with the occurrence of depressions in the Levant, many of which pass over northern Syria or Jordan into the Middle Euphrates area.

There is a well-marked diurnal variation in both the direction and the force of the wind. The north-westerly wind of the morning becomes more northerly and in the summer months even passes to the east or north by the afternoon. From light breezes at sunrise the wind increases to a moderate breeze by about 10 a.m. and, by 2 p.m. to 4 p.m., has become a fresh or even a strong breeze which is strong enough to raise dust. About sunset the wind drops, to rise again in an hour or two as a light breeze, which may continue during the night, falling to a calm before sunrise.

The occurrence of the dust-storms is a noticeable physical feature in this region because the alluvial formation is easily broken up by aridity and hot sun into fine particles. A dust-storm is defined by two criteria, wind force and a decrease of visibility to less than 900[1] metres caused by fine-dust. Dust-storms in this type of climate may in fact reduce visibility to 18 metres. Dust-storms may occur at any time of the year, but they are classified seasonally into two types. Winter dust-storms, from November to May and Summer dust-storms from June to October. Winter storms are generally associated with the westerly atmospheric depressions, as previously mentioned, or with thunder-storms. If the ground has dried sufficiently after the previous depression, dust may rise over a wide area in front of the oncoming depression, as the wind freshens from the south-east.

(1) Iraq and Persian Gulf, by N.I.S., 1945, p.177.

Thus many winter dust-storms come from this quarter. Others caused by thunder-storms are much more variable in direction. Rainfall during this period much reduces the frequency of dust-storms, and rain together with ephemeral vegetation probably accounts for the low frequency of winter dust-storms.

Summer dust-storms appear to be caused by small variations in the pressure gradient, particularly during the onset of the Shamal, and all summer dust-storms come from the north-west quarter. The storms tend to increase in frequency and severity towards the south-east, because of the increasing movement of the prevailing north-westerly wind in summer, and, during this season, dust may be carried down out of the region towards the Persian Gulf. The dust may rise to over 3,000 metres, and from the air looks like a dense irrigular mass visible 48 km . away.

In summer, the first sign of a dust-storm is usually an abnormal glare round the sun, with dust rising in patches from the ground, so that the decrease in visibility is progressive. In winter, particularly when associated with thunder-storms, the reduction of visibility is much more sudden and the onset more violent.

Dust-storms in the Upper region often occur on or about the same date in successive years. For instance, there was one on 29th March, every year from 1929 to 1935, that in 1935[1] being one of the most severe ever recorded.

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(1) Iraq and Persian Gulf, by N. Intelligence Division, 1944. pp.178.

The precise time of day when dust-storms make their appearance is largely influenced by diurnal changes of wind-speed. They normally start about 8 a.m. in summer, and about 10 a.m. in winter, that is, about three hours after sunrise. They generally end in the afternoon, but occasionally persist overnight, especially in March and July. Between March and June they are liable to begin at night, and are then almost always associated with thunder-storms.

Dust-devils are among the minor hot-weather manifestations. They are very common and occur with light winds at any time of the day. They are rapidly moving spirals of dust, originating in a whirling dust cloud near the ground and curling upwards to thin out to a diffuse dust cloud 200-250 metres above ground. They often appear and vanish quite suddenly, and though locally violent do little if any damage, and so are not recorded.

Temperature. The coldest month is January, while the hottest is July or August, there being but little difference between these last two months. There is no great difference between the Upper and Lower areas of the Middle Euphrates Valley except in the physiological effects, into which enter other factors such as humidity, a variable factor, depending upon the locality of water and evaporation from it. Regular official observation has been made in Habbaniya, Ramadi,(1) Babil(2) and Diwaniya for

(1) The data for Ramadi station have been recorded as follows: 1923-27 and 1932-36.

(2) The data for Babil station have been recorded as follows: 1908-1913.

only a few years. These stations have recorded that the hottest month throughout the country is August. According to data obtained from the Mteorological Service of Iraq, the mean maximum temperature during August at Diwaniya reaches 110.6°F, at Habbaniya 109°F, at Ramadi 111°F and at Babil 110.7°F. The mean monthly temperatures at Habbaniya reach 92.3°F. in each of the months June, July and August, at Diwaniya they average 92.8°F. for the same period. In July the extreme maximum for Diwaniya was 122°F. the same as that for Habbaniya (diag. 3a). Map 8 shows the distribution of mean monthly maximum for July, the hottest month, and at the same time reveals that the temperature decreases from southeast and east to southwest and west. From the point of view of temperature the summer regime lasts from May-September inclusive. The winter season (December, January and February) with mean monthly temperatures of 50.6°F. at Habbaniya and 52°F. at Diwaniya is short, and mild. The absolute minima isotherm shows that temperatures below freezing point have been recorded at the two stations, especially in January of 1941-2, which was the coldest month for the last 35 years.(1) Diwaniya recorded 17°F. and Habbaniya 16°F. Map 9 shows the distribution of mean monthly minima for January, the coldest month. The map also illustrates that the temperature decreases from the south-east to the north-west. However, many winter days are warm, and this warmth by day emphasizes the low nocturnal temperatures. The

(1) The winter of 1941-2 caused a great deal of damage to crops and livestock.

daily maximum temperature of Diwaniya has reached 61.8°F. on isolated occasions in January. At Habbaniya, however, it has not exceeded 59.9°F. in January since records were first made. On the other hand, at the former the daily maximum and minimum temperatures in July averaged 109.6°F. and 76.4°F., while the latter averaged 108.8°F. and 73.3°F. respectively as shown on diagram 2.

We shall now proceed to an examination of the monthly temperature range. In January the monthly temperature range is 24.4°F. at Diwaniya and 21.9°F. at Habbaniya. In spring and autumn these figures are very much higher. In April, it is 31.6°F. at Diwaniya and 31.5°F. at Habbaniya, and in October it is 35.8°F. at the former and 30°F. at the latter. In July the figures are 33.2°F. at Diwaniya and 35.5°F. at Habbaniya (see tables 2 and 3).

From the above records, it can be seen that the daily temperature range increases gradually during the spring months and reaches the maximum by the end of July or August. It is also notable that the range of temperature in general is higher throughout the lower region, which is represented by Diwaniya station. In addition, the diurnal temperature range is marked, because of the rapid fall in temperature after sun down due to nocturnal radiation, typical of continental conditions and deserts in particular.

It may be understood from this consideration of the mean monthly temperatures, the highest maximum and minimum temperatures, the daily maximum and minimum temperatures, and the mean monthly temperature range that thermal conditions show no noticeable difference from one station to the other despite the large distance that separates Habbaniya in the north and Diwaniya in the south. According to these weather records Diwaniya which represents the lower Valley enjoys a slightly higher temperature, while Habbaniya which is typical of the upper valley has lower temperatures. This difference in temperature between these two parts of the country is due to their latitudinal positions, to local factors such as the evaporation of large quantities of water from the Shamiya marshes which dominate the lower part of the Valley, to the influence of the Persian Gulf, which tends to be an area of a high humidity, and ultimately to the low land-level of the Diwaniya area compared with Habbaniya district (see physiographical section and diag. 1). Moreover, another few deductions may be drawn from the records. Parts of the Upper region have a physiological advantage over the lower region having cooler nights, a feature most marked in the Ramadi and Falluja areas, situated on the border of the Arabian desert. Also, the Shamal wind is drier, because it has passed over no expanse of marsh, and therefore has a greater cooling effect on the human body.

Summarizing the temperature conditions in this region, we can arrive at the following generalizations:

1. The summer temperature is high throughout the country.
2. The summer season is longer than the other seasons and is shorter in the upper areas.
3. The winter season is mild, but does get cold, and

temperatures below freezing are experienced during a few days of the season.

4. The spring and autumn seasons are very short, but become longer as we go northwards.
5. The daily and annual range of temperature is high throughout the region.

Precipitation and evaporation.

Rain. Almost the whole rainfall of the region occurs in winter or spring and accompanies the depressions crossing the region from the Mediterranean.

Only two stations, Habbaniya and Diwaniya, have kept continuous records for any length of time. During the last 20 years, the rainfall has been recorded at these two stations by observers of the Meteorological Department of the Ministry of Communications and Works. It is possible on the records of these few years to construct an area rainfall diagram (fig. 14). Habbaniya has an annual rainfall of 112.9 mm. and Diwaniya 121.2 mm. (table 5). November to March are the wettest months at Habbaniya, but at Diwaniya, April also is regarded as a wet month.

The normal number of wet days is not high (Diwaniya 25 and Habbaniya 32), even in winter, so that rain when it comes is fairly heavy. The two days on which the heaviest downpours have been recorded are at Diwaniya, April 16th (48 mm.) and February 23rd (22 mm.), 1956 and at Habbaniya April 16th (28 mm.), 1956.

A study of diagrams 2 and 3 (a) reveals that almost all rainfall comes during the winter, spring and autumn seasons. These figures also show that the amount of rainfall is small at both stations. Fig. 2 shows that the maximum and minimum months rainfall averaged over 20 years are 13 and 9 cm. at Habbaniya and 12 and 8 at Diwaniya. Fig. 3(a) reveals that the highest maximum rainfall at Habbaniya amounts to 16 cm. while the lowest minimum decreases to 4 cm. At Diwaniya the mean maximum figure rises to 15 while the minimum drops below 4 cm.

Map 14 shows the mean annual amount of precipitation for this region over a period of twenty years. It is evident that the amount of precipitation decreases from the north-east (125 mm.) to the south-west (75 mm.).

In general, the rainfall distribution varies greatly in amount from year to year, but keeps the same regional pattern, i.e. an increase from south-west to south-east. With such regional differences of rainfall, a variation is to be expected both in the areas cultivated (dry farming) and in yields obtained from them. The above figure also illustrates that the fertile alluvial plain of the Middle Euphrates Valley, the best agricultural land, receives very little rainfall and irrigation is therefore necessary for agriculture.

In addition, there is the problem of the variability of rainfall. Thus it is dangerous for crops to rely on the rainfall alone, because amounts are not only small but also unreliable. Diagram 3(b) shows the yearly variation from mean rainfall between 1937 - 52; amounts are exceedingly variable from year to year. For instance, in 1938 the amount of rain reached 98.6 per cent above the mean while in 1943 dropped to 1.9 per cent of the mean, and in 1951 over 50 per cent below the mean. The table below reveals a great variation of mean rainfall from season to season. For example for a period of 16 years the mean amount of rain in winter and spring was 56 per cent and 30 per cent respectively. However, this mean seasonal variation is not necessarily accurate for long term conditions, e.g. in 1956, the figures for winter and spring were 31 per cent and 67 per cent. The above averages must be used with care for it is the actual amounts that are most important to the farmer.

Seasonal Variations from mean rainfall

Season	Per Cent	Period
Winter	56%	16 years, 1937-52.
Spring	30%	
Autumn	14%	
Winter	31%	1 year, 1956.
Spring	67%	
Autumn	2%	

The effectiveness of rainfall is decreased by evaporation. Surface waters in rivers, canals, streams, and reservoirs, suffer similarly. It is estimated that the evaporation rate reaches about 3.20 metres (11 feet) per year in the Middle Euphrates basin.(1)

(1) Report on the Development Board of The Tigris and Euphrates river system". New York. 1952. pp.III 13 - III 16.

Origin of Rainfall

Rain comes mostly in thunder showers, which last for a short period, and are largely due to the arrival of moist maritime air from the Mediterranean, in the form of shallow and somewhat degenerate depressions.(1) It is believed that these depressions originate in the Atlantic, pass through the Eastern Mediterranean near Cyprus, and cross the Levant shore and the Gulf of Aqaba (2). These depressions move eastwards to the Euphrates valley after crossing the Syrian desert, and then take a south-easterly direction towards the Persian Gulf. During February in both 1940 and 1945, depressions reached the Euphrates valley. Fewer reach the country in spring and autumn, and none in summer.

The only available figures for the number of depressions are for the years 1938-40 as shown in the table below. But these years, besides being few in number, were unusually wet ones, and no generalizations should be made on such figures.

Number of depressions which passes through Lower Iraq. 1938-40.

Year.	Jan.	Feb.	Mar.	Apr.	May.	Oct.	Nov.	Dec.
1938	6	6	5	6	1	3	5	6
1939	4	6	3	4	3	4	4	5
1940	5	8	7	7	4	3	3	6

Another source of rainfall is the Persian Gulf. A strong

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(1) W.B. Fisher; "The Middle East" London: Methuen & Co. Ltd., 1952, p.352.

(2) From interview with members of Meteorological Service of Iraq, and from daily weather charts.

south-easterly wind (Shargi) blows in front of the depression, bringing with it moisture from the Gulf and, nearly always, causes rainfall. When the depression passes, the south-easterly wind changes to north-westerly, without going through the normal changes of wind directions which accompany depressions. The north-west - south-east alignment of the mountains of Iraq may be one of the reasons which influence wind direction in the region.

Map 15 is based on weather charts of the Meteorological Service of Iraq, and shows one of the depressions which approached the Euphrates valley on 22nd February, 1956, passed through it, and left it the following day. It shows clearly this change in wind direction. This depression, however, caused no rain, but in parts of the country the sky was cloudy, and the relative humidity was high. Dust storms developed over the upper region.

Figure 16 shows that the mean number of rain days increases from the southwest towards the northeast. The average number of rain days at the farthest point in the southeast of the region is 20 whilst this figure increases gradually northwards, rising to 36 days on the northern border of the country.

Snow and sleet They rarely occur throughout this region and the station's annual average of occurrence is less than one day.

Thunder Thunder is more marked between March and June than in other months. At Babil, Habbaniya and Diwaniya weather stations where it has been recorded, it shows a well-marked maximum in April and May, especially in Babil. Eight thunderstorms occurred in April of one year and ten in May of another at Babil station, but during 16 years at Habbaniya and 13 years at Diwaniya the average yearly was 11.7 at the former and 5.9 at the latter. Those at Babil amounted to 20.0. In July, August and September none occurred, and only a few in the autumn.

Summarising, the rainfall distribution and characteristics are as follows:-

1. The summer months are dry.
2. The rainfall comes in the winter, spring and autumn, mainly by cyclonic disturbances; the average annual rainfall is about 125 mm., sometimes over 175 mm. falls in winter.
3. Rainfall is very changeable from month to month and from year to year.
4. It is generally low throughout the region but increases slightly and gradually from southwest to northeast.

Humidity.

The relative humidity is low in summer and high in winter, and higher in the early morning than later in the day. This is a natural consequence of the great range of temperature.

Map 17 reveals that mean relative humidity in July increases from north to south. North of Habbaniya the figure is 22%, while near Samawa, in the south-east, the mean humidity is 29%. The increase of mean relative humidity during the summer time in the latter area appears to be due to the fact that the southern tracts are located close to the southern marshes, as well as near to the

Persian Gulf influence. In January (map 18) the gradient is reversed, with less than 58% in the south-east rising steeply at first to 70% near Diwaniya. In the northern part of the region mean humidity lies between 70% and 74%, falling below 70% again in the extreme north-east. To the west, the mean humidity exceeds 74% on the higher land.

Evaporation

Table 6 shows the evaporation data which may be derived from water level observations of lake Habbaniya, Abu-Dibis reservoir and the Euphrates river at Ramadi. The average total evaporation is related to the main dominant factors by which it is affected. These are the vapour pressure gradient between the water surface and the overlying atmosphere and wind movement. These factors, which have already been discussed, reveal the mean monthly temperature, relative humidity, wind velocity and vapour pressure.

In the light of the considerations mentioned above, the data recorded on evaporation from the Lake and the Reservoir indicate that the maximum monthly average (for over 8 years of observations rose to 253.6 millimetres.[1] At Ramadi, it was 511.7 millimetres during the three summer months June, July and August. The Lake and Reservoir evaporation figure for the winter season (December, January and February) was 97.0 mm. and at Ramadi was 36 mm. The maximum monthly rate of 14.5 millimetres in August and the minimum 4.1 mm. in January occur at Habbaniya and Abu-Dibis, while Ramadi has a maximum of 17 mm. and a minimum of 0.7 mm. (table 6)

(1) Figures after "Report of the Development of the Tigris and Euphrates river systems", New York: Knappen-Tippetts-Abbett McCarthy, Engineers, 1952, p.16.

It will be seen by comparing the data of Ramadi with that of Habbaniya and Abu-Dibis that the computed evaporation totals are considerably higher than those derived from water-level observations at Lake Habbaniya and the Abu-Dibis depression. The computed results are probably on the high side owing to assumptions concerning water temperatures, while derived results are on the low side because of seepage and other factors.

According to the derived results mentioned above, it might be that water temperature is the most significant factor determining evaporation loss. Therefore, there is a relation between water temperature and air temperature as appears from these few records. These data give a clear picture of rapid radiation into the dry atmosphere at night and high heat loss accompanied with evaporation in this arid region may in time cause lower water levels. This resource is needed for agricultural purposes because it is regarded as the fundamental factor on which the irrigation system depends, especially during the hot season.

<u>Clouds, fog and sunshine</u>

The region is, on the whole cloudless because of the effect of the arid air descending from the Arabian and Syrian desert and from the Asia Minor plateau. However, there is cloud at certain times - spring and winter - and associated with this phenomenon are mist and dew formations with a significant influence on crop development. Temperature tends to be higher during the night whilst at certain times high humidity leads to beneficial dew formations and occasional mist. The latter can be detrimental especially in spring.

The station weather data reveals that there is a well marked cloudy season from November to April, while from June to September the sky is almost cloudless. There are records covering 16 years at Habbaniya, 13 years at Diwaniya and 5 years at Babil which show that the mean total cloud amout, in Oktas, rose to 2.1, 1.9 and 2.1 respectively. More recently, sunshine records, which have been taken at both Habbaniya and Diwaniya stations for the year 1956, show 5.4 oktas which is the highest figure for monthly mean total cloud in December. But the mean number of cloudy days, recorded for the same time, was 26.4 and 33.6 at Habbabiya and Diwaniya, respectively (see Table 5).

Sunshine Figure 4 shows the mean duration of daylight and mean hours of sunshine observed for each month of the year at Habbaniya airport for a period of observations between 1936 and 1956.

From the diagram mentioned above, the author assesses the monthly average for the three winter months, December, January and February, at 6.46 hours of sunshine, and for the two months of spring and autumn, April and October, at 9.37 hours of sunshine eac The monthly average of the three summer months, June, July and August, amounts to 12.38 hours of sunshine. The maximum is 12.54 hours in June, and the minimum 5.34 hours, in December.

Summarizing the main features of the climate of the Middle Euphrates Valley, there is considerable annual and diurnal variation in temperature. On one hand, there is the hot summer when the percentage relative humidity is extremely low and dry winds further increase the rate of evaporation. On the other there is the winter when frosts are uncommon and small falls of rain may be expected. Throughout the year, sunshine and a clear sky are more common than cloud.

CHAPTER III

Soils and Land Use
(Maps 19, 20; tables 7, 8)

Soil fertility is clearly fundamental to the agricultural economy of a country, and as the Middle Euphrates largely depends on its agriculture soil fertility is obviously a basic factor of economic development.

The characteristics of the Middle Euphrates soils may be summarised as follows: grey colour, friable texture, high lime and salt contents, fair workable deep, suitable slopes for artificial and nature drainage, and, above all, natural availability of plant nutrients, nitrogen, phosphorus and potash, which are so necessary for the successful cultivation of crops.

(1) All soil samples selected from the various areas of the Middle Euphrates indicate a generally high content of sand and calcareous material which accounts for their free working qualities.

(2) Samples taken from the riverine lowlands indicate an unusually high clay content, and accordingly they are most suitable for sugar cane cultivation. Cane has shallow roots and requires considerable moisture and thus clay soils are more appropriate than sandy soils.

(3) The high lime content keeps the soil open, facilitating cultivation and aiding reclamation. With these natural properties it thus seems likely that the soils could be

made to produce a great variety of crops, including especially cotton.

(4) They will of course require an adequate amount of water to counteract climatic aridity and the soil's lack of moisture retaining qualities.

(5) As regards plants nutrients the Euphrates soils compare favourably with those of the Nile Delta. Nitrogen averages 0.079% against 0.09% in the Nile Delta, whilst phosphorus averages 0.25% and potash 0.50%, neither of which, according to Willcocks in his report on the "Irrigation of Mesopotamia", (1) is exceeded in Nile soils.

(6) Salinity is an extremely important factor as high saline soils occupy a greater proportion of the Middle Euphrates area than is the case in the Nile Delta; in the latter only 10% of the land is affected to an injurious extent as compared with 20 to 30% in the Middle Euphrates. Because the texture of the Euphrates soils is such that levelling preparatory to reclaiming is easy. At the same time, given a sufficient supply of water, harmful salts may easily be removed in solution, whereas the heavy Nile soils make such reclamation difficult.

Origin of Soils

The alluvial soils of the Middle Euphrates are of the typical transported type because most of their present

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(1) W. Willcocks; "Irrigation of Mesopotamia". 1917. p.64.

constituents can be traced to the decomposed series of rocks that form the chain of the Taurus. These rocks important in relation to soil formation include limestone, sandstone, conglomerate, and the less extensive formations described in the geological section. The basic similarity between the composition of the suspended soil material contributed by the Euphrates tributaries on the one hand and the soil ingredients as revealed by a series of analyses on the other, indicated how the alluvial soil was composed. (1)

Although the basic constituents of silt, and of fine and coarse sands are common to most sorts of alluvial soils their occurrence in variable proportions accounts for the unexpected difference in soil texture in basically similar types of soil. These variations may be due to original differences in their proportionate amounts when initially deposited, or alternatively because of the admixture of different materials after their laying down.

In fact, the constantly changeable conditions in aggradation and degradation by the river, not only from one section of the channel to the other, but also from year to year, are bound to produce different proportions of soil constituents in the soils of the adjacent lands of the desrt and the upper portion of the Euphrates. Therefore, the variability of soil texture results firstly from differences in mineral content and secondly from differences in the manner of deposition by wind and water.

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(1) W. Ainsworth: "Research in Assyria, Babylonia and Chaldaea." Lonon, 1939. pp.116-17.

It is important to recall that soil development has taken place under the influence of a subtropical, continental arid climate with wide daily and annual ranges in temperature. From chapter II it will be remembered that nearly all precipitation occurs in the cooler months, with an annual total of from 75 M.M. in the south-west to 125 M.M. in the north east of the region, and varies considerably from year to year.

Wind movement is also important in aeolian action; it is highest from March to June when numerous storms cause soil erosion and transportation, as well as drift formation and dune displacement. It usually leads to the local accumulation of a fine sandy surface horizon.

General Character of Soils

The soil composition of the Middle Euphrates has been influenced by several local conditions; namely, the situation of the zone at the apex of the Delta plain of lower Iraq, the effects of the ancient system of drainage, the occurrence of low plateaux of Al-Haswa and Dahr Al-Megass as well as the peripheral desert tracts. Primarily, the coarse material conveyed by the Euphrates is deposited along the river reaches and its ancient branches to the north and east of the Hindiya barrage. Most of these coarse elements are also deposited alongside the present as well as the ancient Euphrates branches with an inclination to grow finer away from the river channels. The practice of the basin irrigation system for many centuries has also produced parallel effects on the soil texture. The sources of sandy elements are the peripheral desert area and also the mounds of Al-Haswa and Dehr Al-Megass. These facts are evidenced by the samples examined in various localities as will be discussed later in this chapter.

In general terms it may be said that the alluvial soils of the region are chiefly calcareous loams, with occasional sandy patches, which are, however, homogeneous in character, and of great potential fertility. Their richness in lime is caused by the light calcareous silt, brought down from the northern highlands. Here and there are saline tracts, found chiefly in depressions as a result of bad drainage and rapid evaporation of successive river floods and on sites of abandoned cultivation where constant irrigation and inadequate drainage have produced the same effect. Such areas, when excessively saline, are quite incapable of supporting plant life. With these exceptions, the soils of the whole alluvial plain under consideration are comparatively uniform, differing slightly in texture, chemicals and fertility, but always conforming to the same general type of a silty calcareous loam. When watered they are usually remarkably fertile, since they abound in mineral salts. Soils are also friable, porous and rich in gypsum, which is found over wide areas, as will be seen later on. In other parts of the region, the soil is composed of gravel or marl with broad sandy stretches as has already been mentioned in the section on physiography.

These light calcareous loams should prove very easy to work, and no difficulty ought to be found in washing out the soluble salts in those areas where reclamation is necessary. The proportion of clay in most of the samples is small, as may be seen in analyses, so that drainage would be rapid.

Soil Texture and chemical composition

The soils of the alluvial plain are generally deep and highly calcareous, saline with a crumble structure, and of fine or heavy texture. Salinity increases in depressions and in a downstream direction, as will be discussed in detail at the end of this chapter.

Soils common throughout the Middle Euphrates basin are greyish-brown while those along the Tigris are pinkish-brown. The latter colour is caused by the presence of more basaltic rock in the parent material. The major soils in the region under consideration may be grouped into five series: (map 19)

(1) Young alluvial bankland (river levee and periodical flood soils).

(2) Hilla and Babil interfluvialland (river basin soils salted phase, and poorly drained phase).

(3) Hammar or Lacustrine soils (basin depression soils, haur soils, and silted haur and marsh soils).

(4) Aeolian or Ifeq soils (active dune land).

(5) Gypsiferous gravel soils (low plateaux desert land).

Table 8, relating to the first three major soil classes, gives particle size, soil texture and depth, chemical composition and pH values.

1. <u>Young alluvial bankland series</u> This series has been tested at a point 20 kilometres southwest of Hilla, at 5 kilometres north-east of Abraham's Tomb and at a garden situated 22 kilometres south-east of Hashimiya town. The soils are composed of coarse sand, fine sand, silt and clay classes. These soil types have been found to have an average depth of between 0-20 to 65-100 centimetres. The average total sand of this group runs between 41.0 to 73.1%. This soil series may be identified as slightly undulating, recent flood plain and bank land soil along the Euphrates and its branches. Included in the series are the light to greyish brown riverside soils which are deep, permeable, and have good internal drainage. A typical profile would show (1):

0-25 cm. brown to greyish brown sandy loam to silty clay, often with platy silt layers.

25-50 cm. lighter brown to greyish brown clay loam to silty clay, which is weakly plastic.

50-100 cm. Dull or yellowish brown silty clay loam or clay, with calcium carbonate flecks; deeper subsoil is often of softer or lighter texture with sediments deposited in layers.

The entire profile is calcareous with phosphate 7.8 to 8.6%.

(1) The profile data for (Hilla, Young Alluvium, Babil and Hammar Soil series) have been quoted from (the Irrigability land Classification of the Babil extension area report) 1955.pp.5-8.

Chemical analyses indicates that, while available phosphate is generally lacking, organic matter and nitrogen are often maintained in fair amounts. This series of soils is usually considered land of Class 1 irrigability.

2. Hilla and Babil series The first category, Hilla soils, (mature well-drained back slope) has been tested in sample pits at a point 12 kilometres east of Abraham's Tomb and 2 kilometres east of Hilla. The chief types of this series are coarse sand, fine sand, silt and clay. They are from 0-25 to 60-100 centimetres deep. Their percentage total sand content is 21.5 to 59.1, while the light clay type is regarded as the textural class of this series.

This river basin soil (silted phase), as shown in (fig. 19) is restricted to the back slopes or nearly flat plains, leading away from the Euphrates, particularly in the eastern part of the northern and the intermediate region, beyond the Young alluvial bank group. Those soils cover an extensive area to the east of the river and are of major importance in grain or general farming. Surface drainage is fair but internal drainage is impeded.

The profile includes:

0.25 centimetres greyish brown crumbly light clay or silty loam or clay.

25-45 cm. Dull brown moderately plastic firm silty clay or clay.

Chemical analyses indicate that the available pH is high (8 to 8.4), and organic matter and nitrogen is generally lacking.

The total salt content is 0.083 to 0.806 per cent. This group is classified as of class 2A irrigability land.

The Babil soils, which form one class with the Hilla soils, have been tested five kilometres west of Rumaitha. They are formed of coarse sand, fine sand, silt and clay at depths of 0.25 to 90-100 centimetres. The total sand content is 6.7 to 33.8 per cent. Thus second soil category occurs in saline flats as shown in the soils map under the description "poorly drained phase". It is associated with the Hilla soils and consists mainly of the interfluvial land (Jezireh Zone) whose trend is towards development of the great climatic soil type known as grey desert. Soil particle size decreases with distance from the river downstream while salinity increases on the lee crest of dunes or in the vegetated rims of flood ways. This soil differs from the Hilla group in having more compact, somewhat mottled subsoil that breaks up into particles having a nut-like structure.

This soil has impeded drainage; the total salt is strong 2.475 to 2.625 per cent, and the pH is so high that in many spots it exceeds 8.6. The soil has high calcareous nodules or filaments in the accumulation horizon. The profile indicates:

0-20 cm. grey or greyish brown silty clay or clay; frequent snail shells.

20-45 cm. Dull greyish brown plastic clays; compact; breaks into mottled, coated nut-like structure.

45-100cm. Dull yellowish drab clay, increasingly softer from 90-100 cm. Second metre is more permeable.

Available phosphate is low to deficient. It is considered as class 2B irrigability land.

3. <u>Hammar or Lacustrine Series</u> This group, which is distinguished on the soils map, consists of basin depression soils, haur soils, and silted haur and marsh soils which are mainly distributed throughout the marshes zone. As can be seen from Table 8, it has been found at Ibn Najim Lakebed at a depth of 0.25 to 45-100 centimetres. The main soil types are coarse sand, fine sand, silt and clay. The total amount of sand is 11.0 to 55.1 per cent. This group occurs in the dark clay back bottoms and shallow playas, and slakes into hummocks. It is partly sedimentary, with greenish grey silty clay in the subsoils.

A second characteristic of lacustrine soils, in haur and marsh areas, is the presence of a horizon of marl 10 to 20 centimetres in thickness which in places is soft, and of nearly pure calcium carbonate. Most often this occurs in the subsoil below a dark to light almost peaty topsoil, high in organic content. In places, both these horizons may be covered with rich brown, silty clay alluvium.

This series is saline and is frequently alkaline with a pH of 7.3 to 8.3 and the greenish-grey colour in the subsoil is due to the presence of a small amount of viviarite which is a reduced form of a mineral containing iron and phosphate. A typical profile follows:

0-25 cm. Dark greyish brown humus - coated clay; highly calcareous.

25-45 cm. Yellowish-drab. silty, lumpy.

45-90 cm. Olive or greenish-drab, silty clay, nut structure.

90-150cm. Dull or greyish-brown, silty clay which breaks into pellets when dry.

The surface may become a stiff, plastic mass when wet. Variations include a shallow phase of decapitated areas with olive-dark horizons exposed at the surface. This series is commonly regarded as of class 3 irrigability land.

4. <u>Aeolian soils</u> (Ifaq Series).

The Aeolian soils are shown in the soils map as active dune land. They are present in scattered spots throughout the Jezireh Zone to the east of the Hilla canal, usually of sandy character or reworked by wind. The sand particles are wind-scored or rougher than the waterworn sand in bankland. These sandy soils are less calcareous, especially in their coarse-textured horizons. The surface is usually hummocky or wind-scored and dunes are numerous.

A fairly typical profile occurs in a locality with 20 per cent dunes, 1 to 2 metres high, and its description is as follows:-

0-60 cm. sandy, clay loam of pinkish-grey brown colour (1) with crumb aggregates and moderately calcareous.

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(1) This soil strata has been affected by the Tigris series.

60-100 cm. Sandy loam, light brown, friable and less calcareous.

100-150 cm. Loamy sand, of brownish-grey colour and loose structure. Slightly calcareous and low in useful water capacity.

Variations in stratification are usual and abrupt. Not only does the soil require levelling but it must also be stabilized against wind erosion, especially when the surface horizon of the profile is sandy.

Major areas of the Ifaq series which have been mapped are of rather mixed origin, consisting of greyish-brown Euphrates soil with some large pinkish dunes of Tigris soil which are at the north end of the south Jezireh Zone. It forms class 4 irrigability land.

5. Gypsiferous Gravel soils This group is found as a cover upon the low desert plateaux which are situated to the east of the Euphrates in the Upper region.(1) The table below shows other soil samples of the Northern Babylonia region, especially from a chemical point of view.

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(1) From a description of this area and a discussion of its soil characteristics see pp.71-72. As these soils are a zonal it was thought advisable to examine them in the chapter on physiography.

Analyses of soils in Northern Babylonia

Sample	4	9	10	15	16	17
Depth in cm.	top 25	top 25		top 25	top 25	top 25
Situation	16 kilometres south of Baghdad between the rivers	a typical salted land near Musayib	At Falluja (Euphrates deposit	Typical salted land near Babil	A bare plain north east of Babil	Uncultivated land north-east of Musayib
Constituents						
Moisture	3.79	7.75	6.53			
Organic Matter	2.44	8.80	2.60			
Insoluble matter and silica	49.92	43.70	47.71			
Lime	13.72	10.87	12.60			
Potash	0.54	0.49	0.48			
Phosphorus	0.19	0.30	0.25			
Nitrogen	0.079	0.067	0.092			
Total soluble salts		4.10	0	2.76	0.93	0.41
Sodium chloride		2.20	0	2.46	0.50	0.16

Source: This table has been taken from "Irrigation of Mesopotamia," second edition, 1917. W. Willcocks. pp. 64-65.

The results of the analyses of other samples of soils from this part of the region show a generally close resemblance to those already given, with however certain minor but significant differences. There is often a low nitrogen content as compared with soils of the Tigris[1] an average of 0.079% as compared with 0.12% soils of the nature of sample No. 4 (see p.137) would certainly require nitrogenous manuring, while No. 10 would also probably show considerable benefit thereby. In phosphorus they both reach the limit, the average being 0.22%. Deficiency would thus seem to be only in N_2 content, but it may be said that an average of 0.079% nitrogen is not low in absolute term for soils which have not been cultivated for ages, and which do not naturally support vegetation.

The average content of phosphorus and of potash for all soils within the area is 0.25% and 0.50%.

It is valuable to compare the soils of the Euphrates valley with those of the Nile Delta: in the former lime content averages about 13% whereas in the Nile Delta soils the quantity seldom reaches 5%[2]. The presence of this large amount of lime has a very considerable effect on the working properties of the soil. Such soils always prove more friable and more easily worked than those containing smaller amounts of lime. The power of the soil to retain moisture may, in this way, be somewhat diminished, but

(1) W. Willcocks; "Irrigation of Mesopotamia" 1917. p.40

(2) Ibid (p. 63)

where water is abundant this is of little moment.

Several notable features of the dry alluvial (i.e. Hilla, Babil and Hammar categories) soils are: (1) Occasional clay drifts, largely of clay crumbs one millimetre or less in diameter, with associated salt drifts or accumulations on the leeward crests; (2) Highly calcareous soils with marly horizons that when flooded develop solution potholes; (3) A hummocky microrelief in the clay adobe of lake beds due to repreated shrinkage and cracking followed by slaking, which leaves intervening mounds as much as a third of a metre high; (4) Depressions four to seven metres in diameter due to collapse of crumb structure; the alkali soil, as it will be seen later on, when drying assumes a columnar structure; (5) Where rains have left puddles, a thin crust on the surface forms after evaporation.

The prevailing texture is silty clay loam or silt being highly calcareous. They are usually crumb stable, and field infiltration tests made indicate that the soil profiles have medium good to fairly low permeability. The moisture equivalent runs from 20 to 52[1] per cent, and the usable water capacity is 190 to 270 millimetres to a metre, which is high.

The soils with between 0.25 and 1.50 per cent total chloride salts can be improved by deep drainage and leaching. Generally the total nitrogen and organic content is very low in these aridic soils. Available phosphate also is low, especially in the red

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(1) "Report on Soils and Land Use capabilities in Iraq". Soil Dept. 1954. p.10.

terrace soils and those low in organic matter. Available potash is ample in most soils and the free calcium carbonate is also abundant. Both soil and associated soil waters show a relatively high content of calcium and magnesium together with other salts.

<u>Character of salinity</u>

No details study has yet been made of the salinity characteristics of the soils of the Middle Euphrates. However, from the available analysed data, it may be indicated that two distinct types of salts are found. The first is composed of the acid salts (An-ions), which are readily soluble in the water infiltrating to the water table and become a detrimental element in the soils. The second group consists of alkaline salts which exert an opposite beneficent influence on the soils. The former mainly includes sodium chloride together with magnesium sulphate; whilst calcium chloride and calcium sulphate mainly comprise the latter. Both types of salt materials (called "sabakh" in Arabic) show a fine texture and with alkaline such the pH value does not exceed 8.5.

The salt content, as appears from the analysis (for details see section on problem of salts) (pp.141-143) is very high indeed on the surface but decreases further down the profile. Thus, the salt content of the water table is usually high and the action of capillarity is effective in drawing up the salt to the surface as the water evaporates. This surface salt usually occurs as small flat patches scattered throughout the soils of the Middle

Euphrates, especially on irrigated lands. These salty patches of flat land are exposed to show a brown colouring and a moist surface. This latter feature, which causes sections of roadway to become damp and slippery after light showers when mornings are cool, is due to markedly hygroscopic nature of the salts. The analyses and observations which have been made in the region have proved that the salt (Nacl and Mg SOH) content is greater than that which a cultivated soil should support. According to the Ministry of Agriculture,[1] these salts are responsible for the deterioration of the soils in the area under consideration. These salted layers are often up to 2 metres deep in the soil. Apart from this there are the calcium chloride and gypsum, which also exist in the soil in considerable amounts. However, these are regarded as useful elements since they are in contact with the solution of the sodium salts and react with these salts to precipitate out the harmful elements and thus are beneficial to the soil.

Problem of Salty Soils:

General review of soil salinity - This area had previously been very fertile [2]. The land between the Tigris and the Euphrates had been the basis of the great civilisations in the area during historic times. Now much of this land is abandoned and has become to some degree too salty for cultivation. According to Russell

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(1) Ministry of Agriculture: "A report of the Iraqi Delegation to the Session of the F.A.O." p.p.20-21, 1955.

(2) W. Willcocks: "The Garden of Eden to the Crossing of the Jorden" 3rd. edt. pp.11-38, 1929

the development of the present saline conditions of this once agricultural land dates from the Mongol invasions some 700 years ago.[1] Because of their destruction of dams, dykes and irrigation canals the region was subjected to annual flooding. After the Mongols had left the country came under the rule of the Ottoman Turks for 400 years. They paid no attention to the water control of the Euphrates and the development of irrigation projects and showed but little concern for the fertility of the land. Now the Iraqi Government is trying to remove by leaching and artificial drainage the salt factor which limits the productivity of the land throughout the region's soils. According to the theories of the archaeologists, which have already been discussed in the geological section, it can be held that 'sabakh' is related to the geological unity of the region. This would stand in contrast to the view of Russell. According to this theory, when the region was covered by the sea, the land gradually rose, and where there were irregularities of slope, depressions occurred, so that the salt water could not drain off, but evaporated and left salt in the soil. Consequently the salt content is now higher in depressions than in other parts of the country.

A further complicating fact is that the salinity cannot be attributed to the salt carried in by irrigation from the Euphrates

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(1) J.C. Russell; "Historical aspects of soil salinity in Iraq" 1956, presented at a joint ICA-FAO seminar on soils,salt, settlement, a paper notpublished.

river. Analysis of this river water by Eaton[1] was as follows:-

Matters	Euphrates (ppM)
Calcium	68
Magnesium	34
Sodium	15
Chloride	78
Sulphate	86
Bicarbonate	178
Total =	459 ppM

Thus by the usual standards of judging irrigation water quality, this river water is excellent. On the other hand pumped water from wells used for irrigation may, of course, be high in soluble salt.

The principal difficulty lies in the high water table which exists in many parts of the irrigated areas of the region. The river bed of the Euphrates, as described in the earlier physical chapter, is about 17 to 20 metres above the agricultural areas situated to the east of the river course. According to the theory of "capillary fringe" the water table of these heavily irrigated areas connects with the capillary action by which the salty water from below is drawn to the surface. As the water evaporates, the salt is left behind. It may be that this has largely been the cause of the movement of the agricultural populations from one part of the cultivated areas to another when their land became too salty for crop growth.

(1) Eaton, F.M. 1949, Irrigation agriculture along the Nile and Euphrates. Sci. Mo. 69 pp. 34-42.

Extent of Salinity

Despite the relative freedom of river water from deleterious salt compounds, because of the extra effects mentioned above, the lack of drainage facilities has resulted in progressive salination and deterioration of the Middle Euphrates valley. Thus almost all land irrigated by flow system has become salty to some degree, resulting in declining crop yields and the migration of the farmers to other areas. Map 25(b) shows such areas as Saqlawiya, Abu-Ghraib and Musayib to the north and north-east of the Hindiya barrage in which the total salty area was found to amount to 247,000 mesharas. To the south of the Hindiya barrage the situation is worst in the districts fed by canals controlled by the above barrage. Thus about 30% of the lands irrigated by the Beni-Hassar Canal and 40% of those served by the Kifl Canal have become too salty for winter cultivation. To the south of these two canal project areas the lands of the rice-growing zone (Kufa - Shamiya - Shinafiya) as well as the depression of Bahr Najaf have the highest proportion of salty lands. Apart from these there are a considerable number of saline areas in southern Jezireh. The latter salty lands extend to the south of the latitude of Diwaniya - Al-Budair, the most important districts being the Rumaitha, Fawar and Khar project areas.

Salinity and Alkali Determinations

Total salt determinations, made from various soil samples by the Bureau of Soils of the U.S. Department of Agriculture Salinity Laboratory, over the upper and lower region areas, have shown that the total salt per cent is usually high.[1]

The study made on drainage experiments at the Saqlawiya project using the open-ditch drain method,[2] illustrates that the land is so salty that the top metre of soil contains ten times as much salt as cereal grain crops can tolerate. The top few centimetres contained about 50 times as much salt as the tolerance level for grain crops. The land had not been under cultivation for 20 years.

In general, the land here is highly calcareous and permeable. Despite this, due to poor drainage, the soil has a high content of sodium chloride and magnesium sulphate. The land can however be easily reclaimed by draining and leaching. From the table below it can be seen that the sabakh soils in the Saqlawiya, Abu-Ghraib, Musayib and Tuwairij areas are high in their content of the soluble salts - sodium chloride and magnesium sulphate. The sodium chloride content varies in the four areas but is generally high and harmful. For instance, in the Tuwairij the mean content varies from 0.61% to 3% and thus cultivation impossible. In Abu-Ghraib the average content is also high, varying from one part to another. Therefore over a considerable area the farmers have migrated as the land became unsuitable for caltivation. In the case of the Musayib canal area (now being drained) the total amount of both salts (sodium chloride and magnesium sulphate) is higher

(1) "A report on the Diwaniya-Dagharrah Extensions" 1955-1956, pp.11-18.
(2) Iraq Directorate-General of Agriculature, Saqlawiya. pp.11-14 Experimental Plots, unpublished report.

than that of the Saqlawiya area. In the former area the content rises to 3.56%, whilst for the Saqlawiya land the figure is 2.76%. In consideration of this it can be concluded that the Middle Euphrates has a high proportion of soil salinity but this varies from one place to another both generally and locally.

Analysis of harmful salts in soils of Saqlawiya, Abu-Ghraib, Musayib and Tuwairij:

	Saqlawiya		Abu-Ghraib		Musayib		Tuwairij (Kifl Canal)	
Salts	Content %	Depth (cm.)	Content %	Depth (cm.)	Content %	Depth (cm.)	Content %	Depth (cm)
Nacl	1.6	50	1-3	50-100	2.16	200	0.61-3	25-200
MgSO4	1.16	50			1.40	200		
Total	2.76		1-3		3.56		0.61-3	

<u>Source</u>: "A Bulletin on Soils Characters of the Delta of Iraq". <u>The Association of Iraqi Engineers, (Arabic) 1955, pp. 6, 15.</u>

The data recorded in Table 7 is derived from some 300 soil samples, taken from Jezireh by the Bureau of Soils. Variation locally in salinity is perhaps the outstanding feature.

At Shinafiya (between Diwaniya - Shamiya extension), a unit which has a gross area of 147,180 mesharas, the salinity value is 2% or more, so that copious irrigation of good quality will be needed before planting.

This land is usually of the Hammar group with deep permeable subsoil and is suitable for deep-rooted crops. The west-central part of the unit is mainly of the slightly saline Babil series.

Other parts are almost flat and moderately saline. The low-lying flat areas are largely subject to seepage or floodwater, and are strongly saline. They require flood control, deep drainage and copious irrigation for leaching before cultivating.

The South Jezireh extension covers an area of 267,286 mesharas, located to the south-east of Ifaq village. This unit includes the Hilla, Babil and Hammar series of soils, but the first group shows a slight salinity. The salinity in the second does not exceed 1.0 per cent, while the third group is strongly saline and in some cases contains over 1 per cent (Table 7).

The Fawar extension (map 29) is the unit which lies between Tel Fawar in the south of the area project and Ifaq-Diwaniya in the north, having a gross area of 124,250 mesharas. Both Hilla and Babil series are represented. The Hilla series is moderately saline, in the case of the Babil soils there can be as much as 15 to 20[1] per cent salts. The average salt content, however, for 50 soil samples of the whole unit as shown on (Table 7) is about 2.92 per cent. The Khar extension, with the Fawar, has a gross area of 517,680 mesharas. Babil soils predominate, with some slightly saline Hilla soils and some permeable Aeolian soils as well as a few Hammar group soils.

In the west-central portion and to the south-east are areas of heavy saline lakebed soils. These are usually soils of the Hammar group. Generally, the average salt content (as shown on Table 7) is about 1.52%.

The classes of soils, by salinity, are, approximately:

(1) (Diwaniya-Dagharah extension Report) 1955-1956. p.III-3.

Total soil percentage 0-0.25 regarded as non-saline:

	0.25-0.75	"	"slightly" affected:
	0.75-1.50	"	"moderately" affected:
	more than 1.50		"strongly" affected.

Most of the soil in this region falls in the last class, and has a salt content much higher than the usual standard of agricultural land.

Systems of Artificial drainage (map 22)

In a region such as the Middle Euphrates basin, with its long hot summer, very low humidity and practically no rain feeding the sub-soilwater, irrigation has for ages been the 'magic power'. Salinity was experienced as far back as the Babylonian period but there is no evidence of any action being taken against it. Drainage is definitely the only way of preventing local water-logging and of reclaiming the land by using irrigation water to wash away the injurious salts.

The construction, management and maintenance of irrigation and drainage systems and the use of water is extremely uneconomical under the "Niren" (1) system. The water requirements for the shitwi crops are 4 mms. per day and for saifi crops 6.15 mms.; if a more systematic rotation is introduced more water will be needed because there is no fallow period.

The total salt content of the soils of this region has already been discussed.

We have seen that as a result of very high evaporation

(1) Niren system - a rotation in which the field is divided yearly into two parts, one is cultivated, the other left fallow.

(up to 16 mm[1] a day from the water surface) and a high capacity, the subsoil water travels slowly but over long distances horizontally from the irrigated to the fallow and abandoned land, taking the salts with it. In this way the salts are shifted. The lower areas, like depressions, dry bedlakes and bedswamps, get the most and become 'matruk'[2]. The areas alongside the canals are badly affected by seepage of water.

The chloride [1] added yearly to the land by normal canal irrigation amounts to about 46 gross grams per square metre. Assuming that no subsoil water drains off, but that all the irrigation water supplied evaporates and transpires through water drains and that salt remains in the top metre of the soil (with an average moisture content of 25% by volume), then the 46 grams would give the soil a chloride concentration of 184 milligram per litre. Taking Tuwary's [3] figures for the salt tolerance of crops, then the conclusion is justified that 33 years of irrigation (excluding flood and seepage water) results in lethal salting if these soils did not originally contain any salt. This explains the extremely high salt content of most of the Euphrates soils.

Accordingly, the lack of drainage facilities has been the

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(1) "Iraq" - Development Board" 1953, by P. De Grurter.

(2) Matruk - land reserved for public purposes and usually disused for agricultural purposes.

(3) "A Bulletin on Soils Characters of the Delta of Iraq" The Association of Iraqi Engineers. 1955. pp. 6.

cause of the progressive salination and deterioration of the soil. The only conspicuous exception to this general statement is the land further north of the river valley, where the river, which has cut fairly deeply from the Spur Al-Aswad as far south as the head of the Saqlawiya canal, acts as a natural drain during the dry season. Pump-irrigated lands generally suffer less from salting, partly because they are higher and thus tend to have better natural drainage, and partly because, owing to the cost of pumping, there is an incentive to avoid the lavish use of water which tends to waterlog the soil and increase the danger of salinification.

The Haigh Commission (1) estimated that in about 60 per cent of the observations, perhaps 20 to 30 per cent of the cultivated land in the irrigated areas has been abandoned during recent decades owing to the accumulation of salt, and that yields on the land still being tilled may have declined by 20 to 50 per cent. The situation appears to be worst in the regions fed by canals controlled by the Hindiya barrage on the Euphrates (see p. 144 and map 25(b).

We have noted that the water of the Euphrates does not itself contain excessive quantities of salt (see pp. 177-179). In the upper reaches the water is generally regarded as perfectly suitable for irrigation, as long as the proportion by weight of dissolved salts does not exceed 30 to 33 parts in 100,000.

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(1) Haigh Commission: "Report on the Control of the rivers of Iraq and the Utilization of their waters". 1951. p.175.

However, lower valley is different, here the proportion of deteterious salts in the drainage waters from the irrigated areas, may go as high as 90 parts per 100,000 in the autumn.

Salt accumulation can be prevented, and existing salt evacuated, only by digging drainage canals which will lower the water table to a level of 1.5 to 2 metres below the surface where capillary action can no longer be dangerous. Under such conditions, water used in irrigation will wash away the salt deposited in the root zone and return it to the subsoil water, which will be tapped by the drainage canals. (Fortunately, the salt found in the soil is not sodium carbonate, or "black Alkali" type, which cannot readily be washed away by water." Owing to the low level of the land, the salty water accumulating in the drainage canals will for the most part have to be evacuated by pumps.

Up to the present, drainage has been the subject of little planning or experimentation in the country. J.S. Turcan (1), the drainage expert of the Haigh Commission, carried out a drainage study for the Aqarquf district, in the upper region and irrigated by the Saqlawiya and Abu Ghraib canals. It was found, that of the total area of 320,000 mesharas, 197,000 needed drainage.

Deterioration of land through salting has become such a serious problem that immediate steps should be taken to initiate

(1) "The Economic Development of Iraq". Report of a Mission organised by the International Bank, 1952. p.205.

drainage on a large scale. The Haigh Commission urged that work on the main drains should be begun as soon as plans can be completed. At the same time, complete drainage systems should be laid out and constructed for areas where the salt problem is most acute, notably those irrigated by the canals dependent on the Hindiya barrage.

The importance of drainage was stressed, both for existing and new areas. It may well be that a greater increase in production can be achieved by new irrigation. By reason of the new settlements, which will be later discussed, attention has been focused on utilizing new land, rather than improving existing cultivated areas. Both types of land improvement should have their place in the development programme, and although drainage of existing land has been stressed, the construction of drains contemporaneously with the building of irrigation canals in newly developed land is hardly less important.

Whilst it is possible, to a limited extent, to drain small areas by returning the water to the river close to the irrigation areas, it is essential, in the long run, to construct proper main outfalls, which will carry the salt away from cultivated areas altogether, and discharge it where it can do no harm.

The ideal outfall is, of course, the sea, but this is generally too remote for a direct outfall. So it must be via the river, in which case care must be taken that the drainage water does not raise the salt concentration in the river water to a dangerous extent, if water is to be used again for irrigation. In view of the characteristics of the topography an structure of the region, as mentioned before, the washing out of the salt would be carried out quite easily if plenty of water was available. The cultivated land which lies mainly to the east of the river coincides with the general slope of the land. running from the river bank and the irrigation canals towards the east and south-east. In addition the basin is divided into a succession of depressions into which the majority of the outfalls are running and discharging.

Because of the high levels at which the river runs in the plain, and the flat slopes available, it should be possible to employ gravity. Here consideration of main outfalls as part of the general irrigation programme may be made as follows:.

Development of Outfalls in the Area

1. The Euphrates-Tigris outfall This drain lies between the two rivers following a natural depression from lake Aqarquf southwards as far as the Haur Al-Hammar depression. It will be given a width of 20 metres along its entire length, so that it can discharge 50 cubic metres per second. Its large section will also enable it to act as a carrying channel and as a collection for flows from the Musayib and Babil outfalls and for other new drains which will be established throughout the Jezireh areas. In 1954 the work of this outfall was started in the northern portions.

2. The Eastern Shamiya outfall (photo. 10). This drain is considered the most important one after the Euphrates-Tigris outfall. It extends between Shamiya and the Hilla-Diwaniya right bank lands as far as a point north of Shinafiya village where it discharges into the Euphrates river. At the present time, it is under construction to relieve areas between these canals, especially those tracts close to the haurs, such as Haur Ibn Najim whose waters used to cause considerable damage in those districts. The drain is also necessary for maintaining orderly development of rice cultivation to the east of the Shatt-Al-Shamiya.

3. The Western Shamiya outfall (Kalbbi) Its design is like that of the eastern Shamiya drain, and has the purpose of draining waters which come from the districts in the adjacent western side of the Shamiya channel, the eastern kufa and Mushkhab Channels. Starting from a point on the road between Abu-Skhair and Shamiya settlements it flows to the south through the Abdul-Kadhim bridge, joining the Euphrates just north of Shinafiya.

In addition to this artificial drainage there is, of course, natural drainage to the marshes, the waters of which at the end of the flood season find their way back to the river or to its branches. This drainage is largely assisted in the Shamiya district by the interesting local phenomenon known as "Nuggara" (see map 4), the retrogression waterfalls which occur along drainage channels and form a drop at each fall which may be as much as 5 metres (see pp. 74-77).

4. <u>Musayib and Babil Outfalls</u> These two drains are important, from the agricultural point of view, because they will relieve adverse drainage and ground water conditions in the adjacent project areas. The construction of these outfalls will aid development of these project areas. The drainage system, when completed, will make it possible for the ground water to move through 2 metres deep minor drains to 2.5 metres deep collective drains, spaced one kilometre apart. The former have been started from north of the Musayib canal, while the latter will begin north of the Hilla settlement. The two main drain lines will pass the ground water to the Euphrates - Tigris outfall, where the water is tapped to evacuate. It has been already planned, however, to instal, in the near future, a huge drain canal which will dispose of the ground water southwards in the Haur Al-Hammar depression.

5. <u>Tuwairij Drain</u> The scheme provides a main drain with branches designated to reduce the sub-soil water occupying the upper Kifl and Tuwairij, covering an area of 31,300 mesharas, of

which only 29% remains under cultivation[1]. The remainder has become unsuitable for crops. It was begun in 1951 and work is still going on.

6. Saqlawiya - Abu-Ghraib drainages This scheme, which includes a main drain with branches and a pumping station, has been prepared for the Saqlawiya and Abu-Ghraib canal areas since 1951. The total area, which the drain serves is 180,000 mesharas, of which 150,000[2] are to be provided with immediate drainage, and about a third of the work has so far been completed. The system comprises a main drain with two branches - the Saqlawiya branch on the north, and Abu-Grhaib branch in the south, extending from the vicinity of Falluja. This drain will divide into branches, one of them discharging into the Tigris at Dura below Baghdad, and the other north of Baghdad at Kadhimain with a pumping station to the river (see map 22).

7. Karbala outfall This drain has already been partially completed but it has not proved very satisfactory. Therefore it was designated in 1951 for modification when the Abu-Dibis outlet (map 28) is constructed. It will then provide adequate drainage for the whole Husseiniya canal area. The outfall, which provides for the drainage of 333,000 mesharas [2], discharges into the Abu-Dibis depression by a pumping station

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(1) "Drainage projects in Iraq: The Report of the Society of Iraqi Engineering, (Arabic) 1955, pp.16-19.

(2) Ibid (pp.9-13).

(photograph 11).

8. <u>Shinafiya outfall</u> This scheme has already been proposed for the drainage of an area, most of which is situated throughout the marshes zone. It will start from the vicinity of Shinafiya village, extending towards the south, parallel with the Euphrates, along the margin of the low-lying land, until it joins the main drain of the Euphrates - Tigris outfall at Haur Al-Hammar.

The drainage system should extend to all areas where the yield of crops is appreciably affected by the high spring levels of salinity, i.e. where the flood season raises the water table to its maximum height. In the existing areas these can be determined by survey, though such a survey has not yet been completed. The Haigh Commission has concentrated its efforts only in places where the annual water table is high and salinization most likely to occur. Consequently this applies to areas in which the drainage projects are either under way (see above) or where planning or preliminary investigation so far undertaken is at an early stage.

The proposed main drains are as follows:

1. Upstream Hindiya drain.
2. Yusifiya drain.
3. Latifiya drain.
4. Iskanderiya drain.
5. Beni-Hassan drain.
6. Hilla left bank drain.
7. Hilla right bank drain.

8. Dagharra - Harriya drain.
9. Diwaniya drain.
10. Diwaniya - Rumaitha drain.
11. Najaf drain.
12. Fawar drain.

Methods of Improvement

The reclamation of saline land is likely to be less costly and more successful in the Middle Euphrates Valley if planned on a wide, regional basis.

From the previous chapter on the geology and physiography of the area it is seen that the lie of the land and the climatic conditions of the region must be thoroughly known in order to understand and perhaps control the movement of water, which is of major importance in soil reclamation. In this review it is convenient to regard certain operations, such as irrigation and drainage, as affecting the local topography or micro-climate in that they may change moisture conditions in the low lying salty land to be reclaimed. It may be noted, for example, that seepage from a newly constructed canal can change fertile soil into a saline swamp and, conversely, that drainage can convert a saline swamp into fertile soil. For such profound changes to occur under natural conditions, progressive movements of the earth's crust extending over thousands of years would be required. The general survey should therefore include the natural topography and climate of the region and also those projected human operations that are likely to have equivalent effects.

The next step is a more detailed study of the area to be reclaimed. This should include the soil and the drainage works as mentioned before in this chapter as well as the soil water, projected irrigation, possible crops and cropping system as will be considered in the following chapters.

To carry out such a scheme there is a wide variety of possible measures to reclaim salty land. Removal of the excess salts from the land will be facilitated by the use of the Euphrates water of good quality, by the use of large quantities of water, by the establishment of vegetation cover when it is necessary to improve soil structure and by improvement of drainage as has already been discussed. In the areas which were considered on page 144 there is a large percentage of sodium chloride in the base exchange complex of the soil. Under these conditions calcium can be substituted for sodium by the artificial use of compounds such as gypsum (calcium sulphate) which exists naturally in a high proportion of the Middle Euphrates soils. The lowering of ground water by drainage is an essential part of the reclamation.

In the Middle Euphrates valley the soil is usually permeable and can easily be reclaimed if the land is levelled, drained, and flooded, and if rice, wheat, barley or other vegetation can be grown. The use of Bermuda grass (see also pp.165/6) which is normally an intermediate stage to the cultivation of crops (rice, wheat, etc.) is not necessary here.

Hawkins, has discussed a particular case of Saqlawiya land which had become salty from the rise of ground water due to seepage from its canal.[1] He reported that this investigation in winter 1946 was in the first experimental field located at the head of the Ali-Sulumen canal of the Saqlawiya. This experimental field had an area of 64 mesharas and required drainage. It was levelled and subdivided into small field units of about 8 mesharas, each having one first-class field drain and canal. The field was again divided into smaller plots by second-class field drains and canals, running alternately parallel and perpendicular to the first class field drain and canal.

After this preliminary work, the field was flooded. At the first flooding, water was admitted both by canals and by drains and held on the land for two or three days. Then the drains were allowed to empty into the collector leaving the water on the land. This method prevented damage to the newly formed drains and land. The level of water on the land was maintained against losses by evaporation and percolation. To remove any remaining irregularities of surface, the land, while still under 7 to 10 cm. of water, was levelled by means of horses, after which the field plots were allowed to drain and dry. This work extended for a period of 70 days. Drying was followed by ploughing and washing

(1) "A Bulletin on Soils Characters of the Delta of Iraq" The Association of Iraqi Engineers. Baghdad, 1955. pp. 6-10.

until the percentage of salts was sufficiently reduced for the land to be cultivated.

This method of reclamation is also followed in the Nile Delta but the required period for washing in the Nile, as was found at Wadi Tumilat (1) was 18 months whereas at the Saqlawiya area the time required was 8 months. This difference in time is due to the degree of soil permeability; in Wadi Tumilat of Egypt the soil is denser because of a high proportion of clay content while in the Saqlawiya the content of both sand and lime is great.

After eight months of the washing the field was soil classified and sown to barley and wheat. The average wheat yield obtained was 482 kilos. per meshara while that of barley was 725. The yields of wheat were twice as much as in other un-reclaimed wheat areas, while the yield of barley increased three-fold.

E. Cole(2) has described the reclamation of the Montgomery salty district of the Punjab by the same method which was successfully employed in the Middle Euphrates soil. He added that the Montgomery soil gave good results when watered, drained and ploughed, the main difference between the two districts being the degree of salinity. The Montgomery, which had a high salt

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(1) "A Report on the National Production". The Permanent Association, Egypt, 1955, pp. 70-73.

(2) H. Green; "F.A.O. AGricultural Studies No. 3. Using Salty Land". Rome, Italy, 1953. p. 14.

content was planted directly after the reclamation operations, to Bermuda grass for three successive years whereas the Middle Euphrates was immediately put to barley and wheat.

It seems, generally speaking, that the only difference in the methods of reducing salinity in the Middle Euphrates valley, as compared with those employed in the Nile Delta and Punjab Valley, is that concerning the use of pumps. In both of the latter areas there is a network of stations for pumping the collected salty water from the main drainage channels; in the case of the Middle Euphrates the salty water is being directed to drain either of itself to haurs in the south of Iraq (haur Al-Hammar) or directly to the river.

Natural Vegetation

Natural vegetation in an arid alluvial plain such as this is sparse, and consists of plants which mostly mature quickly after the winter and spring rains. In the main the dominant vegetation can be regarded as of desert type; all the observations which have been made on the flora of the Middle Euphrates by M. Zohary indicate that the majority of the natural species are of the Arabian desert type.(1) This similarity reflects the degree of the geographical correlation especially in weather conditions between this plain and its borderlands of the Arabian desert. It will be remembered that rainfall in the Middle Euphrates is extremely low (75 mm. to 125 mm.) (map 14),

(1) M. Zohary: "The flora of Iraq and its phytogeographical subdivision". Iraq. Dept. Agr. Bulletin No. 3 and 31.

and its effectiveness is very appreciably reduced by the intense heat and evaporation during summer. On the other hand the presence of much subsurface and surface water in other areas is of great significance. From the point of view of topography and soil the flora of the region possesses varied phytogeographical characteristics, and two principal divisions of plants are represented in the valley's flora; the marsh lands group and the cultivated and uncultivated lands group:-

Marsh lands group

The dominant plants over a wide area of the marsh lands are the giant grasses, phragmites, and the bullrush, typha. These two plants find many uses. The marsh Arabs harvest the stems of both species to make mats for use as floors, fences and houses. They also make a practice of burning large areas every autumn to encourage new growth of the typha and phragmites which are then grazed by the water buffalo and other livestock.

The vegetation of salt marshes varies according to the degree of salinity. For instance among the grasses, (Aeluropus repers) is widely distributed over the marshy places because it is able to grow inland of relatively high salt content. It is moderately palatable to livestock.

Water-loving, marsh-type plants live on most of the canal streams and river banks. The most common plants of the Euphrates banks are the willows which occupy narrow belts along the river in certain places. They grow on islands and at bends of the river and are more common along the lower reaches of the river than on the upper.

Cultivated and Uncultivated lands group

A wide variety of native plants grow on the cultivated and uncultivated lands. Annuals make up the greatest number of species, but perennials are of utmost importance on the cultivated and fallow fields, and abandoned land in the region. One reason that a multitude of weedy plants can persist in the fields is because the tillage implements in use over most of the country disturb only the top few centimetres of soil and have very little cutting or slicing action. Thus, tough-rooted perennial species are seldom if ever destroyed, even by ploughing.

The two most important native species growing on the cultivated and uncultivated lands are the common thorn and camelthorn (called respectively "shok" and "Agul" in Arabic). Both are perennial and are found either scattered or in dense thickets in nearly every part of the country. In some places along the Euphrates 'shok' forms dense impenetrable thickets more than two metres tall, but in most places the stands have been thinned by fuel gatherers and the plants are less than a metre in height.

No one questions the importance of 'shok' and camelthorn to the rural people, and many agriculturalists wonder what would be the result if these plants were eradicated. The two plants seem to be absolutely essential to the agricultural economy. They are the most readily available, and dependable source of fuel and thus contribute greatly to the total fuel supply of many settlements.

In addition they constitute important grazing plants, not because of palatability or nutritive content, but because of their abundance. 'Shok' is of considerable importance for grazing because it covers immense areas of otherwise barren country and supplies green forage in summer when other forage is scarce. Camelthorn is especially valuable since camels relish it regardless of the growth stage of the plant; when the plants are young, camelthorn furnishes grazing for sheep.

Because 'shok' and camelthorn are both legumes and deep rooted, they undoubtedly play an important role in soil improvement, particularly with regard to soil structure, percolation and drainage because they give significant amounts of nitrogen. According to Springfield (1) 'shok' is an indicator of relatively fertile soils of high agricultural potential, whereas camelthorn indicates poorer, usually slightly saline soils.

One of most troublesome grass is a coarse type, called 'Halfa' in Arabic. It is distinguished by a white silky forcene and has no value for grazing. It is particularly detrimental in the date-orchards of the Levee Zone.

The other grass is in a class with 'Halfa'; it is Bermuda grass (cynodon dactylon). Bermuda grass is ubiquitous; it grows vigorously and spreads rapidly where water is plentiful,

(1) H.W. Springfield: "An Official Article on the Natural Vegetation of Iraq", 1957.

but it is also drought resistant. (see p. 159)

Other perennial weeds of importance on cultivated lands are: Haplophyllum spp (widely distributed all over the region especially on sandy soils); and Lycium barbarum (low thorny shrub common on waste land of Dahr Al-Megass and Haswa plateaux as well as on old canal banks). Apart from this, 'harmals', a bushy herb with a strong odour is regarded as the most common plant growing on the wastes of these plateaux.

Categories of Land Use (Map 20)

Personal study and investigation by the author lead him to the conclusion that a system of land classification best adapted to the specific conditions the Middle Euphrates area would take account of the following: physical factors of topography, soil, drainage and water supply; the types of agricultural economy, and the human resources. On this basis of land classification one could arrive at an assessment of potential for agricultural development. The following categories are suggested:-

Class I These lands include the Levee Zone, which may be recognised as a narrow slightly undulating belt, the recent bank land and the flood plain of the Euphrates (river basins silted phase)(1), with other small periodically flooded areas covering the upper region and extending along the banks of the Hindiya and Hilla branches into the intermediate zone (see map

(1) The large flats of extensive natural depressions are flanked by and separated from the river by the levees. These flat depressions are called river basins.

19 and 20) Their soils, whilst being slightly saline, are very fertile and have a depth in excess of one metre with a good water capacity. These lands, with slopes of 2^o or less, are regarded as the foremost arable soils in particular because of their medium texture and are readily ploughable. Included in this group are the greyish-brown alluvials which are permeable and have good internal drainage, and are the best soils for the "garden" type of cultivation. Despite the free drainage the Euphrates, which has cut a fairly deep bed especially in the upper part and throughout the Levee Zone, acts as a natural drain during the dry season. Under natural conditions the levee soils are well drained both towards the river and to the east. This is due to the influence of the river on the level of the water-table and also to the natural drainage towards depressions such as Aqurquf and haur Shuke. Most of the area in this category can be readily supplied with water either from the river itself or from canals so that the whole territory may be regarded as cultivable. It is for these reasons that this class of land is often favoured by the farmers. From the above characteristics the area may be considered capable of intensive cultivation under good management, especially as orchards, vegetable gardens and cotton fields (map 21). As regards human settlement, it is fairly densely populated if compared with the other divisions of the region, the Shamiya area being excepted.

<u>Class 2</u> This land occurs on the back slopes leading away from the Euphrates, beyond the recent bank land of the Levee Zone, towards the flat plain of the Interfluvial Zone, mainly the Jezireh. This class which consist of sandy clay loam with some heavy clay of a depth in excess of 75 cm. and gravel areas has a slope varying between 2^o and 6^o. The pH value is less than 8.5. Surface drainage is imperfect and underground drainage often impeded. Salinity is moderate to strong, according to position. The land has topographical irregularities which require correction by levelling. This lowers yields and increases farming costs. A large section of category 2 is in isolated areas, located far from the water supply of the river and irrigation canals. According to situation, the greater part of it is either uncultivated or used as grazing land. During the fallow period it is covered by natural vegetation of 'shok' and 'agul' as described (see pp.82-85). It has recently been brought under the aegis of the national development plan for the establishment of new irrigation project areas. These districts are fairly extensive in area and are of major importance for general field crops and grain farming. Barley is the main crop (by yield) followed by maize, millet, sesame and beans. Therefore, this class of land has less value for farming purposes than Class I (see maps 20 and 21).

Population and settlement are sparsely scattered over this district, but are denser in the west (see map 50).

__Class 3.__ This class of land is essentially low lying compared with the high tracts of Class 2 of the Hilla and Babil series. It includes lake basins, marsh lands and dry lake-beds. These low lying areas are usually of dark olive-grey or creamy marl soil and subsoil , developed by continuous silting and deposition. They have poor drainage which produces a high salinity, with the ground-water level near the surface or within a distance of one metre below it. Soils in this class vary in classification alluvial loams to heavy clay. Surface water is everywhere normally available from ditches or streams. In the vicinity of irrigation canals and ditches the surface layer is of silty clay loam or silt loam, often with 'sabakh' characteristics. These factors render such land better suited to natural pasture than for arable farming. On level alluvial areas in formations best described as low islands slightly higher than surrounding tracts of marsh, the soil can be loamy and the land is suitable for some crops, such as rice, maize and the cultivation of orchards. In other lower lying areas the water-table is usually high and there is a likelihood of winter and spring floods. Such lands can be used as "water meadows" as a result of periodic inundation, but are unsatisfactory for growing farm crops, except rice and are thus generally left in a natural state (see p.163).

__Class 4__ This occupies the dune areas, which dominate the eastern portion of the Jezireh zone on the north and south of the Ifaq district (see maps 19 and 20). The land is a greyish brown, aeolian soil, usually of a coarse dry and uncompacted character. It has rapid drainage, which is the main reason for its not being economically maintained under irrigation. However, it produces some crops for a limited number of years under low water application and fallow system of farming. The settlements are sparsely scattered throughout the western part of the area, while the eastern and southern parts are neither cultivated nor settled (see maps 21 and 50).

__Class 5__ This group is the least valuable class of land and cannot be reclaimed for any agricultural purpose. Such land includes the low desert plateaux zone and other areas between the desert and the river. These low, bare plateaux have an irregular topography and are deficient as regards soil nutrients because they consist mainly of gravel and coarse sand formations (see pp. 71/2) The land lies mainly about 20 to 30 feet above the surrounding cultivated plain well above available irrigation water levels, so it is impossible to use as farming land. Because of these restrictive physical conditions the areas are entirely uninhabited (see map 20).

CHAPTER IV

The River in Relation to Irrigation

The Euphrates river regime

The climatic conditions governing the mountain basin of the Euphrates affect the river regime in the Euphrates plain. The rising of the river is caused by early winter rainfall, resulting from the passage of individual depressions and storms, and also by the melting of snow in the hills in spring time. The rainfall affects the river to a varying degree throughout the winter, until the rising temperature melts the snow in March, April and May, and brings high snow-melt floods. From June onwards the river subsides until it reaches its lowest level in September or October.

In September, at Hindiya barrage, the water level in the river is low, dropping still lower in October and November. This is no doubt due to the demand for water for winter sowing which occurs at that time and also possibly to the fact that although more rain falls in the catchment area a large amount is drawn off by absorption into the banks where it goes to raise the water-table. In December winter conditions have set in, and the rise becomes more marked. In January and February the fluctuation of level and rate of rise increase, partly owing to the lessened demand for water during these two months, and partly to the additional amount of water supply from the catchment area of the river. In March, April and May the steady rise of the river is due to the reduced withdrawal into the canals and also to the melting of the lower snows in March. The river is not in full flood until May. From June to the end of the year the fluctuation in volume decreases as the flow becomes less, evaporation becomes greater, and the effect of canal tappings increase.

Source:
1953-57 Directorate General of Irrigation

The mean monthly discharge of the Euphrates throughout the years 1953-1957 in cubic metres per second at the stations of Hit and Hindiya Barrage.

Months	Hit	Hindiya Barrage
January	660	385
Feburary	777	419
March	1390	786
April	2084	1330
May	2733	1758
June	1495	1030
July	638	409
August	329	234
September	270	215
October	310	181
November	400	204
December	504	281

From the figures of the table above, we see that the

Euphrates has itshighest mean monthly discharge in May at Hit (situated a few kilometres north of the Delta) and at Hindiya Barrage with 2733 and 1758 cumecs respectively.

September has the lowest discharge at the former station with 270 cumecs, and 181 cumecs in October is the lowest at the latter station. The discharge corresponding to the highest gauge observed was at Hit, in May 1954 (3506 cumecs), at which time the mean velocity at the discharge site was about 2 metres per second. This bears a striking comparison with the highest discharge at Hit of 5300 cumecs during the same period in 1929. There were widespread floods in many parts of the country at that time. The whole of the water of the river used to spread, in flood, over the Delta valley, before 1956; but since that time, the reservoir at Habbaniyah Lake and the barrages at Ramadi and Hindiya have controlled the river water during the flood season.

From time immemorial, floods have caused damage in the valley of the Middle Euphrates. The greatest flood, in ancient history, is that associated with the story of Noah and the Ark.

During recent years, major floods have occurred every two or three years. The following table shows the main stations of observation along the river. It illustrates that the monthly mean maximum flood at Ramadi for the 43 years from 1912 to 1955 in May was 49.05 metres, whilst the highest daily maximum recorded was 50.82 metres above sea-level on the 25th of April, 1948. The monthly mean minimum flood at the same station for the 43 years from 1912 to 1955 in September was 46.16 metres above sea level, whereas the lowest daily minimum was 45.07 metres on the 7th October, 1918. At Samawa station, in the far south of the region, the monthly mean maximum flood for the 27 years from 1928 to 1955 was 10.46 metres above sea level in May and the highest daily maximum recorded was 11.28 metres on the 29th April, 1941. The monthly mean minimum at the same station for the total 27 years from 1928 to 1955 in September was 5.64 metres, while the lowest daily minimum recorded was 4.13 metres above sea level on the 18th September, 1930 (see Diagram 1).

This table shows the highest and lowest recorded at the various stations of the Euphrates

Station	Month	Monthly mean (metres above S.L.)		Total years of observation.	Remarks
Ramadi	May	49.05	1912-1955	40	Highest recorded 50.82 M. in 25/4/1948.
	September	46.16		41	Lowest recorded 45.07 M. in 7/10/1918.
Head of Rudhawaniya canal	May	39.0	1920-1955	36	Highest recorded 40.02 M. in 9/5/1948.
	September	36.78		25	Lowest recorded 33.73 M. in 3/8/1921.
Shamiya	May	20.38	1930-1955	25	Highest recorded 21.50 M. in 26/4/1943.
	September	19.49		24	Lowest recorded 17.20 M. in 16/9/1955.
Ghammas	May	17.55	1938-1955	17	Highest recorded 17.94 M. in 6/5/1957.
	September	16.53		18	Lowest recorded 15.21 M. in 19/8/1951.
Shinafiya	May	14.71	1928-1955	27	Highest record 16.46 M. in 17/5/1928.
	September	8.86		25	Lowest record 7.4 M. in 23/11/1930.
Samawa	May	10.46	1928-1955	26	Highest record 11.28 M. in 29/4/1941.
	September	5.64		28	Lowest record 4.13 M. in 18/9/1930.

Source: Directorate General of Irrigation Department, Hydrollic Division, 1957.

Flood Control The Euphrates, which enters its alluvial plain a few kilometres upstream from Ramadi, is provided with flood embankments which are adequate for moderate floods from this point to the vicinity of Kifl. With higher floods since 1956, the Habbaniya Depression has been brought into use as a reservoir, by deliberately breaching a specially maintained section in the river's right embankment and allowing flood water to escape. The escapage, of course, depends on the relative river and Habbaniya Lake levels, and the capacity of the breaching section. With very high floods, the control is inadequate. In order to provide additional capacity for flood-water passing into the Habbaniya Lake an escape has been constructed at Mujara, permitting water to be evacuated to the Abu-Dibis depression (see map 31).

Just downstream of Kifl, the Euphrates bifurcates and escaping surplus water flows into the marshes, considerably reducing the size of each branch. At Shinafiya, a single river channel is re-formed and is supplemented by water returning from the marshes. From that point to Al-Khider the river is of moderate size.

So far, we have dealt with the flood. There is now the matter of water supply in the "out of flood" season.

As the discharge of the Euphrates at Hit falls from 2,733 cubic metres per second in April and May to 1495 in June, 638 in July, 329 in August and 270 in September, the swamped area decreases steadily. Finally, in September, under heavy evaporation, the level of water falls both in the river-course and the water-table of the plain until December, when evaporation has decreased.

The period of low supply has been the subject of the investigation by the Irrigation Department of the Iraqi Government to see if and when it is possible to raise the level of water in the upper parts of the river for irrigation purposes. To meet the requirements of irrigation, the Euphrates is happily placed in respect of its relative level. The water of the river can be made to irrigate the whole of its plain, otherwise suitable for irrigation, between Ramadi and Samawa, and also all the lands on both the Hilla and Hindiya branches along their entire lengths. With this in mind a selection of tracts for irrigation purposes have been chosen, in suitable situations, within the plain, or on the border of the plain, capable of storing the excess waters for the months of April, and May, and aiding the waters of the river in July, August and September. For example, the Habbaniya reservoir is capable of watering 200,000[1] hectares of rice, and the Euphrates valley, above Ramadi Barrage, 20,000 hectares.

Rice and cotton are the most valuable crops, and the main summer ones, but these need a considerable water supply. Therefore barrages and reservoirs have to be constructed for the storage and control of the supply used and to irrigate the rice and cotton fields.

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(1) W. Willcocks. "Irrigation of Mesopotamia", 1917, p.4.

<u>Needs for Irrigation</u> In considering the organisation and control of water supplies which are used for irrigating different kinds of crops in this region, the Haigh Commission defined as an irrigation "duty" as that portion of the area, irrigated by the water supplies, whose minimum requirement is one cumec over a period of six months. In the Euphrates valley, the Shitwi (winter) "duty", at present, and as thus defined is 9,000 mesharas, the supply being measured at the channel outlets, i.e. the points at which the control of the supply is handed over to the cultivator. At each such point the supply should not exceed one-tenth of a cumec.(1)

In the Saifi (summer) season the duty for dry crops is about 3,000 mesharas, while for rice the duty is about 1,500 mesharas. Corresponding figures for the Punjab region would be 13,500, 7,800 and 4,500. Important factors, which contribute to differences of conditions to those in Punjab, are the more complete absence of rainfall, and extremely high evaporation (see p.121), greater losses due to high temperature and low humidity in the Saifi season. A further factor affecting both seasons is the high absorption losses due to relatively permeable soil (see ChapterII).

<u>River Loads</u>

<u>Quality of Riverwater</u> - The following table illustrates that the chemical quality of the water of the Euphrates is good,

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(1) Cumecs - cubic metres per second.

and gives no trouble when used for agricultural purposes. The monthly data which has been recorded for the water at Falluja, Hindiya, Hilla and Abu-Skhair indicate that all the salts in the water are suitable for irrigation use. Upon completion of the present and proposed storage facilities, the variation in the amount of salts will be minimised so that water available for irrigation use will be of good quality at all times. Following the provision for the drainage and irrigation of saline lands, there will be some increase in the salts in the river-waters in the downstream reaches. However, this increase will not be sufficient to impair materially the quality of the water for irrigation.

Analysis of Riverwater

Total salts p.p.million, 1950.

Month	Falluja	Hindiya	Hilla	Abu-Skhair						
				Ca	Mg	Na	Cl	SOH	CO3	Total salts/mg/
Jan.	255	45	167							
Feb.	228	72	169							
March	388	107	205							
April	484	74	180	63	19	49	62	105	87	440
May	470	58	185							
June	422	83	108							
July	420	91	102							
Aug.	414	221	225							
Sept.	270	207	266							
Oct.	394	268	270	48	22	68	96	107	68	440
Nov.	484	175	191							
Dec.	296	171	214							

Source: Report on the Development of the Tigris and Euphrates River Systems, 1952 - Knappen-Tippetts-Abbett-McCarthy Engineers. pp. III - 19.

Further samples of water from the Euphrates were examined and suspended matter determined. The ordinary water supply of this river contained 28.4 parts of suspended matter per 100,000 while the Tigris contained 191.3 parts, as is shown on the table below.

	Euphrates at Falluja.	Tigris at Baghdad.
Suspended matter	28.4	191.3
Suspended mineral	22.8	171.9
Totally dissolved salts	44.5	33.0
Chloride equivalent to common salt	6.4	0.7

Source: W. Willcocks: "Irrigation of Mesopotamia". 1917. second edition.

Silt Content: The change in water-level and discharge of the river during the year gives rise to the instability of the river-bed and its canals. The degree of river-bed variation is directly related to the silt content of the water, which at the moment is regarded as a major problem of the irrigation system in the Middle Euphrates valley.

During the winter months when the rain falls on the bare hill-sides and pours in torrents down into the Euphrates river the waters are heavily loaded with silt. The concentration of solid matter reaches a very high degree, as much as 6,100 parts per million of dry silt by weight having been recorded at Hindiya barrage at the height of the flood on 17th April, 1928.

Although value of silt as a fertilizing agent is so well recognised, its presence in such quantities is a continual menace to the canals. Indeed, if the accumulation of deposits in the beds of the main canals is not regularly cleared, the task will eventually be too great for the community living on the canal to tackle. The inhabitants of the lands distant from the head of the canal, finding that the diminishing supply is being taken by the more fortunate farmers near the head, are forced to migrate elsewhere. The size of the channel then diminishes year by year and, with its large heaps of silt on either bank, becomes more and more difficult to clear, until at last the whole system has to be abandoned. Such probably has been the fate of the great systems of which remains can be seen all over the plain, and it is only by resolute insistence on a regular clearance of silt that any canal can be spared a similar fate. One of the marked features of the plain is the network of silted and abandoned irrigation canals which in the past were fed by water from the Euphrates. During troubled periods these were neglected and their beds were silted-up. Thus they became like the small canals of today, incapable of taking their optimum amount of water during the flood, and during the low, clear water period. Using only the muddy waters of the river, they gradually choked up and fell into disuse.

Due to the irrigation system silt deposition in the plain gives rise to a characteristic land-form feature. The water in irrigation channels often with a large load of sediment has been deposited on top of the valley soils in a layer of at least one and often several metres. Thus the original river silt formations are found at a depth of a few metres whereas upper layers consist of irrigation sediments deposited according to the system of irrigation canals, branches and ditches.

The major irrigation system has been constructed in such a way that river water flowed through it with enough speed to prevent sedimentation in the canal system. Consequently much sediment in suspension was carried to and deposited on the irrigation fields.

The sedimentation process is in principle the same as that in a natural river system. The irrigation water reaches lands a great distance from the river. The load mostly consists of some fine sand, much silt and some clay particles and is sedimented during the irrigation process along the canals and ditches in a thick layer becoming thinner at some distance from the canals. Such a process forms irrigation levees and river basins where the soil contains a high percentage of silt.

From the table below the surface sediment observations which have been taken in the middle of the Euphrates river indicate a yearly average sediment concentration at Ramadi of 553 grms. of sediment per cubic metre of water. That of the Tigris, at Baghdad, shows 795 grms. of sediment per cubic metre of water.

But the observations made at Ramadi in the highest flood on the 17th April, 1928, illustrated that the average sediment concentration was 6100 grms. of sediment per cubic metre of water. At the same time, that of the Tigris, at Baghdad, was 7550 grms. of sediment per cubic metre of water. Willcocks stated in "Irrigation of Mesopotamia" that the average sediment in the Euphrates is more than three times the average sediment content of samples taken from the Nile during the highest floods.

Silt content of the Euphrates and Tigris:

Estimated approximate average content, in dry grammes per cubic metre of water, of the Euphrates at Ramadi and the Tigris at Baghdad.

Month	Euphrates (Ramadi).	Tigris (Baghdad)
January	250	380
February	340	650
March	480	1400
April	1500	2300
May	1800	2100
June	1100	1200
July	320	380
August	170	240
September	130	180
October	130	170
November	170	220
December	250	320
Yearly average	553	795

Source: M.G. Ionides; "The regime of the rivers Euphrates and Tigris" 1937.

N.B:-
Maximum ever observed on Euphrates: 6100 at Hindiya Barrage on crest of flood, 17th April, 1928, while on Tigris: 7550 at Baghdad, 1909.

Silt observations which have been taken at varying intervals show the extreme variability of the amount of silt in suspension not only from day to day but also from one month to another. The highest recorded figure amounts to 1800 grams. of silt per cubic metre of water in May. In September or October the figure falls to 130 grams. The amount of silt which has been recorded at Ramadi as shown above does not represent the position at other sites on the river. The volume of silt content varies with the depth of water in most cases, and, probably, with distance from the banks of the stream.

Sousa(1) has referred to the samples which have been examined in the upper course of the stream, revealing that the average depth of sediment was higher than that of the lower course of the river. From a study of the recorded data above we cannot estimate the rate of sedimentation caused by the river, because the climate and topographical variations within the drainage basin are too great. In the absence of adequate measurement it is only possible to guess at the average sediment concentration. For the purpose of this study, it has been assumed that the average sediment concentration in the Euphrates river above Ramadi ranges between 0.2% and 0.7%(2) by

(1) A. Sousa. "Iraq Irrigation Handbook" 1945, p. 80.
(2) "Report on the Development of Tigris and Euphrates River Systems, Knappen-Tippetts-Abbett-McCarthy, Engineers" 1952. p.III - 42.

volume. More exact knowledge of the sediment rate is of importance for the determination of storage space in reservoirs, and also as a factor in the design of desilting works. Although the fresh silt sedimentation, brought down by the river, yearly increases the fertility of the plain soils, it also contributes the most serious problems which have arisen since the irrigation system was begun. This problem of sedimentation often results in the abandonment of canals with silt accumulation. The cost of dredging these sediments can be very expensive. It is found to be far better to instal a more modern irrigation system than to waste money maintaining the old canals and keeping them free of silt. The largest irrigation system in this region is the Hilla system which has suffered by silting to a greater extent than any of the other systems, due largely to the fact that the water flows into the Hilla canal at so great a rate that large quantities of river sediment are transported along with the water, (see map 30). The silting is continually reducing the capacity for adequate flow in the canal to the land now being irrigated. The amount of sediment entering the Hilla canal system is so large that a considerable expenditure for a desilting works is justified. The water passing through the desilting works would be clarified by allowing the silt and sand in the water to deposit in large settling basins. These basins would then be cleaned out by sluicing river water through them at high speed.

For the operation of such works, it would be necessary to have an excess flow of water for sluicing at the Hindiya and Ramadi barrages, adjacent to the desilting works.

Underground Water

To deal with the underground water of the Valley a full study of the structural strata under the drainage scheme would be needed in order to discover the potentiality of these soils.

This plain has not only been formed by the sedimentation into an extended Persian Gulf by the Euphrates but is also a vast plain which was built up of alluvium and lacustrine agradation in a general subsiding area (discussed in the geological section). Therefore, the depth and character of the old alluvial fill determines to a large extent the underground water and the drainage conditions.

In the Falluja area (Haswa low plateau), the amount of alluvium overlying the Fars beds is very small, and a well at the west margin of the west desert close to Samawa is reported to have gone through the alluvium into the Dibdiba beds (Bakhtiari formations) at a depth of about 30 metres. To the west of Baghdad, on the eastern frontier of the region under consideration, the logs of the wells in the "Report of Ground-Water Resources of Iraqi" in 1953, suggest that the alluvium is at least as deep as the deepest well, which is 96 metres.

A recent deep boring made west of Hilla by Dr. Buringh(1) to a depth of 150 metres, shows the various formations of substratum. These beds represent successive layers which are arranged from the bottom beds upwards as Fars, Bakhtiari, Old alluvium and Young

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(1) Dr. P. Buringh. "A Report on Soil Survey of the Hilla-Kifl Drainage Project", (unpublished) Ministry of Agriculture, 1958, pp.36-7.

alluvium as the topsoil. From this investigation, together with others, which have been made into soils and the ground water-table it seems probable that these old buried strata (Tertiary) extend over all the plain and affect the drainage of the region because of their relatively permeability. According to Dr. Buringh's investigations, the Fars, Bakhtiari and Old alluvium formations constitute the most important water-bearing strata whereas the salty water-table of the Young alluvium is regarded as the main problem from the agricultural standpoint.

The poor quality of ground water in the Fars series is due to thehigh mineral content, particularly gypsum. The solution of the Upper Fars formation takes place below the Bakhtiari and is considered to be important in forming an aquifer in areas of the western border of the valley where erosion has removed the beds.

This Bakhtiari formation is the most important water-bearing bed in the region. It is important not as a potential ground-water bed but as a permeable layer. Thus it is probable that the water resources from this formation will be developed, bringing greater prosperity to agriculture in the country. The capacity of ground-water of the Bakhtiari layer will be an important resource if such a scheme is envisaged, especially in the isolated areas of eastern Jezireh Zone. The ground-water within the conglomerate formation of Bakhtiari is free of soluble minerals such as gypsum and magnesium carbonate. The beds of their formation outcrop north, north-west and west of the region and thus practically enclose it from three sides. It seems very likely that artesian water pressure will be encountered in these synclinal structure beds beneath the alluvium - perhaps even in most of the region.

Accordingly the artesian water, percolating slowly upwards through the overlying confining beds, may contribute to the shallow water-table in parts of the Valley and to the springs on the western border of the desert.

The only area at the time being which enjoys the use of ground-water for irrigation purpose is the marginal belt of the desert escarpment. This belt, which includes a spring-line, extends along the desert front slope and flattens into the western border of the plain stretching between Habbaniya lake to the north and Samawa to the south. The ground-water level in this area is on an average 7 metres below the ground surface.

The old alluvium contributes a moderate amount of ground-water. The available data indicates that the water of this bed is highly mineralized. This dissolved mineral material is probably a result of the downward percolation of water from the surface where salts have been concentrated.

Generally speaking, the underground water found in deep layers of Fars, Bakhtiari and Old alluvium depends probably on the rain that falls annually on the neighbouring areas of northern mountains and western desert regions. As a matter of fact the water percolates downwards from those regions, through the porous strata of the Tertiary and Old alluvium which are well cemented, so that the Young formation below is kept separate from the underground water.

The water-table which has been investigated throughout the whole Valley, was found within the formations of the Young alluvium, at only shallow depths below ground level.

Report No. 9, of the "Drainage Scheme in Iraq, 1955"(1) which referred to the observations which have been made at Saqlawiya and Abu-Ghraib drains in the upper region (see map 22) indicates a water-table at 120 to 200 centimetres below the land surface. In the Tuwarij drainage area, in the middle region, the water-table was at depths of 75-200 centimetres.

Those observations, which were compiled in 1951, would seem to show that the highest water-tables in the region are concentrated, in the cultivated lands, at a depth of one metre higher than the water-table of the Matrouk lands. This is because surplus water, from the irrigation canals and the river, can penetrate layers of the nearby soil, to the cultivated areas. Moreover, farmers always irrigate their fields by a water supply in excess of that which the crops need.

Generally, the level of underground water rises in December until it reaches its maximum height of about 50 to 150 centimetres below the land surface. During the summer, this water-table becomes one metre deeper, as a result of the drop in the water supply to the river from the rain-fed zone in the north, and also

(1) Association of Iraq: Engineers. "The Drainage Projects in Iraq" 1955. pp. 9, 11, 15.

because of the high evaporation. It is possible thus to summarize the conditions under which the underground water takes its level, as follows: The level of the water table under the land surface is dependent upon the amount of infiltration of the river. Local variations in the level occur at times of flood. The water-table spreads underneath a good distance away from the river and canals. Some compact areas also exist which allow water to penetrate downwards and into the adjacent areas.

The chemical composition of the under-ground waters in the area varies from place to place (see pp. 145-148). In the poor drainage areas, salts have been accumulated on and below the surface for many years. Where the water-table is close to the surface the mineral content at shallow depths may be increased by the annual fluctuations of the water table through a zone in which soluble salts concentrate as water is evaporated. In addition, salt incrustation forms in depressions where water accumulates during the irrigation and flood seasons and evaporates in the summer.

The poor quality of water is one of the most serious problems concerning the development of ground-water resources in the region. Water flowing into Iraq, either from the water-shed area in Turkey to the north or from the desert to the west, and, proceeding on its natural course towards the Middle Euphrates, passes over or through rocks that contain gypsum, sodium chloride, and other soluble salts. During its horizontal and vertical movement it carries these dissolved minerals on the surface.

The only means by which this accumulation of salts on the surface may be removed is by leaching and an improved artificial drainage system, measures already discussed. (pp.153-162).

PART II

AGRICULTURAL GEOGRAPHY

CHAPTER V.

POPULATION

(growth, structure, distribution and a factor in development) maps 23, 24, and 25(a); Diagram 5; tables 9 - 13.

Early Ethnic Characteristics.

The plain of the Middle Euphrates was inhabited by two distinct races, the Sumerians in the south and the Akkadians in the north. The earliest people to settle in the southern part of the plain were the Sumerian, and later the Akkadians of the Semitic race. The Sumerians, an alien people invaded this part of the country in 3,000 B.C. They had been attracted by the existence of potentially fertile soils, the vast Delta valley and sufficient water from the Euphrates capable of supporting themselves. Ancient historical evidence of the antique geography of the region survives only in monumental relics, presenting records of one of the first dominant nations of the world. Sumerian derivatives still make up a large number of well-known names of ruined cities in the southern part of the country.

According to classical writers, the Sumerian immigrants came to the plain from the mountains and plateaux situated to the east of the Delta of the Twin rivers.

There was also in the valley the Semitic element, represented by the Akkadian race, which occupied the upper part of the plain from 2750 to 2545 B.C.[1] This group, which dominated the whole country under the Babylonian monarchy, came from Arabia or rather, from the Amorite region of Syria and Palestine, according to the Delaports Research.

The Sumerian and the Akkadian waves were followed by various other waves of invaders in the successive ages, and all these, mixing together, formed the human unit of the Middle Euphrates 651 years before Christ. Of these waves, the Hithis came from Eastern Asia Minor in a bout 1800 B.C., the people of Elam came from Zagros and from the region beyond and the Semitis came from the west later than 2,500 B.C.

The physical characteristics of these various peoples divide them into two categories. The first includes the Sumerians, the Hithis and the people of Elam, all of whom came from the East and North East of the Babylonian plain. These were normally round-headed with heavily-built bodies. The second category contains the Semitic elements of the Akkadians and the Arabs who came from the Levant and Syria. These have long heads and thin bodies. The round-headed are known as the Alpine race, and the long-headed are known

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(1) L.Delaport, "Mesopotamia, the Babylonia and Assyria Civilization". 1925, p.18 and 354.

as the Mediterranean race. The two races have lost some of their distinctive physical characteristics, but the Mediterranean race, which seems to have lost less than the Alpines, is more clearly distinguished among the people of the area. The cause for the predominance of the Mediterranean physical characteristics could be ascribed to the fact that the Arabs, who belong to this race, were the last invaders of this area, and they were able to leave a most thorough and lasting stamp on the racial structure of the country.

Growth of modern population.

Study of the growth of population in the Middle Euphrates valley, as recorded by the census reports 1919-1957, is complicated by the boundaries of its administrative sub-divisions. The area includes both urban and rural districts, and is made up of the counties (liwas) of Diwaniya, Karbala, Hilla, southern Dulaim (Ramadi and Falluja gadhas)[1] and West Baghdad liwa (Mahmudiya gadha and Abu-Ghraib Nahiya).

In 1919, the first rough estimate was made by the British authorities of that time, when the population was recorded as being 677,500. The second, also roughly estimated, made by the Directorate-General of Census in 1935, gave the population as 830,587. These estimates do not give adequate results but, however, they suggest that the population had increased slightly. The inaccuracy of the estimates result mainly from the fact that the people sought to avoid registration and

(1) While "gadha" is literally translated as urban district it means a large district with a town administrative centre.

census. The main reason for this was their memory of the Ottoman period, when the government counted the population only for purposes of taxation and conscription. So officials tended to rely on estimates made by the local administrators or, in the case of the semi-settled Arab tribes, by the Sheiks themselves. A second cause of difficulty was ignorance, combined with certain social prejudice. For instance, there is a reluctance to travel with the women of the family. Moreover the great majority of rural people did not know their ages. A lack of understanding of the meaning of objective truth also existed on the part of both the enumerated and the enumerators, the result being distortions which are not systematic and therefore cannot be corrected.

The fully nomadic Bedouin posed such great problems for enumeration that they were excluded from the census. Their number was estimated by the Directorate General of Census at 96,545,[1] as was recorded in the General Guide of the General Census in 1957.

It is only when the people begin to realize the benefits in the form of schools, agricultural relief, and the start of irrigation schemes that the accumulation of statistics begins to be reliable. The data for the Middle Euphrates valley

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(1) "General Guide of the General Census" (Arabic), Directorate General of Census, Ministry of Social Affairs, Baghdad, 1957.

have been greatly influenced by these tendencies. The remarkable fluctuation in the estimates published between 1919-1935 in the record data may be noted, particularly the estimated census of the administrative counties which are grouped in the natural unit belonging to this region.

The best available pictures of the population structure of this district are the population censuses of 1947 and 1957.

In the population census of October 1957, the latest date for which figures are available, the total population was registered as 1,345,531. During this period of 38 years the district has changed slightly as to a mainly farming and rural life has been added some urbanized central marketing settlement.

Successive census reports give an indication of the general increase in the population of the district (table 9 and diagram 5). Diagram 5 shows the growth of population from 1919 to 1957.

Table 9 shows a considerable rise of the percentage rate of increase from 1935 to 1957. This rise in the percentage rate of increase from 1935, was a purely artificial result of the inaccurate estimate census mentioned before.

In 1957, it was found that the annual rate of increase had risen by 4.1% over the previous decade. This percentage rate of increase between 1947 and 1957 reflects a high increase of population compared with the previous decade. During this time new factories were established, such as the cement works at Musayib village, (photo. 12) and many employees were engaged in the great Musayib irrigation project also. This growth in population which took place over the past decade, was due partly to those firms, and partly to immigration as well as to the natural increasing tendency of population. This last factor has resulted from the development of social services, such as education, health and housing, and in the provision of food and other necessities of life.

This general historical review describes some economic, social and geographical factors. The economic improvement which is related to the establishment of new plants and works on the one hand and the development of the agricultural economy of the area on the other, has slightly raised the standard of living, especially in the cities and towns. The progress of social services, the establishment of hospitals in many of the countryside settlements, purification plants, the building up of educational institutions and schools, new healthy houses for dwellers in many places, and the construction of communication facilities, all these have resulted in a noticeable progress in the life conditions of people. The Middle Euphrates Valley has attracted a great number of countrymen from neighbouring areas towards the large cities and towns in order to get work. In addition to this, the valley provides a link between the two main great trade centres, Baghdad in the north and Basrah port in the south. These three factors, which are discussed above, seem to be closely related to the population trends shown by the percentage annual rates of increase. The percentage annual rate for the year 1935 was 1.41, whilst in 1957 was 4.1 (see table 9). The resultant picture is one of general development and growth of population. The following is a consideration in greater detail of the geographical and economic factors which have influenced this development.

Table 10 shows the estimate of the total number of population in each of the four administrative units (liwas) which compose the country under consideration between 1919 and 1935. In 1947, at the first national census, and at the last census in 1957, the same table illustrates the total number of people recorded in each gadha unit (urban districts) (see map 23). It is on this basis that figures for the total population of the Middle Euphrates Valley have been constructed. In 1919, the gadhas of the Valley gave an estimate of the number of people inhabiting them. The estimated records show that there were 150,000 in both Ramadi and Falluja gadhas, 173,000 in Hilla and Kabala gadhas, and 394,500 in Diwaniya gadhas. The Census of 1957 shows the major concentration of population in the districts to be in cities, towns, and in those villages which were located close to the river banks and irrigation canal-belt.

It can be observed as a whole, (table 10), that the rise in population of the various divisions continued up to 1957 as a result of the alteration of agricultural conditions under the National Government formed in 1921.

The increase in population of this region for the 23 years after 1935 depended on the successive development of the agricultural aspect. The current trends of population change in this period brought about the gradual growth of the recently irrigated areas, such as Ramadi, Falluja, Hilla, Musayib and Diwaniya gadhas until they became the main settlement areas of the region, together with the main cities and towns. This evolution also coincided with the success of medical progress which has raised the general level of health, strength, and energy far above its previous level in this area. There are many kinds of disease, of which malaria is the most widespread. The results of malaria control are seen not only in reduced mortality, but also in the greater and more efficient existence of the living. The enhanced reliability and output of labour increased both personally and nationally. Improved land utilization and reduced agricultural costs were out of all proportion to the smaller cost of controlling the disease. This marked feature in the population growth is apparent in the case of the main cities and towns, which are the market centres for the agricultural areas. As well as the areas which have already been described, there are scattered settlements in the districts of Jezireh and the Low Desert Plateaux. (see map 50).

The general impression gained from a study of the growth of population over the last 38 years is, that in this region, including both the rural and urban divisions of the valley, there has been a continuing increase of population from one decade to another. The natural increase in population, especially among the younger people, is exhibited in an increasing birth rate rather than in any lowering of the death rate. In addition to this, there were immigrations in the recent periods, generally from the rural areas which surround the Valley, towards the city-centres, such as Hilla and Diwaniya. But the most considerable immigration is that of the Persian pilgrims, who are yearly accustomed to visit the holy places in Karbala and Najaf. Some of those people stay and become absorbed into the ranks of the original inhabitants.

The Middle Euphrates Valley, has, at the present, too small a population density (63 per square km.) for it to be completely cultivated and for its potentialities of development to be exploited to the full. In comparison, the cultivable region of Syria has a population density of 75 per square kilometre while the Nile Delta of Egypt has about 668 per sq. km.

Age and sex structure (tables 11, 12).

The ratio between the sexes in this region is normal. In all census years, with the exception of 1919 and 1935, for which figures are not available, there were more females than males (see Table 11). This predominance of females noted in the censuses of 1947 and 1957 is to be expected, for two main reasons. Firstly, most farmers have more than one wife, and secondly, whereas many men leave the land to work in the towns, the women stay to work in the fields. Quite a number of the countrymen have two wives, and some of them three or four. Polygamy is disappearing in Iraq but is still common among those portions of the population which consider it a matter of prestige. In 1947, 8 per cent of married men were married polygamously, and of these 90 per cent had two wives, 8 per cent had three, and 2 per cent had four. If data on the marital status of the nomadic Bedouin were available, these percentages would undoubtedly be higher. Their influence is seen among the sedentary populations of the liwas of Karbala and Diwaniya which are bordered by the desert to the west.

In the 1947 census, the excess of females over males, amounted to 1187 women to every 1,000 men. In the census for 1957 the number of females amounted to 1152 to every 1,000 males. This slight decline is because some migrants left the area to go to the city of Baghdad which attracts the unemployed from the countryside of this region.

Table 12 shows the population of males and females subdivided into four main age groups, as in the census of 1947. The 1947 figures are the only ones available. In this year, each 1,000 of the population in the 0-19 years age group was made up of 458 males and 541.4 females. The slight excess of female births over male births is a natural feature. The number of people in the 20-39 age group was the highest of all the age groups. In this group the margin between males and females was largest also. This extraordinary feature is due to polygamy, because most women who have been married were registed in this age group. The third and fourth age group includes people between the ages of 40-59 and over 60 years respectively. In these there was a balance between the two sexes as a result of the natural trend of these groups.

Migration.

Two important factors, the territorial movement of population and the Persian pilgrims yearly who enter Karbala and Najaf cities resulted in the increase of population. But the emigration statistics are not available, except for 1956.

The net natural migration amounted to + 2,865 revealing that there was an increase during this period, as in the table below.

Mid-year population	Total change	Natural increase	Net natural increase
1,137,643	8,997	6,132	2,865

Distribution of population (maps 24, 25(a); Table 13).

The distribution of population within the Middle Euphrates district is a resultant of the interaction of all the geographical factors already discussed. The number of people in each separate sub-region depends primarily on the geographical factors of the vast flat plain, the potential fertility of the soil, the location of the agricultural areas in relation to the water resources of the river and canals and the suitability of climate for agricultural production. The agricultural economy, dependent on these factors, is an important criterion in the distribution of population. Table 13 shows the population density per square kilometre of cultivable land in both rural and urban districts in this region, from 1947-1957. Thus a survey of population distribution should be discussed with reference to two main factors, topographical influences and economic conditions.

From the point of view of settlement, the Middle Euphrates valley falls into these main divisions:- The Jezireh, some low-lying lands where the rural conditions are sparsely scattered and the districts which the river and its irrigation canals pass through. Of these both the rural and urban areas are the most characteristic. Table 13 illustrates the population density per sq. km. in the various gadhas units of the region whilst maps 24 and 25(a) reveal the distribution of population density. Map 25(a) which represents the population density in 1957 shows an increased density of population in all the units as compared with densities in 1947 which are shown on map 24.

In 1919 and 1935, gadhas units did not each show separate figures because they were included in their own liwas. In 1947 and 1957 the gadhas showed a considerable grouping of the country people. The Najaf, Shamiya, Abu Skhair, Karbala, Hilla gadhas supported a higher number of people than other gadhas. The proportion density of Najaf unit was 459.8 persons per sq. km. That of Shamiya was 348.0, Abu-Skhair 273.1, Karbala - 202.3, Hilla - 118.7 and those of Ifaq, Hindiya, Samawa, Hashimiya, Diwaniya, Musayib, Ramadi, Mahmudiya and Falluja were lower, between 20.3 (Ifaq) and 79.8 (Falluja). The higher population and its greater density in the Najaf, Shamiya, Abu-Skhair, Karbala, and Hilla was due to good agricultural conditions, the dominance of small holdings, (especially in the Najaf, Shamiya and Karbala areas), and to the long established interest of farmers in relatively intensive agriculture, particularly in the cultivation of orchards. The sparse distribution of population in Ifaq, Samawa and Hindiya is closely related to the eastward extension of the Jezireh Zone, especially that of Ifaq and Samawa, most of whose lands are under development or still undeveloped. In the case of Hindiya, the unit has been extremely affected by salinity in the soil, which resulted in the movement of rural people away to the neighbouring districts. The table mentioned above reveals the gradual increase in population density of these gadhas from the 1919 estimated census until that of 1957 (see map 25(a)).

The population of the valley can be divided into two major sections; firstly, the dense population of the cultivated land together with the urban regions which extend along the banks of the Euphrates, and secondly, the canal irrigated areas. Map 50 shows the variation in population density in 1957 within both sub-divisions, and in the development of settlement. The map also shows the relative importance of both rural and urban life, together with cultivated areas, in the distribution of the pattern of settlement. In the rural areas the settlements are sparsely distributed while the urban districts show a closer and more nucleated distribution. Thus the population is concentrated throughout the most fertile land with an adequate water supply. The concentration starts at Falluja in the north and extends to the south as far as Shinafiya, through the Falluja, Najaf, Karbala, Hilla, Abu-Skhair, Shamiya and Diwaniya gadhas units.

This distribution of population can also be seen in relation to the standard topographical map of the district. The numerical importance of the hamlets and villages has been shown on the population map. The data for this map has been obtained from the administrative units of the various sub-divisions of the Middle Euphrates district of the 1957 population census. This, supplemented by field enquiry, represents a fairly accurate picture of the location settlement in the district at the present time.

The topography of the area is a very important influence on the settlement. The majority of settlements are concentrated in the parts of the Levee Zone and in the areas alongside of the river banks. Away from these belts are the low desert plateaux with a few farms, the low-lying lands of the lower valley with a scattering of villages and hamlets and the largely uninhabited Interfluve of the Jezireh further east and south. All these areas tend to produce poor quality pastures, especially in spring. Although not always far distant from the main population concentration, from the human point of view they are isolated. The spread of farm settlement bears a close relationship to the distribution of cultivated land. There are broad expanses of settled farm-land in the middle reaches of the Valley and a scattering of farms on the east flat of the Jezireh, especially in Hashimiya, Diwaniya, Ifaq and Samawa gadhas.

The hamlets, villages and towns are situated on dry sites above the flood plain of the river in the Middle and Lower sections of the region. Some of them are located on dry sites of the Tertiary formation in the further north and west. The farms themselves seek sites accessible to some natural or artificial routeway, often near or along the flood plain of the river and its canals.

Population as a factor in development.

Population and land agricultural resources are the two important factors for development, which with the existing cultural techniques of a particular society, determine the amount of material supplies available for consumption and reproduction. Thus, the relation between the factors of population, land and state of technology constitutes the core of the "population problem". Upon the combination of these agents depends the resultant agricultural wealth or poverty of the area. The importance of the proportion of these factors to the social welfare of the people is witnessed by the definite limits set thereby on the production capacity of the region. They consequently determine the "per capita" level of income enjoyed by the people.

The man-land balance is the main determinant of the size of population. Accordingly, "man and land" are considered as "the ultimate elements offered for a scientific study of the evolution and life of human society[1]". When these are given "there arises at once the necessity of adjustment between them". "How much land there is to the number of men is the fundamental consideration in the life of any society.[1] Such a contention may largely be true in a predominantly agrarian economy where an unfavourable man-land balance may become a limiting factor in population growth and progress.

In this light, we find that the two factors of manpower and land area, in this region, are not in the most unfavourable proportion. The advantage of having so much land in relation to people in the area is to provide more scope for increased productivity. If the district, under consideration had insufficient land for her growing population with the existing area under cultivation, it would have to face a population

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(1) W.G. Summer and A.G. Keller; "The Science of Society" (New Haven: Yale University press 1927, vol. 1, p.4.)

pressure, similar to those prevalent in other peasant countries, such as Egypt and India. In these countries, the additional food supply required to support the new increased population has been secured from the original land, by cultivating it more intensively. In such a case the yield would most likely be subject to the Law of Diminishing Returns. Also although productivity per acre might be remarkably high, the output per individual is likely to be very low. It has been suggested, by some observers, that the marginal productivity of labour, in heavily populated agricultural countries might approach zero or even be negative. This would imply that, by removing people, farm output per capita, and possibly per acre could actually be increased. Situations like this would mean that people are working beyond the stage of diminishing returns, or in what may be called the stage of "absolutely diminishing returns," where both output per acre and output per man fall off.

In the Middle Euphrates valley, land has been so plentiful that diminishing returns to labour have scarcely made themselves felt. But there would appear to be diminishing returns to land. Instead of having too much labour and too little land available, the Middle Euphrates district shows quite the opposite picture, with too much land and too few workers. In fact, the density of population on the cultivatable lands of the region under consideration is 63 per square kilometre, compared with 668 in the Egyptian Delta area and even 75 in Syria. Thus the correct balance of the two factors - land and labour - is not found in the Middle Euphrates valley, under present social and technical conditions.

In the most densely peopled areas, land has been the fixed factor and labour the variable, but in this region land has never been fixed in this way, and in the past four decades the cultivable area has increased beyond even the requirements of the growing population. The total cropped area in the district was only 1,008,000[1] mesharas in 1939, and this rose to 2,213,910[2] mesharas in 1957. The total population in the region was about 830,587 in 1935[3] and about 1,345,531 in 1957[4]. Thus, during 18 years while population rose to about 1.6 times its 1939 figure, the cropped area increased to 2.2 times its 1939 figure. Land has been lavishly used, because there has been no benefit of an increased population. Output per head remained virtually unchanged until 1952 (when a sign of slight change appeared) and output per mesharas has seriously declined in considerable parts of the region. Many land-owners, through various means, held immense estates

(1) A. Sousa; "Iraq Irrigation Handbook" (Arabic), part 1,1945, p.20.

(2) Directorate General Settlement of land, Baghdad, 1957.

(3) A. Sousa; "Iraq Irrigation Handbook"(Arabic) part 2,1945 p.27.

(4) Directorate General of Census; "The final population census of October 1957".

stretching over large areas of the best fertile land, especially in the Hilla and Diwaniya liwas. They have attempted to farm all the land which they have owned, and large units of land were given to each share-cropper to cultivate. But the share-cropper has neither the tools nor the incentive nor the energy to farm the land fully or to maintain it. Thus, the result of excessive landlordism is the poor utilization of both land and human resources.

The conclusion may be drawn, that the farmers of the Middle Euphrates Valley have not benefitted much from the abundant fertile land at their disposal. In most cases, much harm has been done to the land by the expansion of extensive not intensive farming. More output could have come from wiser use of the existing land resources rather than through the extension of arable land. Extension of arable land has been brought about without a consequent increase in profit or improvement in the methods of cultivation. The result is that both productivity per man, and productivity per meshara declined. However, the decline in productivity per meshara has been more apparent. It has reached a remarkably low level - lower than the Delta of the Nile which has analagous natural conditions.

<u>Future population.</u>

The Middle Euphrates Valley is sparsely populated as shown in map 50. This district, with 1,345,531 inhabitants, is, under existing conditions, under-populated (see pp. 198-199) and suffers from lack of a labour force sufficient for its vast area. This problem of labour shortage is further aggravated by the exclusion of women from the labour force. The problem of economic development in the progress of this region will become more acute as development schemes are launched and as new land is reclaimed, opened for settlement and brought under cultivation.

When the general development progress is fully under way, the standard of living rising, then the district will attract labour. A considerable number of Arab refugees from Palestine have already made their way to work and settle in the area. An improvement in agricultural conditions, as a result of the economic development to be discussed later on, will attract more people to work in this area.

In addition, there are about a million Bedouin tribesmen in Iraq, mostly in the western desert on the border of the western Euphrates basin. They breed animals and graze large flocks of sheep and goats. It should be borne in mind that the nomadic people will be able to settle and become the key citizens in the community. A social worker with the right approach, can convince the leader of a tribe or the head of the patriachal family that certain steps must be taken. This is particularly true of those tribes wandering in the valley area. The total number in these tribes amounts to 96,545 persons.

The cultivated and cultivable land available in the country is more than enough both for homeless tribesmen and the people possessing land already, if techniques of resource use are improved.

In fact, the Government, in recent years, has seriously been considering putting such a scheme into operation. In 1951, it promulgated a law dealing with development of Miri Sirf Lands (State lands). By this legislation the Government subjected all State lands, which have been or will be developed or reclaimed, to a system of small holdings. These, then are to be distributed in the district to the peasants and tribesmen. This scheme has been started in the project areas of Musayib, Latifiya and Babil throughout the Jezireh zone.

This district is one of the most fortunate, because it possesses a unique combination of advantages. First, it possesses important unused resources, particularly in land and in the waters of the Euphrates. The Development Board envisages doubling the area under cultivation during the coming generation, combined with more intensive use of the present cropped land. The quantity of water will, however, eventually set a limit to the amount of land that can be cultivated. Secondly it has a population small in comparison with those resources. As economic and social development proceeds, thereby lowering death rates and accelerating natural increase, the increased numbers can be put to work both on agricultural land, newly brought under cultivation, and in newly created industries. Factors which have caused fertility to fall in the Western world, themselves casually related to economic development, will probably begin to operate in this region to bring the period of rapid natural increase to a close, although not for several generations at least. Thirdly, the State has a large source of foreign exchange in the form of oil revenues, with which this region, with others, may purchase the technical assistance necessary for economic development. If the resources of this district are properly developed, it will undoubtedly be able to support a growing population at a rising level of income.

The future level of population will depend on the trends of birth and death in the country. Details of the population growth, given in Table 9, show the population at the census of 1957 to be twice that at the first estimated census 38 years ago. The same Table also illustrates the rate of natural increase, for the estimated census of 1935 to be 1.41 per cent a year, whilst that of 1957 was 4.1 per cent. In the light of this, a growth of population to almost twice the present figure is forecast during the next 40 years. In view of this forecast, it seems reasonable to assume that, given peace, the already much reduced death-rates in the area will continue to fall until they ultimately reach Western levels. The rise in the natural increase rate will determine the future population growth in the Middle Euphrates Valley.

CHAPTER VI.

IRRIGATION

(maps 26-31; diagrams 6, 7; tables 15-17)

Factors in irrigation development.

Under the climatic conditions which exist and have existed in historical times in this region, inhabitants of the Middle Euphrates valley have been presented with clear cut choices between different ways of life. Nomadic or semi-nomadic pastoralism, and the utilisation of water other than direct precipitation for irrigation, these alone are possible.

Precipitation as noted in the climatic section is in fact absolutely inadequate for the support of natural vegetation except for ephemeral flora (pp.163-166) or cultivated plants. On the other hand the river bed by precipitation outside these regions (see pps.20, 171/4) is a source of water which can be used by man. The whole history of the Middle Euphrates region is one of human intervention by utilising this river water, and within certain limits imposed by natural and ecological factors producing an artificial landscape.

Those geographical factors which have influenced the way in which man has intervened in the landscape may be considered as follows:

As noted in the physiographical section, this region is generally level but the prevailing slopes are those which fall away from the river to the east and south, in the areas classified as forming the Interfluvial zone (pp. 77-85). Thus water can easily and cheaply be led off from the river to a wide belt of river bordering land (see map 28). In the northern part of the region, North of Hindiya, the fall of land away from the river is relatively steep (p. 78) so that water will naturally flow into and along diversion canals at all seasons. This, the simplest form of irrigation may be entitled the Flood Canal System.

Downstream of Hindiya, the situation changes. First, the gradients of the slopes away from the river decrease. Secondly, there is a general loss of water from the river because of percolation, evaporation and upstream diversion. This loss becomes particularly great during the summer. As a result, barrages must be built in order to permanently overcome the greater topographical difficulty by raising the water level in the river channel, and therefore producing a greater head at canal entrances. Seasonally, the use of barrages is essential to ensure supplies during summer, the period of greatest need and of lowest natural water level. This more complex form of irrigation work is usually termed the Perennial Canal System.

In the Middle Euphrates, the availability of water is the dominant factor in that there are no thermal bans to cultivation. A study of the agricultural geography of this region therefore becomes a study of the degree of intensity of farming, which in turn is controlled by details of irrigation practice and the character of the society concerned. The ecological response to varying methods and intensities of farming is of equal importance (pp.144&246/69). For example, in succeeding chapters emerges the point that the potential created by irrigation possibilities is much greater than the present use of land resources. The gap between actual and potential resource exploitation is largely due to human factors, some of which in turn result from dependence on irrigation (e.g. see Section on Land Tenure).

Without irrigation, sedentary life is impossible - the region would be desert. With irrigation, the need for capital, and for control of works by individuals or institutions imposes special strains on society. In contemporary Iraq the revenues from oil are now helping to make capital available for development in this region. A strong central government is necessary clearing and repair of canals, and later documents, written by his subject kings, name the cities to which water was brought.

Some canals are no longer in existence such as the Nahr-Al-Malik and the Nahr Kutha. Others such as the Isa and the Sarsor have been renamed, and some changes have been made in their courses, but in main alignment they date back to Babylonian time. These four ancient canals all lay North of Hindiya and may be combined to form a single group constructed to serve the flood canal system area.

Isa Canal. The earliest canal, flowing from the Euphrates, at the head of the present Saqlawiya canal, to the Tigris, just south of the location of Baghdad, was the Isa canal. The earliest known name, Nahr Isa, is derived from that of an Abbasid prince, the nephew of Mansur although the canal itself is much older. The whole canal was navigable until at least as late as 1838, but because of the wide inundations it caused in the district west of Baghdad, the head of the canal was closed about 1870 by Midhat pasha (see p. 92). It was breached again in 1917, but a new cut has been made to the south of its old head to irrigate what is now a large fertile region.

The Sarsor Canal, was situated to the south of the Isa canal along the present course of the Abu-Ghraib canal. The Nahr Sarsor flowed off towards the Tigris, which it entered 19 Km. above the ruined city of Madain (Selman Back). This canal irrigated the district which lay to the south-west of Baghdad. In Arab days, Ibn Serapion,(1) in the 10th century described how numerous water wheels were set up along its banks for irrigating the fields. The contemporary name was taken from that of the flourishing town of Sarsor lying 9 Km. from Karkh, the western resident area of Baghdad. The town of Sarsor continued to be a place of importance down to the close of the 14th century, when Timur took possession of Baghdad and garrisoned the surrounding district. Further to the south lay new abandoned canals.

Nahr-Al-Malik (Royal Canal) (photo. 15), was the third transverse canal in this group. Its inlet lay at the site at the ruin of Caesar Fredirick(2), 24 Km. below Madain. This canal dated from ancient times, and is mentioned by the Greeks as the Nahr-Al-Malik. On its banks was the town called Nahr-Al-Malik, with a bridge of boates, on the Kufa road, and lying 11 Km. south of Sarsor. According to Ibn Hawkal, it was famous for its corn-lands and palm-groves.

Nahr Kutha. was the fourth transverse canal, its point of origin on the Euphrates being 24 Km. below that of the Nahr-Al-

(1) G. Le Strange; "The Lands of the Eastern Caliphate", Cambridge 1933, p.67.
(2) (Ibid) p.68.

Malik, and its outflow 48 km. below Madain. The Kutha canal may be regarded as occupying the earliest known course of the Euphrates as noted earlier (see pp.87-89). It watered the district of Kutha, which was also known as the Asdashir Babgan[1] district (after the first Sassanian king). The city of Kutha Rabba[2] stood on the banks of the main channel and was one of the important towns of the neighbourhood of Babylon.

According to Moslem tradition, Kutha, the present hill of Ibraham, was the place where Ibraham was thrown into the fire by the tyrant Nimrod, and the town took its name from Kutha, the grandfather of Ibraham.

In addition to these canal works the Babylonian engineers seem to have used the Habbaniya lake, the Abu-Dibis, and Aqarquf depressions, as reservoirs.

As an example of later construction, one may consider the Nahr Sura. This was a very important irrigation canal constructed in the 10th century, involving flow diversion at a point some 29 Km. below the place where the Kutha canal was led off. This channel was considered by Ibn Serapion[3] and other Arab geographers as the main irrigation canal in the Middle Euphrates valley. The upper course of this canal coincides with the upper part of the present Hilla course. Sura channel was divided at

(1) G. Le Strange; "The Land of the Eastern Caliphate" Cambridge, 1933, p. 68.
(2) (Ibid) p. 68.
(3) (Ibid) p. 70.

a place adjacent to Babylon, into two branches, the eastern called the Shatt-al-Nil, and the southern named the lower Sura canal. Both of them finally poured their waters into the swamps of the lower region.

In the light of a study of historical developments, it seems to the author that the irrigation system of the region under consideration reached its highest point of development under the Sassanids (third, fourth, fifth and sixth centuries. A.D.)(1). Most of the great canal-beds which still exist in various stages of disrepair seem to have been either wholly, or for the larger part, the work of the Sassanian Government. Under the Arab Caliphate, systematic irrigation was at first fairly well maintained, but with the weakening of the central Government it fell gradually into decay, and was finally wrecked in the havoc caused by the Mongol invasions of the 13th century.

The absence of barrages on the Euphrates above its bifurcation must have made it very difficult to keep up perennial irrigation and thus the region was very vulnerable to the effects of breakdown of control. But this district was incidentally protected against inundation from the Tigris by the embankment of canals drawing their water from the Euphrates. For instance, in the case of the Nahr-Al-Malik, the high banks

(1) "Handbook of Mesopotamia", vol. 1, second edition, 1918, p. 156.

of which are still to be traced for long distances between the neighbourhood of Ctesiphone (Selman Back) and Kut city along the right bank of the Tigris have always provided some such protection.

Before the Arab conquest, and after the Sumerians had begun to build up their civilization in this plain, much of the region was brought under cultivation by dyking, drainage, construction of canals, and irrigation. The Great Swamp (Al-Batiah), as it existed in the period of the Calphate, was formed at about the time of the Moslim invasion, as a result of violent diversion of the Tigris river through the present Shatt-Al-Hai beside the south-east boundary of the Middle Euphrates district (see pp.72-74).

After the Mongol invasion, in the middle of the thirteenth century, the irrigation system collapsed. Dykes and dams could not be maintained at adequate strength, and the waters of the river passed more and more out of human control, spilling where they should not have spilt, and leaving the channels on which cultivation depended dry. The great canals silted up and could not be properly cleared, or were broken by floods, or by diversions of the river into new beds as described already in "the evolution of the Euphrates" (pp. 86-89). No government arose that was capable of devising or making a practicable systematic plan of irrigation.

At the present time, some of these maintained under the Caliphate canals carry a certain amount of water, though not nearly so much, nor generally for so great a distance, as they did a thousand years ago. Some are high dry channels enclosed for long stretches between lofty earthen banks; and some have been almost obliterated.

Between 1870 and 1914, the Turkish Government, though it was still a long way from introducing systematic irrigation, attempted to introduce the services of foreign engineers to check the process by which the Hilla branch of the Euphrates was being dried up. This process seems to have been started by the damming of the Saqlawiya canal-head for the protection of the Western Baghdad district, (p. 92). (a) The Hindiya barrage and Hilla Regulator, were planned to adjust the distribution of Euphrates water between the Hindiya and Hilla branches (see p. 93). (b) The conversion of the Habbaniya basin into a reservoir for the storage of Euphrates water had been taken in hand. The escape-canal from Ramadi had been cut, but the outlet through which stored water was to return to the river had not been made when the First World War began. (c) Regulators had been placed at the heads of a few of the large canals leading off from the Euphrates, e.g., the Abu-Ghraib and the Yusifiya canals. In the other areas of the region, irrigation for rice was carried on by the primitive means of water-lifts or oil motor pumps on the river banks, canals and earthen dams.

<u>Present Systems of Water control</u> (maps 26 & 30)

The modern system of irrigation in the Middle Euphrates valley was started 45 years ago when the construction of the Hindiya barrage was completed in 1913. This construction marked the recognition of the differences in character between the zone north of Hindiya from that of the southern districts as noted on pp.77-85 . At the same time new co-ordinated scientifically based policies began to emerge. The progress of irrigation projects continued under the British mandate in 1917. A programme for the collection of basic data was initiated and more determined efforts were made to encourage this scheme. Hence, the first Directorate General of Irrigation was established to co-ordinate this work.

Between 1917 and 1921 (1), the first three ancient canals of Isa, Sarsor and Malik were reconstructed under modern methods as the Saqlawiya, Abu-Ghraib and Yusifiya canals respectively. In addition these canals which pre-dated the building of the Hindiya barrage but which were so located as to serve as potential distributors from the upstream barrage zone were inspected and some incorporated into the whole

(1) "The Development of Irrigation in Iraq" (Arabic report), Iraqi Engineering Society, 1955, by Faud Al-Khauly.

new Hindiya system. Thus to the Hilla group in the east side of the river became added the Kifl, Beni-Hassan and Hussaniya canals and the Euphrates itself becomes termed the Hindiya branch of a newly controlled water distribution system. This scheme was being carried out on a large scale, when the National Government undertook the responsibility in 1921. Between 1921 - 1948 there were some further noteworthy projects. In the Hilla system the Hurriya canal took water from above the new Dagharra barrage (photo. 16a), and a network of branches was built at the termination of the main Hilla canal (Rumaitha). In the Hindiya (Old Euphrates) system the Meshkhab regulator was built, (photo. 16b) bifurcating from the Kufa branch south of Abu-Skhair.

Up to the end of the 19th century we may say that the main (but not the sole) emphasis was placed on the devising of distributary systems largely based on flood canal methods. In the first decades of the 20th century more attention begins to be paid to the overall problems of water control (see pp. 227-230), but not until after 1950 is effort devoted to construction works to deal with floods, water storage and perennial irrigation of the southern zone, south of Hindiya.

In 1952, a Development Board was established to undertake the further development of schemes for the continuation of the control of the Euphrates and utilization of its water.

The development plan covered the following subjects and it will be convenient to deal with each in turn:-

1. Flood control and storage.
2. Irrigation.
3. Drainage (which has already been discussed) (see pps. 140 et seq.).

1. Flood Control and storage:

The Euphrates has a mean discharge of 837[1] cumecs, and a maximum record discharge of 5,200[2] cumecs. For flood control, it is desirable and practicable to limit its discharge to a maximum of 1500 cumecs. The natural flow of the river is adequate for a supply of 280[3] cumecs for irrigation. Of these it is estimated 228 cumecs are used by the existing shitwi developments, which serve, rather inadequately, about 4,700,000 mesharas gross. By means of storage it is practicable to increase the usage to about 510 cumecs, sufficient both to irrigate a further 4,000,000[4] mesharas for gross areas, and to improve the supplies of the existing areas.

The Habbaniya and Abu Dibis reservoirs, (map 31 and photo. 17) are the best projects of storage and irrigation and deal with

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(1, 2, 3, 4) F.F. Haigh; "Irrigation Development Commission", Report on the Control of the Rivers of Iraq and the Utilization of their Waters, 1951, pp. 8-9 the problem of floods, as well as being used for irrigation purposes. Habbaniya, as mentioned earlier (p. 94) lies slightly to the south of Ramadi, close to the right bank of the Euphrates. It is a large depression 25 kilometres long and 12 kilometres wide, and is enclosed within small hills, except to the north, where the low land extends to the river. To the south of the lake, but separated by high grounds, is the Abu Dibis depression, which is about 30 metres below the average flood level at Ramadi, and extends over an area of about 150 square kilometres. At its higher storage level, the retaining capacity of the lake reaches as much as 10,000[1] million cubic metres.

In 1911, Sir William Willcocks recommended the utilization of the two lakes for flood relief, and work began in 1913 to construct an inlet channel to Lake Habbaniya from the Euphrates. This was interruped by the outbreak of the First World War. The scheme was revised later to include an outlet channel and a regulator from the lake to the river, but again the work had to be stopped during the Second World War.

The Development Board, aware of the soundness of this scheme undertook to complete the project with little modification. The capacity of the lake was to be increased from one milliard to two milliards[2] cubic metres by raising the water

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(1) "Report of the Iraqi Delegation to the 8th Session of the F.A.O. Conference", Rome Nov. 1955. Ministry of Agriculture Baghdad, p. 30.

(2) One milliard = 1×10^9

level of the lake from 49.5 metres to 51 metres. A barrage, across the Euphrates, down-stream of the inlet channel, was constructed in 1956 as a complement to this work (photo. 18). The barrage passes part of the flood water down to the lake through the Warrer canal, completed in 1953 (photo. 19). The canal connecting the lake to the river, is 8.5 kilometres long, and is under construction with a regulator of 24 openings, each six metres wide, allowing a discharge of 2,000 cumecs per second.

The Dhiban outlet channel (photo. 20), 9.5 kilometres long, which connects the lake with the river, allows a discharge of 200 cumecs back into the river for Saifi cultivation when needed, especially during summer time.

The Mujara canal (photo. 21), leads from the new Habbaniya lake to the second depression, Abu Dibis. This project is also designed for flood-control and to enable stored water to augment the supply in the Euphrates for irrigation during the late summer, when the river is low (see map 31).

The Habbaniya reservoir, from the control and usage point of view, will have a final storage capacity of 3.5(1) milliards gross of 2.7 live. It will restrict the Euphrates flow to 2,000(2) cumecs and will raise the dry season mean supply to 440 cumecs; sufficient for the

(1) F.F. Haigh; "Report on the control of the rivers of Iraq and the utilization of their waters". 1951.

(2) (Ibid) p. 9.

extension of irrigation to 2,800,000[1] mesharas gross, and for the improvement of supplies to existing areas.

Additional flood control and storage on the Euphrates can be provided by the use of the Abu-Dibis and Haur Al-Milih depressions (photo. 22). This reservoir area will have a very large capacity, about 21 milliards gross or 14.5 lives. It will be used for perennial, or over-year-storage and in this way the flow control may be further restricted to 1500 cumecs; and the mean supply may be raised to 510 cumecs, sufficient for irrigation extensions, to an additional 1,200,000 mesharas, making 4,000,000 mesharas in all.

When the flow has been restricted to 1500 cumecs (of which 510 will be used for irrigation), the river below Kifl will be able to carry the balance of the water without difficulty until it discharges into the Hammar Lake, south of Samawa.

2. <u>Irrigation</u>.

The irrigation methods used in the Middle Euphrates valley nowadays vary from one part to another, according to the topography, soil, the amount of water supply, and the type of crop. Taking into consideration the fundamental factors, the means of irrigation should be classified as follows:-

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(1) International Bank; "The Economic Development of Iraq". 1952, p. 186.

(a) Flow irrigation.

(b) Lift irrigation.

(c) Flooding irrigation.

(a) Flow irrigation (maps 26, 27).

Generally speaking, there need be little actual control of the flow of the river and canals in order to provide effective gravity irrigation, and to take full advantage of topography conditions in order to obtain a maximum extent of gravity irrigation. Where areas are irrigated by gravity, primitive flooding is generally practised rather than modern methods employing borders, checks, basins or furrows. The present flow irrigation depends on the projects of the Habbaniya reservoir, Ramadi barrage and Hindiya barrage which have already been discussed. Irrigation at this stage deals with the system of net canals which are bifurcated either from the Euphrates itself or from its branches throughout the region, from further north to the south. Accordingly, it is possible to divide these canals into two main groups; upper Hindiya barrage group and lower Hindiya barrage group.

1. Upper Hindiya group.

The canal diversions lying upstream of the Hindiya barrage effect may be grouped into three divisions : from north to south, (1) Saqlawiya , Abu-Ghraib, Yusifiya, and Latifiya canals; (2) Those further downstream are three in number, and all issue from the left bank. They are called the Iskanderiya, Musayib and Nasiriya canals; (3) Those which deport immediately upstream from the Barrage are four in number, the Hilla branch and Kifl canal (on the left bank), and the Beni-Hassan and Husseiniya canals (on the right bank).

The first group which consists of four canals, branches off from the left bank of the Euphrates. They run on roughly parallel courses between the Euphrates and the Tigris-Euphrates natural outfall drain. The four canals, serve an area of about 500,000[1] mesharas at the present time. They are not affected by the water level upstream of the Barrage because of the vast distance which separates them from the influence of the high water level before the Hindiya barrage. These are inundation canals because their connection with the river in this region is not controlled artificially. Therefore all the water can usually be admitted in winter, but in summer the Euphrates is too low here, and the number of mesharas on which summer crops can be grown is restricted, despite the use of diesel-pumps.

Saqlawiya canal (photo. 23) branches off from the left bank of the Euphrates at a point 149 kilometres north of the Hindiya barrage. This canal runs eastwards for 27.5 kilometres as far as the Aqarquf depression. It is bifurcated at its

(1) "Session of the F.A.O. Conference", Rome Nov. 1955, report of the Iraqi Delegation.

mid-point into two branches, each of which has a regulator to distribute the water supply in the small canals for irrigation purposes. In the limit of this canal district, the gross area under cultivation used to be 254,000 mesharas. This figure has gradually decreased until nowadays it amounts to only 167,000 mesharas as a result of the accumulation of salinity, already discussed (pp. 144). It has a mean discharge of 9 cubic metres per second.

Abu-Ghraib (photo. 24). This canal takes water from the Euphrates at a point 126 kilometres north of the Hindiya barrage. It irrigates the area lying to the south of the Saqlawiya district and the south edge of the Haswa low desert plateau on the north border, restricted on the south by the Yusifiya canal. This canal through a regulator and eight subsidiary canals serves 280,000 mesharas by means of flow irrigation.

This district as a whole has been extremely affected by salinity as a result of over-irrigation and lack of drainage facilities. It was stated by Sousa in the "Irrigation of Iraq" handbook that 19.8 per cent of the land in this area is unsuited for cultivation. The regulator of the canal has a mean discharge of 10 cubic metres per second.

Yusifiya canal (photo. 25) is the third branch which leaves the Euphrates, at a point 49 kilometres south of Abu-Ghraib on canal. It supplies the district which lies between Abu-Ghraib on the north and Latifiya on the south. The gross area under cultivation irrigated by 23 small canals amounts to 278,000 mesharas within the district defined by the Euphrates to the west, and by the Tigris-Euphrates outfall to the east. It has a mean discharge of 14.4 cubic metres per second. Latifiya canal (photo. 26) leads off from the Euphrates at a point 51 kilometres north of Hindiya and is thus on the margin of the water-level control by that barrage. The land which is supplied by this canal and its subsidiaries lies between the Dahr al-Megass low desert plateau to the north-west, and the Great Musayib project to the south-east. The total cultivated area of this district covers 122,000 mesharas. It has a mean discharge of 8-10 cubic metres per second.

The project land is relatively flat and level except for a few hills here and there about four or five metres high. This land has already been adversely affected by pre-existing irrigation systems, in that it has been salted up because of the rise in the water table, a result of long continued seepage

The greater part of the district is Miri Sirf land. In June 1952, a surveying party was sent to the area to make necessary preparations for new settlement. The project was divided into sections and these were sub-divided further into rectangular farm units, each being 50 mesharas in area.

Since 1952, and up to and including the present day, applications for farm units on the Latifiya project are approved by the Government Committee. The selected tenants are settled on the 50 mesharas farm units. About 40%[1] of the selected settlers are retired civilian and military officials, and graduates from religious schools, the first being chosen from a number of tribes living close to the project area at the present time (photo. 27). It will be possible to expand this scheme in the near future, in accordance with existing land and water resources.

The second group consists of those branches whose mean discharge is affected by the controlled water level of the river upstream of the Hindiya barrage. There are three branches, all issuing from the left bank of the Euphrates, as follows:-

Iskandariya canal. This canal which takes off water at a point 36 kilometres upstream from the Barrage is clearly under the Barrage control. This canal, constructed in 1928 and 1930, takes water southwards for 26 kilometres throughout the district. It has a mean discharge rate of 2.5 cubic metres per second, and serves a total area of 30,000 mesharas, most of which is irrigated by means of the flow system.

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(1) Hassan M.Ali; "Miri-Sirf Land Development Committee", Baghdad, 1955.

Musayib canal (photo. 28, 29) is the largest canal in this group system. It runs eastward for fifteen kilometres. The present project covers a gross area of 60,000 mesharas, most of it under the flow system. It has a mean discharge rate of three cubic metres per second. The district lies to the north-west between the Hilla canal on the south-west, and the Tigris-Euphrates outfall. In general, the topography is smooth. In the western and southern portions, however, large salt and silt drift are present.

Here a reconnaissance land classification survey is being conducted by the Miri-Sirf Land Development Technical Committee to locate the area suitable for irrigation, and to designate which areas are suitable for irrigation under a specific plan for development.

The work in this district started in 1952, and is still in progress.

Nasiriya canal also depending for its mean discharge on water level control by the Barrage, branches off from a point 9 kilometres north of the Barrage, and runs parallel to the Musayib canal. It serves an area of 27,000 mesharas, and has a mean discharge rate of three cubic metres per second.

Third group:

Before dealing with the system of this group, it is necessary to understand the position of the Hindiya barrage in relation to these canals.

As noted on pp. 85 et seq. and in the physiographical section, at Hindiya where the ancient bifurcation of the river into the Hilla and Hindiya branches occurs, there is a crucial change in waterflow and regional topography. At this point downstream where flood-canals of a simple gravity type no longer suffice was built the Hindiya barrage. (photo. 30). This barrage made it possible to the depth of water upstream of the barrage to 6.25 metres. The Hilla and Kifl canals, from the left bank of the Euphrates, and the Hussiainiya, and Beni Hassan canals from the right bank, depend immediately upon the barrage for their command level.

The Hilla canal system: (map 30 and photo. 31). The existing Hilla canal system, which is now served by an intake just upstream of the Hindiya barrage is the largest system in Iraq to be served by a single intake. At the present time 2,255,400 mesharas of land are irrigated by water entering through the Hilla intake, and eventually the area to be served by this intake will be 3,760,000 mesharas. Because of this great reliance on a single intake it is estimated that unless means are provided to exclude sediment, about 42,000,000[1] cubic metres of silt and sand will pass through the intake each year and will be deposited in the canal system or on the land. For this reason

(1) "Report on the Develop. of Tigris and Euphrates Rivers Systems, Knap.-Tip-Abb. Mec. Engineers" 1955.

a special structure will have to be built at the Hilla intake to get rid of this accumulation of sedimentation.

It is possible to divide the Hilla canal zone into two main divisions the first of which is the upper part, extending for 104 kilometres from the canal head, as far as the Dagharra barrage in the south. The second division is divided at Dagharra barrage into three chief branches, Diwaniya, Dagharra and Hurriya.

The Hilla canal system as a whole, from source to finish, irrigates 2,222,000 mesharas by means of the flow system while 33,400 (1) mesharas of orchards are supplied by means of lift irrigation. At the first division of the Hilla canal, there are 37 small canals branching off from both sides of the main canal, 13 of which are situated on the right bank and serve 900,700 mesharas, while 24 are on the left bank and irrigate about 1,801,300 mesharas (see map 30). These have an average mean discharge of 146 cubic metres per second.

Diwaniya canal. The gross area of 130,000 mesharas which lies above the upper reaches of the canal depends entirely on lift-pumping for irrigation. The rest of the project, which covers an area of 532,000 mesharas, is irrigated by means of the flow system from the main canal and its subordinate branches.

(1) Statistics from the Department of the Hilla Irrigation Division, 1967.

Dagharra canal (photo. 16a) branches from the left side of the Dagharra barrage and is controlled by two regulators. The total area served by the canal amounts to 371,000 mesharas, of which only 35,000 mesharas are under the lift pumping system. Hurriya canal branches off from the left side of the Dagharra barrage, just north of the Dagharra canal. It irrigates a total area of 171,000 mesharas lying along both sides of the canal. In 1942, it operated to irrigate an area 25 kilometres long. It has a mean discharge of 9 cubic metres per second.

Kifl canal (photo. 32). This canal takes water off from the left bank of the Hindiya at a point 120 metres south of Hilla intake. It was reconstructed in 1917, and has been improved gradually until now it is suitable for irrigation purposes. It flows southwards for 69 kilometres parallel to the left bank of the Euphrates behind the Barrage. It serves a total area of 144,000 mesharas, of which 17,000 mesharas are orchards. It has a large proportion of saline land estimated at 40 per cent of the total project area. Accordingly, the Haig Commission prepared a drainage scheme (see map 22) to cover the whole district. The southern areas are in a worse condition than those on the upper part, the Shitwi and Saifi cultivation being

9% and 15% respectively, the rest of the district being mostly rice.

This district depends mainly on flow irrigation, with the exception of a few water-wheels and chareds [1] and levers for the irrigation of high-lying lands (photo. 37). It has a mean discharge rate of 4-7 cubic metres per second.

Beni-Hassan canal (photo. 33). This canal is the third of those which depend immediately on the Hindiya barrage for their discharge. It bifurcates from the right bank of the Euphrates at a point 800 metres north of the Barrage. It was constructed at the same time as the Barrage itself. At the later stages, the canal has been modified to deal with the necessity of irrigation. It serves a total area of 162,000 mesharas, 30,000 mesharas of which are date-trees mixed with other types of orchards. The project area is restricted to the west by the desert, and to the east by the Euphrates. The proportion of saline land in this district is less than that in the Kifl project as a result of the existence of a natural drain called Fishaika. It has a mean discharge rate of 4 cubic metres per second.

Husseiniya canal (photo. 34) is the fourth of the third group of systems which starts at a point 3.5 kilometres north of the head of the Beni-Hassan canal. The origin of this canal dated

(1) Another primitive means of lift irrigation.

from 1534 in Ottoman times. But it has been reconstructed to correspond to the necessity of modern irrigation. The water makes its way south-westward for 32 kilometres until passing through Karbala city it reaches the end of the western margin of the plain. Through subordinate canals it serves an area of 141,000 mesharas of which 33,500 mesharas are orchards. It has a mean discharge rate of 3-4 cubic metres per second.

II. Lower Hindiya Group System.

This is the area in which the perennial canal system, as opposed to flow irrigation, is being developed. This group consists of the land which lies along the Euphrates and its branches, from the Barrage as far as the termination of the region at Kidhr village. The only division of these tracts which has a flow irrigation system is the area of the Hindiya Branch, while the other districts are irrigated either by means of lift pumping or by means of flooding, as will be discussed later on. The Hindiya Branch district includes the area which extends southwards 70 kilometres between the barrage and the north border of the Shamiya district, along both sides of the Hindiya Branch. It is irrigated by both the Kifl and Beni-Hassan canals as has been mentioned above.

(b) Lift Irrigation: (map 27, Diagram 6).

A very distinctive feature of the Middle Euphrates valley is its extensive system of lift irrigation, which has largely developed in the last twenty-eight years. Table 16 shows the increase of installed pumps in the following decades. At the end of the year 1929 the number of established pumps was 400. In 1940, the figure reached 654 pumps, whose total horse-power was 20,660. In 1950, the figure rose gradually to about twice the previous number, and the horse-power climbed up to 37,650. At the end of 1957, the number had increased to 1,864, and the total horse-power was 52,176.

Riverine lands, of a width varying up to about 20 kilometres are irrigated by water lifted from the Euphrates by oil-powered pumps. The pumps are privately owned, but the installations are controlled by a licensing system. Lift irrigation consists of lifting the water by means of pumps, water-wheels, chareds and levers, (photos. 35,36,37), but pumping is the main means used. The areas served by pumps in the region under consideration may be divided into three main districts as follows:-

(a) The upstream Hindiya barrage and its irrigation canals is the chief pumping district, as is shown on map 27. Lift irrigation here extends along both banks of the Euphrates throughout the plain of the upper region, especially over the higher reaches. It is also to be found on the banks of the main canals where they pass through high ground between the north border of the region and the Hindiya barrage. The following table shows that the number of installed pumps in 1957 amounted to 720 with a horse-power of 19,528, while the total cultivated area irrigated by them covered 425,000 mesharas.

Distribution of pumps in the three main districts of pump irrigation.

District	No. of pumps.	Horse power.	Gross area per meshara.
Upper Hindiya barrage	720	19538	425,000
Shinafiya-Samawa	108	3748	150,384
Diwaniya Canal	161	6695	173,920
Other various pumping areas	875	22975	309,513

Source: Directorate General of Irrigation, Statistical Division Baghdad, 1957.

(b) The second remarkable district which enjoys the pumping system is the lower Euphrates. This tract, 150 kilometres long lies between Shinafiya village and the terminus border at Khidhr village.

The concentration of pumps in this area is for two main reasons; firstly, there are no irrigation canals, as in the case of the upper parts of the Euphrates; secondly, most of the land is comparatively high, particularly the level tracts on both sides of the river, so it can only be irrigated by this method. The number of installations in 1957 was 108, with a horse-power of 3,748. This number of pumps serves a gross area of 150,384 mesharas, as is shown in the table above.

(c) Diwaniya canal, including the whole Diwaniya gadha, constitutes the third pumping area. Large divisions of it are irrigated by means of pumps as a result of an inadequate system of flow irrigation, and because some areas of the district be high above the river, especially in the upstream portion of the district. The pumps, which serve a total area of 173920 mesharas, number 161 with a horse-power of 6695.

(c) Flooding irrigation (maps 26,27; Diagram 6).

In the lower Middle Euphrates valley, the Shamiya-Abu Skhair-Shinafiya, and the depression of Bahr Najaf are the main rice areas. These tracts are situated within the limits of the marsh zone already discussed. This rice district is delimited by the Kifl and Beni-Hassan projects to the north, the Shinafiya-Samawa pump zone to the south, by desert to the west, and by the Diwaniya pump district to the east. Rice cultivation is increasing in area under the present flood irrigation system, because of the results of the natural progress of silting up, and because its general suitability on this low-lying land.

In this irrigation system are included the marsh areas of the region, where rice, (the only main cereal crop irrigated), is cultivated on lands which are flooded in spring by the River and its branches (see map 21).

The crop areas vary greatly from year to year, according to flood conditions and summer water supplies, and shift about as the channel changes. However, it can be concluded that on an average 173,000 mesharas are irrigated annually.

On the upper reaches of the Shamiya, a considerable number of pumps have been installed on the Channel itself and on its branches, to lift water and irrigate the rice fields and the orchards. But in the lower reaches of the Shamiya district, the irrigation system differs from that of the upper part as a result of a change in the landscape. Because it is a lower lying district, most of the area is covered by swamps connected by a network system of canals, as far as the confluence of this Channel with the Mishkhab stream. The irrigation here is performed by this network of canals, taking water from the main stream towards the rice fields which lie on the higher silt areas surrounding the marshes. The water then pump lifted out of the channels. At the head of these canals which connect the lowlying swamp "reservoirs" and the river are earthen dykes reinforced with timber, which have been constructed to temporar-ily raise the water level in the channel streams.

In the case of Mishkhab (lower Kufa stream, further down from Abu-Skhair) and Bahr Najaf areas, many small canals branch from the left side of the stream (map 4). The irrigation practised here is the same as that in the Shamiya district. Throughout this district there are considerable areas of orchards irrigated by means of water-wheels and chareds, as well as by pumps. (photos. 38,39). The largest branching canal, which takes water from the Kufa channel south of Abu-Skhair and parallel to the Mishkhab branch, is the Chihat canal. This has several subordinate canals which irrigate low-lying lands, especially the rice-fields of the Najaf depression. It has no means of regulating irrigation, so that its water pours into the neighbouring swamps through many channels and nuggars.

<u>Future developments and policies:</u> (maps 28,29; Diagram 7).

Established works and work in land have been devised for holding the situation. Although, as already pointed out (pp. 215 – 217) much of existing cultivated land is not used to full capacity, the need arises for making plans to allow for the settlement of cultivators who are landless, some groups of semi nomads and for the possible loss of land due to salinity. Therefore at present great emphasis is being placed on the creation of policies which will deal with all cultivable land i.e. potentially irrigated land as well as the improvement of existing methods.

The experts of the "Development Board" have selected certain areas which are suitable, topographically and hydrologically, for extension, and where there was reasonable evidence that soil was or could be made suitable for cultivation. Accordingly the work started naturally with general surveys similar to those which have been made by Irrigation Department and Development Board since 1951. These provide the basis for decisions as to where the great water structures can be built.

The technical surveys also, of course, decide what natural potentialities the land possesses for fruitful cultivation, aided by irrigation and drainage. As a result of this survey, the Board made plans for developing the land for future cultivation and for supporting more settlers. Under this scheme the actual irrigation projects are planned to meet the needs for water supplies necessary for agricultural development. The irrigation constructions are as follows:-

(a) The Habbaniya -Abu- Dibis reservoirs, Ramadi Barrage, Drainage Outfall Scheme and the present irrigation canals system (see maps 22, 31).

(b) The Main Irrigation Channels, Barrages, Regulators and project areas (see maps 28, 29).

The already established works of the first of these have been discussed above and extensions and alterations are planned. The second scheme is an integrated proposal for future gradual development and progress and will be discussed in this chapter.

This plan, designed to remedy the lack of water supplied to the new areas, is very important and, it should be stressed, the improvement of the agricultural economy of the region depends on projects such as this. Diagram 6 shows that 27% of the irrigated lands are supplied with water throughout some sort of pumping-lift system. The other areas which are irrigated by flowing and flooding systems consist of 66% and 7% of the irrigated lands respectively. It seems that there are several factors which lead to the present excessive use of pumping (see pp.275-276); (1) the desire to use good bank-land, adjacent to the main stream and where drainage is adequate; (2) The independent action of large land-owners, prior to any concerted effort by the State; (3) The supposition that less water would be used if it were necessary to pay for pumping; (4) The enormous silt problem faced in flow and flood irrigation when the river waters are ponded and allowed to deposit their silt loads.

The table below shows the present total area irrigated by means of pumps in relation to the flow system of cultivated lands.

Pumping from streams (river and canals	1,058,827
Gravity irrigation from the river	2,848,557

Source: Directorate-General of Irrigation Department, 1957.

The total cultivable, and potential extension areas in this region at present irrigated under "the fallow" system are as follows:

Total cultivable land (in mesharas)	Present irrigated land (in mesharas)	Potential extension land (in mesharas)
7,952,089	3,907,384	4,044,705

Source: Directorate General of Irrigation Department, 1957.

The present total area of good arable, irrigation land in this region amounts to 7,952,089 mesharas of which 3,907,384 mesharas are cultivated on a practical basis at present, as is shown in the table above. It is within the large remaining area of 4,044,705 mesharas that the Development Board intends to concentrate the efforts for future schemes of settling large numbers from amount the great bulk of the population that now have no land. Figure 7 also shows these categories of land utilization in the Middle Euphrates Valley. The first, which occupies 42.5% of the valley, is cultivated land while the second and the third, which cover 44% and 13.5% respectively, are potential and waste lands. Accordingly, it is realized that an enormous task still remains for the 62.5% of the Valley area (3,907,384 mesharas) now irrigated, considering that the proportion of these lands can be increased many times through the provision of artificial drainage, improved farming and irrigation practices, flood control, and additional water-control structures.

Some agricultural practices are neither based on intensive use of irrigation methods nor conducive to the maximum use of the land. The so-called "fallow" system is followed, whereby the land is allowed to "rest" in alternate years. The theory is that during the rest period the productivity of the land will be restored. That this theory has not worked well is demonstrated by the low crop yields in comparison with those obtained in other countries where modern improved practices have been followed, such as crop-rotation, drainage, and proper methods of applying the water to the land. The "fallow" system is one of the reasons why it is impossible for a family to retain the use of a particular parcel of land from year to year, with the result that little interest in the improvement of the land can be maintained.

As for the lands now irrigated, over a fourth are supplied with water by means of pumping from rivers and canals, rather than by gravity. The pumping lift being low, and in view of the large aggregate area served by pumping, it would seem uneconomical to go to the expense of installing and operating pumping equipment, when low diversion dams, reservoirs and barrages could be built that would enable gravity supply. Several factors have led to the present excessive use of pumping, as mentioned earlier in this chapter. In addition, there is an extensive system of credit operations arising from the dependence on pumps which has become a characteristic feature of the local economy.

Where gravity irrigation is practised at present, little actual control of the flow of the river and canals is obtained, so that full advantage of topographic conditions is not taken and the maximum extent of gravity irrigation is not reached. Furthermore, primitive flooding is generally practised so that some crops get insufficient water, while others are over-irrigated; thus, in general, much wastage of water takes place.

Of equal importance with the supply of irrigation water to the land, is the provision of drainage facilities for the removal of excess water. Lack of drainage facilities in the irrigated areas at present, particularly in the flat low-lands of the lower valley, has resulted in extensive deterioration, because of salt accumulations over wide areas. (see pps. 144 et seq.). The continued reclamation of land in this region depends mainly on the flow irrigation system. The new areas have been sub-divided into "project areas". With the land classes and soil characteristics determined, (see chapter 3) it was possible to establish a cropping pattern for each project area, that is, the amount of land to be devoted to each crop. In setting up the cropping patterns, the need for a rotation of crops was taken into account in order to preserve the productivity of the soil.

With the cropping pattern established, it was possible to estimate the amounts of water required for the maximum yields of the various crops (see p. 148).

The water requirement of the projects which have been designated have been computed so as to maintain a water balance in accordance with temperature regimes and water supply. Following this procedure, the annual water requirements for the existing, and proposed project areas were estimated by the Irrigation Commission and are summarised as follows:-

Middle Euphrates Valley.	Area in mesharas.	Water requirements in milliard cubic metres.
Existing projects	3,907,384	4.9
New projects	4,044,705	5.09

Source: Directorate General of Irrigation Department, 1957.

In the light of land and water resources which have been discussed before it is now possible to assess the following projects. (see map 29).

Upper Hindiya Barrage project areas:

These canal systems have already been discussed from the standpoint of their present position. But at this stage they will be considered with regard to their future agricultural project. This group includes the Latifiya, Iskandariya and Musayib extensions.

For the Latifiya Extension it was suggested that a drainage plan should be worked out for the extension tail of the canal which covers an area of 24,958 mesharas and that the farmers should dig the ditches on their own farms. The Government would then provide the necessary materials and technical assistance. It was further suggested that a strong educational programme of proper irrigation should be established, and recommendations should be made as to the kind of crops to be planted and the best methods to avoid the concentration of surface salts which had prevented germination and had stunted growth in the adjacent areas. As an initial step, a small observation drainage system was worked out which was to be placed on one of the farm units to provide a training centre and an example for local farmers.

The irrigation extension, a network of branches and ditches was designated to cover the whole area in the future.

The agricultural crop rotation programme for this project was marked out in 1954 by the Committee experts. The programme was carefully prepared, and studied in advance, in relation to the soil, to the market situation, to the available labour supply, and to the irrigation water. Such a plan, will, no doubt encourage the neighbouring farmers to follow this method of farming when sufficient water is available.

<u>The Iskandariya</u> extension is a small area between the Latifiya and Musayib canal areas. It has soils similar to those of the adjacent areas. The canal trail, which has been proposed as an expanded project, covers a gross area of 34,081 mesharas.

A network of irrigation branches, together with drainage facilities, has been designed to do the same work in the future as the similar system on the Latifiya project.

<u>Musayib Extension</u> is called the Great Musayib project. It is located about 20 kilometres east of the village of Mahawil, and about the same distance north-east of Hilla, near the ruins of Babylon. The soils are of the Hilla and Babil series. (pp.132-133), and because of their inferior qualities many areas of this type of land have been eliminated from consideration for this project.

The available water in the Great Musayib canal was insufficient to irrigate the vast areas of Miri Sirf land in the eastern Jezireh Zone. The Development Board has undertaken to expand, lengthen and deepen the canal. The designs, specifications, and estimates have been completed and the work has been divided into many sections under a number of companies. Work has been going on since 1952, and upon completion, the canal will be 49.5 kilometres in length with 12 branches. It is expected to irrigate a new area of 246,000 mesharas, all of which is Miri Sirf, in addition to the existing irrigated area of 60,000 mesharas.

The completion of the Warrar inlet and the Dhiban outlet canals, connecting the Euphrates with the Habbaniya lake, will make it possible to utilize the stored flood water to augment the flow of the Euphrates with 200(1) cumecs, during late summer when the river is low. The Musayib area is one of these projects, that will make use of this additional flow by bringing the water down through the Musayib Canal. The canal is designed to allow a flow of 40 cumecs. on the basis of 1 cumecs. to every 8,000 mesharas of winter crops and every 6,000 mesharas of summer crops. The traditional "fallow" system will not be followed in the project, and the area will be under intensive cultivation.

As for the settlement, more than 20,000 applications for farm units on the project have already been received by the High Committee. The Committee is, at the present time, studying each applicant's file to select about 3,000 settlers for the area. It is hoped that within the next few years the project will be ready for settlement, the first in the Middle Euphrates basin.

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(1) "Report of the Iraqi Delegation to the 8th Session of the F.A.O. Conference, Rome. Nov. 1955.

Lower Reaches of the Hindiya Barrage and Hilla canals-system:

According to the plan, it is proposed to extend irrigation to the whole area of the left bank of the plain of Middle Euphrates, as far as the natural drainage line between the Euphrates and Tigris. (Euphrates-Tigris outfall). The upper reaches of the left bank canals have been discussed above, and in the south, the principal features of the development scheme include the lower Hindiya barrage project areas, and the Hilla canal-system.

The Lower Hindiya barrage projects involve the construction of, (1) a proposed Kifl Barrage, controlling the Kufa branch, with a regulator on the Shamiya branch which will be canalized later, (2) The Bahr-Najaf extension, (3) Shamiya extension, (4) The area between Shamiya-Diwaniya, (5) The Southern Jezireh areas which will be irrigated by a Feeder Canal from the Shamiya branch to the old Shatt-Al-Khar (see maps 28, 29). This will take over the supply of the greater part of the southern Jezireh, and will serve the remaining lift bank area almost down to the terminal border of the Region.

The Kifl Barrage will be built in a diversion leading out of Shamiya branch 8 km. below the bifurcation of the present Kufa and Shamiya branches. The diversion will be 2 km. in length and will join the Kufa branch. The present Kufa branch head will be closed, and the river will pass down the Shamiya branch to the head of the diversion.

The following preliminary figures for the design have been quoted from the Irrigation Department.(1)

Capacity	1500 cumecs in flood
Maximum flood level	25.2 m.
Normal pond level	23.4 m.
Present river bed level	19.0 m.

From the right and left banks of the Barrage, parallel canals will lead off, running on either side of the Kufa branch, the one on the right bank serving mainly the Bahr-Najaf which leads off to the south of the area at present being developed in the vicinity of Najaf town. The development of the Bahr-Najaf area cannot be satisfactorily carried out until a proper drainage system is provided, which in turn depends upon the right bank of the Mishkab area ceasing to be flooded for rice.

<u>The Main river south of Kifl Barrage.</u> The Kufa branch and its tail reaches, the Mishkhab branch, will become the main river line. With the completion of the final stage of the Habbaniya project, the river will be limited to 1,500(1) cumecs. in flood. Of this discharge, some 500(1) cumecs are to be

(1) "Irrigation Depa rtment of Ministry of Agriculture", Baghdad, 1957.

passed downstream to the Kifl barrage. The Kufa barrage now has a capacity, without breaching, of some 1,200[1] cumecs.

The Mishkhab Branch south of Abu Skhair now has a capacity at its tail of some 350 cumecs only, being limited by the tail-cross-regulators which maintain the water levels during summer for rice cultivation. The balance of the flood water is now passed out through the rice channels south of Abu Skhair. This area, like that on the Shamiya, has a necessarily limited life, and when it is ready to come under normal cultivation, it will be served by canals commanded by the Kifl Barrage. At this stage, the tail cross-regulators will be by-passed, the Mishkhab being allowed to flow directly into the scoured river channel downstream below the regulators. The lower reaches of the Mishkhab will then be rapidly developed to carry away in safety, the flood discharge of 1,000 cumecs, without breaching. Downstream from this, the stream will follow its normal low gradient braided form onward to Samawa.

Shamiya Branch. This will become a controlled canal commanded by the Kifl Barrage, and the area from then onwards will come under the normal system of cultivation and canalization.

(1) "Irrigation Department of Ministry of Agriculture". Baghdad, 1957.

The salient features, which have been quoted from the Haigh report will be as follows:-

	Capacity
At Head at Kifl Barrage	272(1) cumecs.
At 33 km. at Shamiya town at head of Shamiya-Diwaniya canal.	250 cumecs.

At the first stage of development of the Shamiya-Diwaniya Feeder a capacity discharge of some 100 cumecs only, will be required at the head of the Shamiya branch and 73 cumecs at Shamiya town. In order to supply the canal and the whole of the area on the branch itself with Shitwi irrigation water it will be necessary to maintain 250 cumecs at Shamiya town that is, the water level must be about a metre higher than the Shamiya now requires with its present natural discharge of 75 cumecs. Accordingly, it will be necessary to run an actual discharge of 272 cumecs which must be maintained whatever happens in order to supply the distributaries in the upper and lower Shamiya district. This development will be gradual, and even the system of flood rice cultivation in the lower Shamiya can continue for considerable periods.

Shamiya-Diwaniya Feeder. The final stage of the Habbaniya project, that is, the Abu-Dibis reservoir, is essential in order to provide perennial storage. But the water of this

(1) F.F. Haigh, "Report on the control of the rivers of Iraq and the utilization of their waters", 1951, p. 143.

proposed reservoir cannot be used to any extent until a feeder canal is constructed between the Euphrates and the Abu-Dibis reservoir. That feeder canal, which it has been proposed should discharge into the Euphrates downstream from the Hindiya barrage, would be called the Abu-Dibis outlet. Various alignments for this Feeder have been considered and the most suitable and economical one is that shown on the map 31.

The main course for the proposed Feeder will be from the Shamiya to the Diwaniya canal (the latter some 13 km . downstream from Diwaniya city). Haigh has said that "the Feeder cannot be constructed on the proposed alignment unless either the eastern Shamiya district ceases to be cultivated with rice on the present flooding system or a large and costly crossing is constructed to pass the flood drainage water now there, (amounting to a maximum of some 400 cumecs.) across the canal".

The experts of the Irrigation Department believe that, in any case, the life of this particular rice district is not more than another 20 years or so, owing to the natural silting-up of the depressions in which the rice is grown and the consequent decay of the rice channels, and it is not likely that the stage of development at which the canal is required will be reached in less than this period, at the end of which, only a comparatively small siphon need be provided to by-pass the drainage.

The whole of the area to the south of the Shamiya-Diwaniya Feeder and its extension eastwards to the Shatt Al-Khar will be served by it, as far as the left bank of the Euphrates and including the pumping area of Shinafiya-Samawa, now served by pumps installed on the river (pp.242-244). The reason for transferring this pumping into the control of the flow canals is a significant example of change of approach to irrigation. Because of the deficient water supply in the River course south of the Mishkhab branch pumping is the easiest solution but better water control at lower cost will be achieved by constructions which will enable the development of flow irrigation. The Mishkhab branch will be controlled by the tail cross-regulator which will maintain the water levels for the purpose of cultivating its own areas.

The present Diwaniya canal, south of the crossing of the Feeder, will become a branch of the new canal, thus relieving the Hilla tail of a capacity discharge of some 38 cumecs. This can then be used for the development of the Lower Jezireh Zone to the south east of the Dagharra.

The project includes the nearly flat Jezireh area below the Shamiya-Diwaniya Feeder. It is situated between the Kut-Nasiriya boundary from the south-east, and the lower reaches of the Euphrates river. The area studied is mostly Miri Sirf on the farther east of Jezireh (Ifaq and Samawa gadhas), while the extension of this project to the west of Mishkhab branch and to the south of Abu-Skhair is mostly Miri lazma land (see map 52). In his report Haigh stated that these proposed projects, covering a gross area of 3,230,000 mesharas, would be supplied by the proposed Kifl Barrage and its network of regulators as described above.

Hilla canal system:

In accordance with the plan for the development of irrigation from the Euphrates already explained, the Hilla canal system will be required to take over the irrigation of extension areas in eastern Jezireh, and to provide adequate irrigation facilities for the whole of the area which it must serve.

It is proposed that this development should take place in three stages, the object of each being as follows:-

(1) To provide a shitwi increment of 50% over the whole of the area served at present, and an average overall increase of 75% throughout, as suggested in the Haigh Report.[1]

(1) F.F. Haigh; "Report on the control of the rivers of Iraq and the utilization of their waters," 1951, p. 146.

(2) To extend irrigation to some 670,000 mesharas gross in eastern and central Jezireh, via the Babil canal.

(3) When relieved of the Diwaniya Branch by the Diwaniya Feeder, to extend irrigation to some 868,000 mesharas gross in southern Jezireh and north of the Feeder. (map 28).

The most favourable of the areas for development proposed in the Hilla canal system from the point of view of land classification (map 20) are those to the east of the Hilla canal, lying between those lands which are irrigated by the left bank distributaries of the Hilla and Dagharra canals, and the natural main drainage line of the Euphrates-Tigris outfall. The Haigh Report proposed that these lands should be served by an extension of the Babil Distributary from the Hilla canal, and a new branch 32 km. away on the left bank of the the Dagharra canal. But the Hardy[1] Report has given new advice and now indicates that it is preferable to increase the remaining area to be served, by means of a new branch, 72 km. from the Hilla canal, leading out about 4 km. downstream from the settlement of Hashimiya, from which a favourable canal alignment offers itself. This new branch would follow the line of the Argub-Guddis, and hence may be

(1) F.S. Hardy; "Development of Irrigation on Hillah canal and its branches", 1952, p. 15.

known as the Guddis-Branch (see map 28).

This re-arrangement would greatly facilitate the water distribution on the two different systems envisaged, both for the existing areas, and for the new areas. It also obviates the necessity for any substantial enlargement of the tail reaches of the Hilla canal and of the first 32 km. of the Dagharra Branch, and other re-modelling structures.

This plan, first of all, consists of desilting works at the head of the Hilla canal, which will discharge relatively clear water into the Hilla and its branches. The second stage deals with the remodelling of the Hilla canal to provide a sufficient capacity to serve the existing and new areas for a period of at least ten years. The design will make provision for an enlargement to an ultimate capacity when it becomes necessary. The water in the canal will be carried above control structures at a height of about one metre above the natural ground surface. Two escapes will be provided, the first 42 km. away from the Hilla canal head, called the head of Babil canal. This escape will be provided with a cross regulator. A second cross regulator will be provided 72 km. away, near Hashimiya, to control the water level in the Hilla canal. In addition to this, the Dagharra canal will be enlarged and extended, and provided with new headworks able to supply the new areas proposed for development under the extension of the Dagharra canal. These areas are the upper Fawar area, which lies to the north and east of the large Al-Khar extension area, to be served by the Shamiya-Diwaniya Feeder, and the South-East Jezireh area which lies immediately east of the Ifaq branch of the Dagharra canal.

The Diwaniya canal will also be enlarged and extended, and the present headworks enlarged. An escape will be provided to allow excess water to be discharged into the outfall channel. A cross regulator will be provided on the Diwaniya canal at the confluence of this latter canal with the Shamiya-Diwaniya Feeder. This is to supply the Al-Khar canal which will be provided with a headworks. The main escape proposed is on the right bank of the Diwaniya Branch at Khan Jadwal 33 km. from its head (see map 28). It will discharge into the Shamiya Eastern Drain (map 22) which is only 6 kilometres away at this point. This new canal will serve the southern extension area, which lies to the west of the channel and along the upper trough of the valley between the Shamiya, and the Diwaniya Branches, north of the Feeder.

The Hardy Report proposed that when the new structure of the Hilla canal system is completed, it will be required to cover the final capacity of 330 cumecs at its Head, decreasing to 263 cumecs 72 km. away. Below the diversions at this point, the canal will be required to carry 130 cumecs, decreasing to 109 cumecs at the tail.

Some detail of the engineering implications of the development projects has been given in order that one significant point may be appreciated. For some years development has proceeded on an unco-ordinated regional basis. While some of the work has been useful from a long term point of view, other points notably the uncontrolled increase in individual pumping installments have been short term reactions to circumstances. Now the whole complex of water control and irrigation must be dealt with in an integrated way. In order to deal with floodwater, water-level and supply and distribution of irrigation water costly capital construction by central authority is needed to restore unity to the region. To the geographer there are two especially interesting features, first, the physical landscape changes secondly the new relationship man and resources.

The first obvious result of the developments in the Middle Euphrates region is striking agricultural progress in those areas. The policy of reclaiming land and distributing the arable Miri-Sirf Lands, particularly to farmers who had no land, is regarded as an advance in agricultural improvement. This step was taken after it was approved in 1952 (in the Latifiya and Musayib projects). The success of this policy in the Dujaila project in the Tigris basin in 1945 encouraged the Government to follow it in the Middle Euphrates areas. The policy is to reclaim and develop all the available Miri-Sirf land, forming the greater portion of these project areas. The purpose of this policy is to distribute the land as small units to landless farmers.

In its final form, the Miri-Sirf Development Law is designed to provide for reclamation and development of all the arable government-owned lands, and their distribution to qualified people who apply for such land. The area of each farm unit rented to each settler should not be more than 100 mesharas in flow-irrigated areas, and 200 mesharas in higher land which is irrigated by pumping, within the boundaries of these new projects. The actual size of the unit within the boundaries of the Law of Miri-Sirf land is to be determined by the Committee, according to the productivity of the soil, the environment, the available quantity of irrigation water and the market conditions and locations. Within each project, however, the size of each farm-unit should be uniform, in accordance with the law.

It is hoped that the application of the Miri-Sirf Land will have a wide impact on the agricultural economy and the social conditions of the rural population of this region, in the near future.

Up to the present time, within the projects which have been developed, the Committee has distributed a total of about 173,000 mesharas to 2,377[1] settlers in the Latifiya, Musayib and Saqlawiya project areas. The Committee's "Five Years Plan", approved by the Ministry of Development, provides for the reclamation and development of the projects under consideration. Such a programme gives wide scope for the settlement of vast areas of arable land, by establishing the necessary irrigation and drainage system, and by the use of better soil-management practices.

Up to the present time, two projects have been established, Latifiya and Musayib. Some areas of the Hilla canal have just been started, while the rest of the projects are still under either construction or consideration.

The agricultural plans for these new areas are based on the soil, the topographical conditions, the available quantity of water supply, the climate and the market conditions. The best practices of the farmers are also taken into consideration. In addition, the plans are worked out in such a way

(1) "A report about the Great Musayib Project" (Arabic) 1957.

that the farmers' time is distributed evenly throughout the year and the settlers will have no need to use hired labour. Diversification in farm production will follow in these plans.

As for settlements, the Committee is considering a programme for establishing modern rural communities in these projects. Extensive studies have been carried out to enable low-cost farm houses to be built on these project areas. Such houses will have all the sanitary facilities required in modern communities. Schools, clinics, storage facilities and other buildings have been established on the Latifiya and Musayib projects. On each project, modern houses have been built for the accommodation of project managers and their staffs.

CHAPTER VII

A. TRADITIONAL PATTERN OF AGRICULTURE.

From prehistoric times, the Middle Euphrates Valley has been outstanding in importance from an agricultural point of view. We find in Herodotus, the Greek historian, a description of agriculture in this district which tells us that it used to produce one or two[1] hundred times as much as it does now. We are informed, also, that the greater part of the Middle Euphrates Valley was suitable for cultivation, even the parts which are nowadays irrigated by artificial means. We can begin to understand this district when we know how much importance the Ancients attached to agriculture; many of their Gods were Gods of agriculture and fertility the ancient inhabitants of this region, the Sumerians, developed the form of the wooden plough which was used in older times which later spread over the whole world and to a great extent, still resembles the primitive plough used by the peasant of the Middle Euphrates Valley today.

It is hard to believe the description, given by Herodotus, of the productivity and fertility of this land, because we

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(1) T. Baqir; "Ancient Cultural history of Ancient Iraq" (Arabic), part 1, 1955.

cannot make sure whether his figures refer to weight or simply to number. But historical documents give indisputable evidence that the products were 30 times as much as the seeds used. This is the minimal estimate which could rise to a maximum of forty-fold.

The quantity of a crop depends on the kind of soil, the method of cultivation, the irrigation system and on the amount of work expended on it. The average return in early days was usually twenty-fold. A meshara of seed produced about 250(1) kilogrammes, (or 9½ bushels).

Historical documents of the cultivated crops of the region, give evidence that plants, such as wheat and barley which are still grown in this district, were grown then. These came from the Near East where they first grew in a wild form. Millet and Sesame were also known, and their names are Babylonian in origin. Rice was not known except in later ages, and perhaps comes first from Persia during late Assyrian times or even later. However, it has its origin in the Far East. Cotton was not known either, and it has only recently been grown in the Middle Euphrates Valley. Palm trees were known to the lower part of Sumer and Akkad, where earliest man lived, in the age called Abeed's Age, about 4,000 years ago.

The palm-tree is mentioned in Old Semitic literature.

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(1) T. Baqir; "Ancient Cultural history of Ancient Iraq", part 1, 1955.

It was considered a sacred tree by the people of those ages, who had adopted it from the civilization of the Middle Euphrates (Sumer and Akkad). Palm-tree cultivation has been important in this area since the beginning of recorded history and, until now, the region under consideration has been regarded as the centre for the cultivation of this tree.

The genus of palm-trees has a variety of types which no other tree can give. It comprises about 170 kinds of at least 250 different shapes.

In this district agriculture flourished through the different ages, until the invasion of the Mongols in the 13th century who destroyed all means of irrigation, and subjected the country to complete confusion. The peasant fared little better during the Ottoman epoch which lasted until 1917. The position was the same until the National Government took over in 1921. Agricultural conditions then took a favourable turn.

The new tendency of cultivation, is to develop as the principal crops in this district, cereals, dates, fruits and cotton.

Table 14, which indicates the total cultivation development in the area, shows the number of mesharas of crops of shitwi, saifi and of orchards between 1918 and 1957. In this region, in 1918, during the last stages of Turkish rule, very little land was cultivated, and the population was very small. Since 1918 the area has been brought gradually under the plough. The present cropped area is about three times that of 1918. In the years between the two World wars, agricultural production increased slightly. In areas under flow-irrigation it increased with the construction of the Hindiya barrage.

Table 14 shows fluctuations in the figures between 1949 and 1957. This slow and unusual development was owing to adverse factors in environment. These adverse factors were related to the Euphrates, which provides a regular natural increase of the fertility of the soil, as the Nile does. Until 1956, the danger of floods was always present in this district, major floods occurring once in every two or three years. The exceptionally severe flooding of the Euphrates in 1954 destroyed crops in about one-quarter of the total area.

Until 1956, there was a shortage of water, which meant that in most of the districts only a winter crop could be grown. There was, and still is, much underdeveloped land because of inadequate water supply from the river during the summer months.

Floods, and seasonal shortages of water, are not the only obstacles with which this region has to contend. Soil salinity is another problem which has already been discussed in the chapter on soils. The methods of farming in this zone are most primitive and wasteful, as will be discussed later. The problem of manpower shortage has been considered in the chapter on population.

In addition to the areas which are cultivated, as shown in Table 14, there are large areas of cultivable land (some 7,952,089 mesharas) of which 3,907,384 mesharas are at present under the plough. It will be possible to bring the rest under cultivation when the storage projects are completed.

Farming techniques.

The agriculture of the Middle Euphrates Valley was, and still is, primitive in its tools and its methods. The fellah still used the old methods and implements, and was comparatively very backward. He never introduced any improvements into the old primitive implements, nor could he make use of the modern methods of cultivation. He used his old plough, (photo. 13) his spade and scythe and threshed his corn by means of animals or a jarjar (photo. 14). Such primitive methods of threshing and winnowing waste a great deal of time, and these operations often last from June to October, leaving little time for other work. He did not find guides to show him how to revolutionize his agricultural methods of fertilization or to supply him with modern machinery.

At the root of all this deplorable backwardness and ignorance was the Ottoman rule, rulers who knew only how to exact his taxes from the poor peasants, leaving them to struggle in the haze of their complete ignorance.

This stage of agriculture lasted all through the Ottoman era, and until the National Government took over in 1921. Everything, then, took a favourable turn. Consummate care was taken by the New government to raise the standard of agriculture, and rescue the poor peasant from his ignorance. New kinds of plant were introduced into the agricultural life of the country, and were distributed among the farmers. Many agricultural specialists and guides were appointed to look after the peasants, and all varieties of modern machinery were introduced. New agricultural departments, Ministry instalations and research Farms, were set up all over the country to test the right summer and winter plants and ascertain the right plants for the climate and soil of this area, and to overcome the plant diseases which are liable to attack them.

The use of modern machinery were increased after the beginning of the National Government. Between 1925 and 1930, a large amount of machinery was imported, but in the next five years (thirties) the economic crises reduced that total import by nine-tenths. In 1946 therewere only 6 tractors in the Middle Euphrates district but that figure increased steadily every year until in 1950 it was 50 tractors, 48 ploughs and 10 combines. A scheme for importing machinery and other implements was then planned to be worked and maintained under the control of the Department of Agriculture. Table 15 shows that at the end of 1957 this region had 90 tractors, 91 ploughs and 55 combines.

The establishment of irrigating pumps is considered an important phase in the improvement of the irrigat ion system and also a remarkable step forward in the modern agricultural method used in this district. Table 16 illustrates that the number of pumps and their horse-power which were installed was 654 and 20660 respectively, at the end of 1940. This plan carried on steadily until the figure rose to 1864 pumps and 52176 horse-power in 1957, (but see pp.241-244).

Cultivation is based on the "fallow" system, rotational dry farming.

In this district, half the land is left fallow and half tilled each year. (see pp. 288-290). The fallow system is necessary in order to prevent soil salination in the irrigated areas.

Until recently the use of artificial fertilizers was practically unknown, but lately, the use of it has been practised on a limited scale as a result of encouragement by the Agricultural Department.

Holdings.

The land tenure system in the Middle Euphrates Valley is extremely complex. It grew up over a period of more than a thousand years with no fixed basis until the Ottoman Land Law of 1817 laid down definite classifications for land tenancy. Attempts to redistribute land in accordance with this law failed and the complexity remained.

Until the end of the Ottoman period, the basis of land-ownership was the tribal dira , a large area not limited to land actually tilled, but including also non-cultivated land or submerged marsh land, over which the tribe exercised customary right of occupation. The tribal system, as it then existed, had no legal basis and no protection from the state. In law, the tribal lands were regarded as state lands and the tribal occupants as tenants-at-will.

Under the tribal system, cultivation was partly communal, partly individual. The method of farming necessitated some communal organization, since single households could not undertake the clearing of land, building of dams across channels, and strengthening of the river banks. The head of the clan, the Sirkal, managed these functions on behalf of the tribe, organizing canal clearance and irrigation, allocating the seed, and performing other duties necessary in the organization of cultivation. Within the tribal dirah, the area cultivated was small, and shifted about as canals silted up and the land became impoverished by salt. So the area cultivated by each peasant shifted also. Individual prescriptive rights to land were known (Lazma and other customary forms), but these were restricted to a small class in the tribe, in areas permanently cultivated.

Under this system, the Sheikh collected one-third or one-half of the produce of the cultivated land from sirkals, who received it from the tribesmen. The tribesmen were neither individual owners nor labourers; they were cultivators of land communally owned.

Since the early years of the twentieth century the tribal system has been breaking up, as a result of settlement for permanent cultivation, the opening of markets, greater political security and technical change. When steamship transport came to the Persian Gulf at the end of the nineteenth century, markets for Iraq grain were opened up, and the sheikhs of the Middle Euphrates district found it profitable to take more grain from their cultivators, in order to export it. In the 1920's pump irrigation gave them a strong incentive to acquire land as their own property. These economic changes were consolidated by the settlement of the question of title to the land, carried out from 1933 onwards, and which is described below. The sheikhs have now become legal owners of the dirah; the sirkals have become the managers and agents; and the tribesmen have become share-cropping fellahin, with no rights or status.

The prestige of the sheikhs rested, primarily, on their holding leadership in a tribal society which owned no allegiance to the state.

Dowson drew up a report in 1931(1) when he was requested by the Iraq Government to investigate the problem of settlement title.

Dowson's report said that "no attempt should be made to introduce a general settlement of title in freehold ownership", but that "grants should be made, after survey, in ten-year leasehold tenancies". In such agricultural districts, the state had to retain its rights of ownership so that it could resume control of the land at a later stage in the development of the region.

The second of the main recommendations was that the settlement of rival claims should be made on the principle of, "beneficial occupational use", which would give weight to the prescriptive claims.

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(1) Sir Ernest Dowson; "Land tenure and Related Questions", 1931.

Dowson believed that the government would be able to arrive at satisfactory settlements by reconciling the rival claims of the sheikhs, sirkals and cultivating tribesmen on the basis of confirming the previous rights. In accordance with this, the sheikh had a claim to one-fifth of the produce from each of a hundred cultivators, so that he would receive a holding of land equivalent to one-fifth of the total area, and each cultivator would receive a holding equivalent to four-fifths of the land he cultivated. The local settlement authorities were not impartial, and generally acceded to the claim of the sheikh to the whole of the tribal land.

This course was suggested to Dowson as the only practicable one, in view of the difficulty of investigating and settling the rival prescriptive claims, but he rejected it on the grounds that "it savours of a new allotment of land rather than of a recognition of a claim based upon previous use".

In fact, both Dowson's main recommendations were set aside. From 1933 onwards, land settlement was carried out, under the supervision of British officers, on a systematic basis. Tribal land was allotted, in what are, in effect freehold tenures, to the sheikh landholders. This result has not been universal. The principle of subdividing land in proportion to the income received by the sheikh, giving a portion to him and a portion to the cultivators, has been practised in the Middle Euphrates Valley. What happened in most are as was that the size of the plot varied inversely with the power of the Government. Where it was powerful, as with the people in the upper region, the tribesmen gained a useful share of the total, and where it was not, the land was assigned in enormous holdings to the tribal sheikhs as their individual property, as in Diwaniya liwa in the lower region.

Registration of title was carried out under the Land Settlement Law of 1932 which gave the Government the right to settle title to land, and also established the following classification of lands:

1. Privately owned (by traditional or feudal title).
2. Public land (largely uncultivated).
3. Wagf land (property of religious institutions).
4. Miri (Government) land of which there were three types:-
   (a) Tapu - permanent tenure amounting to ownership which had already been registered.
   (b) Lazma - where the occupier had been settled and cultivating the land for 15 years or more. It is held under similar conditions to tapu except that the Government may veto its conveyance in certain circumstances.
   (c) Miri Sirf Land - Government owned land with no previously established tenancy.

The Government then set about the task of demarcation and registration of land in accordance with these classifications.

Miri Sirf is land for which the title has not been settled. This category includes land actually in the possession of sheikhs or other landowners who, in fact, enjoy undisturbed rights of possession. These occupiers pay a light tax on their holdings. The Miri-Sirf lands also include all uncultivated lands which are not registered. The State's power of disposal is important, because it gives the Government a right to grant title to land which will become cultivable through the new irrigation works.

The Miri Sirf Lands Development Law of 1951 was intended to govern the distribution of holdings on all state land which had been or would be developed or reclaimed. It fixed maximum areas of holdings for different parts of the region and different types of farming: 500 mesharas (300 acres) on high pump-irrigated land, 200 mesharas (120 acres) for low pump or flow areas.

The official returns of the Directorate-General of Miri Sirf lands give the following figures for land distributed under this law.

Distribution of State Land in the Middle Euphrates, 1952-4.

Place	Area distributed (mesharas).	No. of holdings.	No. or persons living on these lands.
Latifiya canal	23,250	465	2,325
Saqlawiya canal	30,000	300	1,500
Musayib canal	10,500	175	875

Source; Development Board, Directorate-General of Miri Sirf Lands.

If a programme of State-land distribution is put into effect along these lines the agrarian structure will undergo change at once beneficial and considerable. Such schemes will also make it possible for the farmers on the Miri Sirf lands to avoid exploitation by the landowners and sheikhs and will give them an excellent opportunity for an independent free life. At the same time, a class of small farm-owners, essential for the health of the country's economy will appear.

Even now the settlements are, of course, directly beneficial to the farmers who manage to obtain holdings. But the numbers who benefit are too small to effect the position of cultivators in general.

Even if this type of settlement were to be carried out on a much larger scale, it would not be able to bring an improvement in the conditions of cultivators on privately-owned estates by producing more competition for labour, because there is so much under-employment on the land as a result of landlord inefficiency. The rural exodus to the towns reduces the numbers of cultivators on private estates to a far greater extent than settlement schemes - even on a bigger scale- could do, yet there is so far no sign that this induces landowners to improve the conditions of the fellahin, neither is it likely that landowners will make any efforts in this direction since machines can be substituted for hand-labour, and present returns, even though at a low level, maintained.

Absence of economic and social responsibility on the part of the larger landowners, while not universal, is therefore nevertheless serious.

B. THE MODERN AGRICULTURAL PATTERN

(maps 32-42; Diagram 8; tables 14, 18, 19, 20)

I - Agricultural Economy.

II - Agricultural Regions.

I. Agricultural Economy.

The topography, soils, climate and system of irrigation of the Middle Euphrates valley restrict the range and profitability of farming over practically the whole area (map 32).

The predominantly Jezireh Zone, which comprises the far east and south-east of the lower region, together with the low desert plateaus of the upper region (Haswa and Megass), is given over mainly to sheep farming on its grazing land, especially in the spring-time. During the summer period it is desert land. The Levee, the back slopes of the Interfluve and the marshes zones, which cover the remaining tracts of the valley along the River and its canals are, as a whole, arable or mixed farming lands. This area contains all types of crops, such as cotton, rice, orchards, vegetables and cereals. But barley and wheat cultivation is concentrated in the upper region, while the middle part, especially the back slopes of the Interfluvial land, (where soils are mainly clay, the ratio of salinity high and there is no drainage) is occupied by barley, wheat and a limited area of rice fields, with other subordinate cereal farming. Throughout the Levee Zone the orchards, including the date and fruit trees together with the vegetable crops, are concentrated on the better soils of the young alluvium bankland zone. Rice farming alone is generally found in the low lying land of the lower region, particularly close to the marshes where there is silty soil and sufficient water supply.

While there is no temperature bar to plan growth at any season, as may be seen from the Section on climate, the cool, relatively humid and rainy winter, extending from November to May, is best suited to cereals and temperate crops. During summer the constant high temperatures enable crops such as rice, maize, millet, sesame, cotton and vegetable crops to be grown when water is available. The seasonal contrast is therefore between the winter growing of a slightly thermally restricted range of crops in which the cereals are dominant, and during summer pseudo-tropical cultivation where land is irrigated. On non-irrigated land summer growing of non-tree crops is prohibited by aridity. The tree crops, as considered later, are those which are suitable for temperature seasonality and have efficient means of extracting ground water. Some such as citrus and apple have high water demands which must be provided for by irrigation.

Great attention is given to the question of cotton-cultivation at the present time. The climate conditions most suitable for this crop, as was discussed in an earlier chapter, are found in the Middle Euphrates Valley. The temperature throughout the country seems to give the necessary conditions for successful cotton-raising i.e. a high average temperature with only slight variations. In addition, the cotton plant grows best in deep loams, well drained soils of a somewhat light nature, such as those found in this region. (Also see pp.125-126).

Basic Systems of farming.

The types of farm in the region of the Middle Euphrates may be divided into the following kinds.

1. Cereal farms on which are grown the principal grains of wheat, barley, rice and other subsidiary grain crops.
2. Cash crop farms which specialise in growing cotton, but there are few of these.
3. The orchard cultivated farm is another type, in which the farmer grows date trees and fruit trees together with vegetable crops.
4. Those farms of various type associated with livestock breeding, including animal husbandry on the mixed farming of the agricultural holdings. There are

sheep, goats, cattle and buffaloes for meat, milk and other produce, and horses, donkeys and mules for draught animals.

A two year rotation of crops is generally practised with winter crops, summer crops and fallow land alternating. This agricultural method is called locally the "Niren system" or fallow system. Rotation, in accordance with this method, is based on the Shitwi (winter) cultivation. Shitwi crops consist mainly of barley, followed by wheat and other minor crops, and only half of the area is cultivated. After the shitwi harvest, some of this land put under summer crops and the remainder is fallow until the autumn sowing (see Diag. 8). As will be later seen there are many variations but this is the basic practice. The use of fertilisers (natural manure) is confined to limited areas of vegetables and fruit trees. The earlier sowing, called harfi, is usually done during the months of October and November (sometimes as early as the latter days of September), while the later sowing, called afli, is delayed to the end of January, sometimes as late as February. Harfi crops thrive better and, as ripening takes place early in the spring, they are more likely to escape the attacks of pests and plant diseases than afli crops. Harvesting begins in April and generally extends until the end of May.

The "Afli" or late sowing of winter crops is most practised. South of Hindiya i.e. in the region where the timing of cultivation processes is most controlled by the irrigated summer growing of crops such as rice and vegetables. In the northern districts the dominance of the cereal, particularly dictates the agricultural calender and here "Harfi" is most important.

The land in cultivation under the Saifi (summer) crops is far less than that of the Shitwi areas. Table 18 shows that the total area of saifi crops is about a fifth of that used for Shitwi cultivation.

The most important of the Saifi crops is rice. This crop consists of harfi, or early broadcast rice, and afli, or late broadcast. The seasons for the sowing and ripening of these two types of rice cultivation vary in accordance with the locality, but, generally speaking, the sowing of rice may be said to take place in May and June or even as early as the end of April. Its ripening is from the end of August to the end of October.

The winter crops consist of cereals like barley and wheat, grown over extensive areas, while the subsidiary crops of linseed, lentils, vetch and beans are grown in limited areas. Summer crops are much smaller and depend very largely on the amount of irrigation water from the canals which is inadequate for cultivation on the same scale as winter crops. Rice is the main summer crop, and is grown principally in the riverine and marsh areas. Sesame is widely cultivated as a summer crop, and cotton is grown in small areas; green gram, millet, and maize are minor summer crops. Vegetables are grown in the proximity of large towns and cities.

Date trees and fruit trees are growing permanently but their crops ripen mainly in the summer and autumn seasons. The details of rotation on most farms varies according to the conditions of the soil, the irrigation requirement, and the different needs of the varied crops, and depends also on the farmer himself and his needs for different kinds of products. As a result in the Middle Euphrates basin there seems to be a tendency for the farmer to regard the whole range of crops as being divided into the following categories, for farming purposes.

a - Cereals.

b - Cotton.

c - Orchards.

d - Vegetables.

Group types:

Varying conditions of physiography, water resources, and economic and human factors cause considerable variation in the production of the arable farms (map 21) in the different sections of the valley. For instance the extensive ploughed lands adjacent to the River and its canal banks (Levee Zone see pp. 68-71) comprise a large percentage of the arable land in the country. Cereals are the main crops, especially barley and wheat.

Maps 33 to 42, illustrating the distribution of the kind of arable land, show the importance of the cereal land through the whole region particularly the areas of barley cultivation.

(a) Cereals: By far the largest and most generally grown cereal crop is barley. Table 18 shows a total area of 1,103, 933 mesharas of barley. This is about 50 per cent of the total area planted with annual crops and 33 per cent more than the area planted with wheat. Barley and wheat together accounted for 67 per cent of all land planted with annual crops (see Table 18). Barley is grown as a winter crop in most cereal-producing districts. Map 33 shows the areas of greatest production throughout the northern and intermediate gadhas such as Falluja, Mahmudiya, Hilla and Karbala. Karbala is regarded as the most important area for growing barley crops. Gadhas of Najaf, Abu Skhair, Hashimiya and Ifaq have a smaller production compared with the gadha units mentioned above. Conditions in this country suit barley better than wheat. Barley has a shorter growing season and demands less water than wheat, and can endure a certain degree of soil salinity. The native kinds are brown and white, the latter being used for export, while the former is suitable for green fodder and dry fodder (photo. 40(a)). Hence barley competes on favourable terms with wheat both as an export crop and for home consumption and is generally more popular with farmers.

Wheat (map 34) is less important than barley, though grown in certain areas as a winter crop, particularly when there is the prospect of good prices. Map 34 shows the principal wheat areas of Musayib, Mahmudiya, Falluja and Ramadi in the upper region, and Diwaniya, Ifaq in the lower Valley as well as Samawa, further south.

Wheat, as well as being characteristic of these areas, is one of the important crops grown throughout the whole region. A total of 373,736 mesharas is recorded in Table 18. This shows that roughly 17 per cent of the total area of annual planted with wheat is in the upper region.

There are several native varieties of local origin whose yields are poor. After several experiments the Department of Agriculture has produced a variety of Punjab wheat called Ajiba which has early maturity, marked resistance to rust, and heavy yield.

Rice (Map 35) is another important food crop grown in the country. According to Table 18 the area under rice cultivation is 93,544 mesharas. This is 4.2 per cent of the total land planted with annual crops. The lower gadhas of Shamiya, Abu Skhair, and Diwaniya as well as Hindiya which is situated in the intermediate zone account for about 80 per cent of the whole area planted for annual rice cultivation. Shamiya and Abu Skhair represented 60 per cent while the remaining gadhas account for 40 per cent as shown on map 35. Rice is the third most important of the grains crops of this region under consideration, because yield and price are generally higher than for barley and wheat.

The amount of irrigation water available is an important factor which often causes wide annual fluctuation in the area planted and in the total production. Rice needs heavy irrigation and uses water extravagantly (photo. 40(B)). Hence, by a law of 1932, its cultivation was restricted to certain mesharas in areas dependent on irrigation. Other limiting factors have been the extension of cotton cultivation, and measures taken for the control of malaria. Most of the rice is consumed in the country, and for many years only a relatively small proportion of the annual crop has been exported to nearby countries. The principal varieties are known as Anbor, Nuggaza, Huwaizawi, the first two being the main ones.

Minor grains (map 36) include maize, sesame, millet, and green grains crops. This group, grown over all the country, occupies a total gross area of 164,665 mesharas, and accounts for about 7.4 per cent of all the land planted with annual crops. Map 36 shows the main production is concentrated in the extreme north of the region, in gadhas of Ramadi, Falluja and Mahmudiya and also in the south in Ifaq, Diwaniya and Shamiya. The intermediate gadhas have a smaller production especially in the western areas.

The maize crop is concentrated in the lower reaches of the valley, mainly in Diwaniya and Ifaq, and the southern part of the Shamiya gadhas. In the upper district it is grown sparsely in Ramadi, Falluja and Mahmudiya. This summer crop is grown primarily as food for livestock.

Sesame is grown intensively in the upper region, mainly in Musayib, and Mahmudiya, and sparsely in Falluja and Ramadi, while in the lower valley and the eastern reaches it is very rare. But it is predominant in the southern Shamiya, and the Abu-Skhair districts as well as in Ifaq. Sesame is a summer crop planted in the spring and harvested in the fall. Part of the annual production is usually exported but most of it is consumed in the region. Sesame and its products are used in many ways, particularly in the preparation of various foods and as an ingredient in food for livestock (photo. 41).

Millet is grown in a small measure all over the southern half of the country as in the Diwaniya gadha, but is concentrated in Hashimiyah. Millet has a lower moisture requirement than many other grain crops and while it does best on rich, well-drained soils, it tends to be pushed off the best land by competition from higher value crops. A high percentage of the annual production is exported. Most of the millet which is consumed locally is fed to livestock, while a small percentage is used for food.

Green gram occupies a limited area of this country. Therefore it is sparsely cultivated in comparison with the previously mentioned minor grains. However, it is predominant in the upper region in Musayib and Mahmudiya, as well as in the Shamiya district in the lower region.

It is a summer crop. The seeding is usually carried out in June while the harvesting takes place in September and October. The crop is consumed as food.

Broad beans (map 37) are another minor winter crop, grown on 9,750 mesharas according to table 18. Production is concentrated in Hilla, Hindiya and the eastern portion of Najaf (Kufa Nahiya)(1) as shown on map 37. These three gadhas raise about 80 per cent of the total annual yield of the crop.

Broad beans are planted in October and November. Part of

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(1) Nahiya is the smallest administrative unit (civil parish).

the crop is picked while it is green, during the winter and early spring, while most of the produce is harvested later as dry beans. The crop is consumed as food and forms an important part of the diet for some people.

(b) Cotton (map 38)

Cotton is grown over all the country with the exception of the marshes zone in the Shamiya, Abu-Skhair and the northern Samawa districts. Table 18 shows that the area of the cotton crop is 28,122 mesharas or only 1.8 per cent of the total area planted with annual crops. About 90 per cent of the area is located in the four principal gadhas of Falluja, Mahmudiya, Hilla and Najaf throughout the northern and the intermediate i.e. Gadhas regions. This distribution of the cultivated cotton areas is shown on map 38.

Though cotton is a summer crop which has long been grown in the region, and is one of the important cash crops, its cultivation on a commercial basis is a relatively new development in this region. Work is going on to develop better varieties and to improve production practices. Roughly half of the average production, of both lint and seed, for the past few years has been exported. In addition to this, it is used for local purposes, so that its extensive cultivation for export is the result of encouragement given since 1919 by the Department of Agriculture and by the British Society for the

Cultivation of Cotton. Since then, this society has built a ginnery at Baghdad and maintained an experimental cotton plantation, the success of which created great interest in cotton growing amount the cultivators of the above districts. The suitability of the soil, the climate and the abundance of irrigation water, with the long absence of frost and rains in the growing period, followed by the sharp fall of temperatures in the autumn, all help to produce large crops, especially at the present time. Department experiments have shown that the best sowing period for the Middle Euphrates valley is from mid-March to mid-April, and that cultivation on ridges is better than on the flat (photos. 42(a) and 42(b)).

The principal difficulties of cultivation are poor cultural practices, certain pests (photo. 42(c)) and soil salinity. These conditions, causing damage and limiting the returns to producers, have no doubt retarded expansion in the area plan,ed. The last factor is harmful to cotton and is intensified by the heavy irrigation necessary and by the inadequate drainage. The crop is more popular with land-owners, pump-owners, and sirkals than with the fellahin, who dislike a crop the value of which depends on factors beyond their control, and which cannot be realised until the product has been marketed; unlike a food crop which pays rent and fills bellies independently of markets.

The type of cotton which is cultivated is American in origin. Since 1949, the cultivation of cotton has been legally confined to American types on account of their good quality and ready market abroad as well as their suitability for the physical geographical conditions.

(c) Orchards:

Orchards may be divided into two main groups according to the type of production, date palm trees, and fruit trees. Date palms (map 39) are the principal fruit trees in this region and dates form the main food of the people and also the most important export crop. They are to be found from the far north of the district down to Samawa in the south. The plants stretch back from the river banks towards the desert margin on the western side and extend inside the plain in an easterly direction for distances varying from a few hundred metres to some eight kilometres. Indeed the Middle Euphrates region is the leading date-producing area in Iraq with the exception of the Shatt-Al Arab district. Table 18 shows that the total number of date palm trees, reported by the Date Association, to be 10,174,600. This figure is roughly 30 per cent of the total palm trees, planted in the whole of Iraq. According to the same table, the gross area planted amounts to 203,397 mesharas. This is about 9.2 per cent of the total area planted with annual crops, and 3 per cent more than the area occupied by fruit trees. Map 39 shows the distribution of this type of tree is concentrated close to the river banks of the three central gadhas of Karbala, Hindiya, (photos. 43, 44, 45), and the north part of Shamiya and Abu-Skhair (photo. 46). About 65 per cent of the total area of the date plantation is found in three areas while the other 35 per cent is scattered throughout the remaining eleven gadhas (photos. 47, 48). The annual production varies from year to year and from place to place but the average yield of a healthy tree is estimated at 35 to 60 kilograms, according to the type, size and age.

The date-palm matures its fruit in this region as a result of the suitable long, hot, rain-free summers. The palms need a liberal supply of water at the roots in order to bear heavy crops. The quality of the soil and water is less important. The date can endure a greater degree of salinity than any other cultivated crop in this region and grows in a variety of soils; limey loam, river silts, and desert sands, but dislikes both a permanently water-logged and an over-dry soil, though it will endure even these for many years.

Varieties of dates are numerous, totalling over a hundred, but the commercial sorts for export are restricted to four;

Hillawi, Khadrawi, Zahidi and Sayir.

In April the cultivators usually climb the palm and fertilize the female flowers with a sprig of a male flower (photo. 49). The harvest is in August (photo. 50). Most of the produce is exported but a considerable quantity is consumed within Iraq either as food or as a raw material for the spirit industry.

The promotion and improvement of the date industry is entrusted to the Date Association under a law of 1933. Ever since 1939 the Association has had a contract with the Andrew Weir Company. This company undertakes to buy at fixed prices and to export all the best varieties of dates offered for sale from the Middle Euphrates district. There is general agreement among the growers that this arrangement has helped to stabilize prices. On the expiration of the current contract with Andrew Weir after the 1952 season, the Association concluded a similar agreement with a newly-formed Iraqi Company. The Association, the growers and the foreign companies engaged in the date trade are each expected to subscribe one third of this new company's capital. In addition, the Date Association is contemplating a distillery to convert into alcohol dates which are surplus to market needs. With respect to the proposed alcohol plant, caution should also be exercised. For the time being the demands for alcohol may make another plant appear attractive, but it is doubtful that in the long run dates can compete with other raw materials such as molasses as an economical source of alcohol.

Fruits. (map 40). These types of tree are mostly grown close to the date-producing areas. The total area planted with fruit trees is shown in table 18 as 171,500 mesharas. Approximately 70.5 per cent of this is in the six intermediate gadhas of Karbala, Najaf, Hindiya, Hilla, Hashimiya, northern Abu-Skhair and Shamiya, as shown on map 40. Map 41 illustrates the distribution of fruit trees and percentage of each type. A remarkable feature of the land used for fruit growing in the central parts of the country is that the land planted with date palms is also often utilized to produce the other fruits. This concentration is a result of the advantages of the area, because the plantations are sufficiently watered by the river and canals, and because of the good soil. This group of crops is found only sporadically in the east and south of the Jezireh and is absent from most of these tracts. The typical orchard will contain a wide variety of citrous fruits with trees of all ages.

Pomegranates are considered as one of the important fruits grown in this region. Table 19 shows a total of 576,000 trees of bearing age are planted mainly in the four gadhas of Karbala, Najaf, Hindiya and Mahmudiya. Map 41 shows that Karbala, Najaf, Hindiya and Mahmudiya account for 90 per cent of the whole area planted annually with this type of tree (photo. 51). The principal harvesting season for pomegranates is from August to December. Most of the fruits are consumed locally and Karbala is the main central market for them (photos. 52, 53). Some quantities are exported to nearly all countries. The skin or covering of the fruit is used to some extent in the local tanning industry.

Oranges are another important fruit crop produced in this region. Table 19 shows that the number of orange trees amounts to about 189,000. Production is concentrated in the four gadhas of Karbala, Najaf, Hindiya and Hashimiya. These four units account for 80 per cent of the total trees as shown on map 41.

The oranges produced in the country are mostly of very good quality. Practices leading to good production include planting on well-drained soil, and with date palms so that they will receive some protection from frost and also from intense summer sunshine and hot winds. Usually a small proportion of the annual crop is exported to the neighbouring countries.

Apple trees, shown in table 19, amount to almost 180,000 trees of bearing age. Of this number Mahmudiya and Hilla alone account for 75 per cent, while the remainder is distributed mainly in Hindiya, Hashimiya and Shamiya.

Most of the apples are of the summer variety. The fruit is sent directly to the central markets in Karbala, Najaf and Hilla as well as to Baghdad, resulting in a rather short period when the local crop is available to the consumer.

Apricots are one of the important fruits produced throughout the region. Table 19 gives a total of 140,500 trees of bearing age. Most of these are in the Karbala, Hilla provinces and Mahmudiya gadha (photos. 54, 55). These areas account for about 65 per cent of the total trees planted for this type of yearly crop. The general location of apricot trees of bearing age is on good soils and near to the retail markets, to ease the movement of the crop over a relatively short period of time. A great proportion of the crop is harvested during May and June.

Lemons consist of two types; sweet and sour. They occupy second place in importance, oranges being first. Table 19 shows there are 73,500 sweet and sour lemon trees of bearing age, most of which are in the gadhas of Karbala, Hilla and Hindiya as shown on map 41. About 70 per cent of the total number are in these two areas.

The principal harvesting season is from October until February. Because this fruit is particularly sensitive to cold weather, losses sometimes occur from sudden drops in temperature. Production is consumed locally and is hardly enough to meet the demand.

Peaches and Pears. The number of trees of bearing age in the Middle Euphrates valley is 26,600. This figure is distributed through all the gadhas with the exception of the Hilla province. About 86 per cent of these trees are found in the Mahmudiya, Shamiya, Karbala and Abu Skhair gadhas as shown on map 41 (photo. 56).

Most of the crop is harvested from the latter part of June until early September. The production is consumed locally. In addition small quantities are imported from nearby countries.

(d) Vegetables. (map 42)

The growing of vegetables is limited in the Middle Euphrates Valley to certain areas around towns and villages, near the river and canals from which local irrigation is possible. Summer vegetables are often grown in the broad beds either of the river or the canals, adjacent to the water's edge as well as being grown by inter-cropping in palm-groves and fruit orchards. The summer vegetables include cucumbers, water-melons, bamia (okra) tomatoes, onions, eggplants and potatoes. Winter vegetables are cabbage, cauliflower, carrots, turnips, spinach, beetroots, lettuce and celery.

Land used for the cultivation of vegetables amounts to about 74,923 mesharas as indicated in Table 18. This is about 3.4 per cent of the total area planted with annual crops and less than half of the area planted with fruit trees. Water melons, other melons, tomatoes, cucumbers and eggplants account for 86 per cent of the total area planted with annual vegetable crops.

Map 42 shows that Mahmudiya, Falluja, Hilla, Hashimiya and Diwaniya gadhas are by far the leading districts in the production of vegetables with about 69,350 mesharas or a three-fifths of the Country's total. The first two areas enjoy a good situation, near to Baghdad regarded as the largest consumer market for vegetable crops, whilst the other three gadhas are located close to the cities of Hilla, Najaf and Diwaniya which represent the main consumer markets for this type of crop. For the other gadha units, with the exception of Musayib and Hindiya, the greater part of the vegetables are produced, for nearby markets like Karbala, Kufa, Hashimiya, Samawa, Shamiya and Abu-Skhair. A few vegetables are exported, chiefly during the peak of the harvesting season. Imports include potatoes and tomatoes.

Livestock (maps 43-49).

Probably as many families in the Middle Euphrates district depend upon stock breeding for their livelihood as upon cultivation of crops. It is the sole source of wealth of the semi-nomadic peoples (Shawiya tribes), and many of the fellahin people also keep sheep, cattle, goats, buffalo, horses, mules and donkeys. Stock breeding is regarded as the second economic resource after cultivation. But it is by no means certain that the improvement of stock quality rather than an increase in numbers, particularly of sheep, does not offer a simpler and equally suitable method of enriching the population. Cultivation and stock breeding do not seem to have been regarded as complementary forms of agriculture, yet even in the primitive system of this region they are so in fact. The limiting factor with live stock is the irregularity of natural grazing and the inadequacy of fodder supplies. The basic agricultural problems such as soil salination, the shifting of cultivation and of the fellahin population, and the extreme dependency of the cultivators for the disposal of second-class products upon an overcrowded world market - all these might well be modified by a more systematic interrelation of good stock breeding and cultivation. However, the livestock-raising as part of the limited amount of mixed farming of this region is based on the production of fodder crops and some use of the fallow lands. Sheep and goats are kept in large numbers in almost all parts of the country. The main cattle areas are in the intermediate region, and water buffalo are numerous in the riverine areas, particularly in the south. Donkeys and mules are used as draught animals.

Generally speaking, livestock is left to forage for itself, with a little supplementary feeding of straw and perhaps a little barley in winter. The livestock that enjoys systematic feeding is that raised in and around the towns.

By and large, those who are engaged in livestock raising in the country do so rather haphazardly, paying no attention whatsoever to the improvement and selection of their breeds. Sheep and goats predominate because they thrive despite poor grazing and feeding.

Most of the cattle in the region are kept outside agricultural holdings, in villages and around large towns. This is also true of buffalo. Owners of milking cows and buffalo find it necessary to settle around the consuming areas. Unfortunately, however, there is no modern dairy industry in the region. The larger towns receive their milk and milk products from cows, buffalo, sheep and goats. Milk pasteurization is not known except in Baghdad when a small pasteurizer was installed in 1946, capable only of pasteurizing the milk coming from the Abu-Ghraib agricultural station.

<u>The sheep</u> (map 43) industry ranks first among the various

livestock enterprises in this country. Sheep are an important source of meat, wool, milk, skins and casings. Table 20 shows 1,096,428 head of sheep, or 61 per cent of the total livestock, on holdings which were rather well distributed throughout the 14 gadhas as indicated by map 43. Table 20 shows that 59 per cent of the total number of sheep is concentrated in the four gadha units of the valley. Map 43 illustrates that the highest proportions are at Samawa, Abu-Skhair, Ramadi and Falluja, in these areas of poor grazing land marginal to the desert on the west, and the Jesireh high plain to the north i.e. The lands unsuitable for cultivation. The concentration along the northern and western borders of these four units reflects the proximity of the Jezireh grazing land to the north and the desert to the west. This natural grazing, together with the cultivated grass and the fodder supplies of the valley, determine the number of sheep which can be carried. The concentration of sheep decreases in the Karbala, Najaf, Hilla north of Hindiya and south-west of Musayib gadhas, the lowest proportion being in these areas. Here, the number of sheep depends proportionately upon the amount of permanent grass and other fodder available. These latter gadha units are occupied mainly by orchards. Sheep in this region are of the fat-tailed Arabic type, evolved over the centuries in adaptation to harsh environments (photo. 57), but because of their high evaluation are now found in the areas of best farming.

Sheep and their products are, undoubtedly, one of the big sources of revenue of the country and, in spite of the primitive methods followed in breeding, they occupy the third agricultural economical position of the area of the Middle Euphrates, cereals and dates taking precedence.

The type of sheep in this district is fully adapted to its environment and the mode of life of the villagers and semi-settlers. They are able to travel long distances, following the pastures during the spring either in Jezireh or in the Arabia desert (photo. 58). They can stand climatic variations and shortages of food and are relatively hardy and resistant to disease.

The main kinds of sheep which predominate, are the Awassi and the Arab. The former are found in the upper and central parts of the valley. They are hardy and able to travel long distances in search of food on the plains and desert pastures where grazing is often very sparse. The latter, which are called Arab sheep, are distributed widely in the southern parts of the valley especially in the Jezireh Zone where they are also known as Shevali. They are very docile and hardy and their wool is shorter and finer than that of the former type (photo. 59). All sheep-breeding depends on seasonal migration. In winter and spring shepherds follow the growth of vegetation in the Jezireh steppes and desert, and enter the rivers and canals as the summer heat dries them up, pasturing their flocks upon empty lands close to the water-courses and marshes or upon cultivated fallows, after making an agreement with the cultivators whereby the fellahin receive a rent in animals or their produce in addition to having their fields manured.

Lack of a continuous supply of fodder and the prevalence of parasites are the two outstanding drawbacks to sheep-raising in the country and both these problems will have to be solved before any further policy of improvement in sheep husbandry can be established. Therefore, there can be no improvement in any flock unless each individual of the foundation stock is healthy and well fed. Selection of breeding stock is carried out by the shepherds themselves with little regard to any laws of breeding.

Cattle (map 44) are one of the most important kinds of livestock kept in the country. Table 20 shows a total of 216,385 head or 12.5 per cent of the total livestock on agricultural holdings. Of the total number, about 67 per cent are in the five gadhas of Mahmudiya, Ramadi, Najaf, Samawa and Hashimiya as indicated by the map 44.

Cattle are mostly kept by fellahin and semi-settled tribesmen in riverine areas where there is permanent pasture (photos. 60, 61). They are also found around the larger urban centres which offer local retail markets, and the Co-operative Dairies at Hilla, Baghdad and Abu Ghraib, this last the main centre, are particularly important centres of attraction. Cattle are important sources of milk, meat and hides. They are also used extensively for ploughing and working water-lifts. But milk products such as butter, milk and clarified butter (ghi) are staple foods, and the last product is a valuable export item.

The methods of stock farms are most primitive, except in some limited areas where there are modern breeds as a result of the recent programme carried out by the Veterinary Department to improve the milk industry. The Abu-Ghraib is an important modern industry and the best one, not only in the Middle Euphrates district, but in Iraq. (photos. 62, 63).

There are two main cattle breeds. The Janabi, which is the best milker, is found mostly in the lower regions, while Grosses of Ayreshire, Friesian, and Sindi breeds are found to some extent around the town centres throughout the country. Goats (map 46) are also numerically important. Table 20 shows 162,887 head on holdings or 10 per cent of the total number of livestock. Map 45 shows the distribution of goats throughout the region. Of the total number, slightly less than two thirds are concentrated in the gadhas of Falluja and Mahmudiya in the upper region, and Ifaq in the Jezireh Zone. But it must be noted that practically all farmers have some goats.

Goats serve the same purpose as sheep but their produce is less valuable, though ordinary goat-hair is used for the material from which the tents of nomads are made (photo. 64).

Buffaloes. (map 46) Another kind of livestock raised in considerable numbers in the region is commonly referred to as the "Water Buffalo". According to Table 20, a total of 13,106 head, or 1.5 per cent of the total livestock, are found on holdings in the valley. Map 46 indicates that the buffaloes are found over the whole country but that most of them are concentrated in the four central and southern gadhas of Najaf, Abu Skhair, Diwaniya and Shamiya (photo. 65). Slightly over 65 per cent of the total number are kept in those districts where there are large areas of marsh-land, providing a favourable habitat for these animals. In the case of non-cultivating semi-settled tribesmen and marsh villagers in the marsh-lands, water buffaloes rather than sheep are the principal means of subsistence.

Buffaloes are raised and kept mostly for milk production. Their milk is much higher in butterfat content than milk from the average dairy cow. They need careful attention and suffer from insects in summer and cold in winter.

Horses. (map 47) The number of horses as shown in Table 20, is 43,958 or 3 per cent of the total number of livestock on the holdings. About 59 per cent of the horses throughout the region are in the four gadhas of Samawa, Hashimiya Mahmudiya and Ramadi as shown on map 47. The concentration throughout these four units reflect the distribution of Arab tribes who use horses for riding in these areas.

Only Arab horses are bred in this country. The better ones are kept for breeding and racing while the inferior type are used for farm or other heavy work. A relatively small proportion of horses are exported each year.

Mules (map 48) are bred and raised throughout the northern part of the country. Table 20 shows 2,295 mules on holdings, slightly over 95 per cent of this number in the five gadhas of Ramadi, Falliya, Mahmudiya and Najaf. Map 48 shows where they are distributed. They are used primarily for ploughing and transport on farms, because of their strength and ability to withstand hardship.

Donkeys (map 48) are rather common throughout the country as is indicated by map 48. Table 20 shows a total of 174,813 head on holdings, or 10 per cent of the total livestock in the region. About 70 per cent of these are in the five gadhas of Ramadi, Falluja and Mahmudiya in the upper, Najaf in the central, and Samawa in the lower, valleys.

They are by far the most important, being the principal pack and riding animals in the rural life. They are used extensively for transporting agricultural products from the farm to the local markets in towns and villages.

The donkeys are of two types. The majority are of the indigenous Iraqi breed, dark coloured and of small size. The other type is the Hassawi breed which is much larger, white in colour, stronger and faster in movement.

Camels. (map 49) Most of the camels in this region are bred on the Jezireh plain, and are also found on farms or holdings but they are relatively unimportant compared to most other classes of livestock. Table 20 shows a total of 18,326 camels or 1.4 per cent of the total livestock in the country. Map 49 shows the distribution of camels. These are concentrated along the northern border in Falluja gadha and on the western edge of the desert in both Najaf and Abu Skhair as well as upon the further east of Jezireh in gadhas of Hashimiya and Ifaq. These concentrations reflect the distribution of grazing land, and, at the same time, correspond with the original homes of the Dulaim tribes on the north, the Khazail on the west and Albu Sultan on the east.

They are used for transport, but their usefulness is limited by the fact that the soft going of the alluvial plains in winter makes movement difficult as compared with the arid areas.

There are two kinds of camels kept in the region. One breed, relatively few in number, is used primarily for riding and is found mostly in the Jezireh areas. The other kind is larger and kept primarily as a beast of burden. Camels are also important as a source of hair, but of relatively minor importance as a source of milk and meat. In recent years the number in this country has been decreasing due mainly to the increased use of the truck as a means of transport.

Livestock improvement

The productivity of livestock is extremely low, primarily because of an inadequate food-supply. Existing practices are such that the farmer generally tends to concentrate on grain and cash crops and leaves such animals as he may have, to forage for themselves. In some circumstances, as in the case of cotton, where high prices have stimulated a rapid expansion of production rapid commercial response by the farmers has resulted in the neglect of the livestock settler. In the main, however, greater productivity in this field depends on the success of efforts to persuade large numbers of landowners and cultivators to change their old methods and techniques of handling livestock.

Improvement in both the quality and quantity of livestock production is likely to be of increasing importance in the future, particularly since the anticipated rapid increase in public expenditure on development as a whole will create an expanding and more discriminating market for animal products. The first requirement for improving the health of livestock is to provide adequate food. At the same time, attention should be given to the prevention and cure of diseases and the care and protection of animals. One of the best methods of exploring the possibility of improved breeding, and the results of better feeding, and other livestock practices, would be to establish a number of herds and flocks of indigenous breeds on government farms throughout the country. There, careful records could be kept to discover for the first time what these animals can really produce with improved feeding, breeding and management. These livestock stations could also make available to farmer progeny-tested sires for breeding. Above all, farmers could be brought there to see with their own eyes the benefits of better livestock practices and the value of mixed farming.

A start toward establishing such herds and flocks has already been made.

At Abu Ghraib Farm, the selected flock of Awasi sheep, which has been established recently, should prove very useful for providing information on breeding performances, milk production, wool yield, etc. The herd of Janabi dairy cows, should follow a carefully planned programme for breeding, feeding and types of management to determine their performance, the influence of improved feeding, and be used, if possible, to found dairy stations for the Middle Euphrates valley.

The Agricultural Department has taken a step in the right direction in installing a small milk pasteurizing plant in Baghdad, but the only milk passing through the plant is some 300-400 litres a day from Abu-Ghraib agricultural station.

The improvement of livestock and livestock products and its role in the country's economy can hardly be over-estimated. Livestock not only provide the people with an important source of food, but there has long been a surplus for export to other countries. Sheep, goats, cattle are exported to Syria, Jordan, and Kuwait; horses are exported to Egypt, Saudi Arabia, Jordan, India, Ceylon, and France. As to livestock products, wool is exported to the U.S.A. and U. Kingdom.

2. <u>Agricultural Regions</u> (map 32)

The agricultural regions of the Middle Euphrates valley are as follows:-

I - The Upper Valley, between the Great Musayib canal and the far north boundary.

II - The intermediate region, between the Great Musayib Canal stretching south as far as the town of Kufa.

III - The Jezireh Zone.

IV - The rice zone, between the Kufa and the Shinafiya village.

I. <u>Upper Valley.</u>

Below the steppes of the upper Euphrates-Tigris (The Jezireh high plain), lying between the two rivers, there is a region usually called the upper valley, with much arable land which is mainly limited to river and canal bank zones in the west, and the natural drainage of the Euphrates-Tigris outfall to the east. Cereal predominate, particularly wheat and barley as shown on map 32. The farms of this area control most of the fields, except for some land which is owned by the sheikhs of the Dulaim tribes and other land-owners who live in the towns of Ramadi, Falluja and Baghdad. The latter type of absentee land ownership predominates in the Saqlawiya and Abu-Ghraib project areas. Most of the farms grow cereals, mainly wheat, the area under which is twice that used for barley. The cotton farms, and vegetable farms (mainly growing water melons which are used as a cash-crop) come second, whilst the other minor grain farms, orchards and mixed farms of livestock take third place. The cattle and buffaloes are bred for milk and meat. Milk produce is more important than the output of meat which is consumed locally; most of the milk is transferred to the chief collecting centres of Ramadi, Falluja and Baghdad.

Muhsin Ahmed farm (Diagram 9) is typical of mixed farms in this region. It is situated on the left side of the Euphrates river about 5 kilometres north of Saqlawiya village and just south of the Saqlawiya head canal. It occupies 390 mesharas: 50 mesharas of this area in saifi crops, comprising 15 mesharas of cotton, 20 mesharas of vegetables, 10 mesharas of orchards, 3 mesharas of sesame and 2 mesharas of alfalfa.

The shitwi crops comprise 155 mesharas, 90 mesharas of which are wheat and 65 mesharas are barley. The land lying fallow is 145 mesharas. Altogether there are 30 head of livestock, 20 sheep, five cattle, one buffalo and four horses. Some of the cow milk is sold locally but most of it is sent to Falluja, the market centre of the district. At the farm, all sheep are put out on the fallow fields of the farm, while the cattle and horses are kept on the alfalfa pasture. The horses are used for farming and transport.

This farm is watered by means of a 36 horse-power pump.

(photo. 35). Other agricultural processes, such as ploughing and thrashing, are accomplished partly by tractor and partly by horses (photos. 66, 67, 68, 14).

There are only 4 tenant farmers with their families who depend on its income for their livelihood. The total income received from this farm has, however, to be shared by both the owner of the pump who in this case is the landowner and the farmers. Usually, the income or the production of the farm is divided into five shares, two-fifths of which goes to the landowner and three-fifths to the 4 farmers. The table below shows a rough annual income of the farm which is a typical average for the farmer in the upper region.

Annual farm crops	Annual gross farm income (Iraqi Dinars).	Value of share
Wheat	100	116 Landowner
Cotton	70	174 (for 4 farmers)
Barley	45	43.5 (for one farmer).
Vegetables	50	
Animal produce	25	
Total	290	

The table above shows 290 I.D. as the annual gross income from the farm. The farmer with an average size family of 7 thus gets either a fourth of this crop, or a fourth of this income which amounts to 43.5 I.D.

II. Intermediate Region.

Below the Great Musayib Canal, as far south as Al-Kufa town, the agriculture of the valley as far west as the desert and as far east as the Tigris-Euphrates outfall seems much more prosperous. This region can be divided into the following divisions:-

(a) Levee Area.

(b) Western margin.

(c) Eastern margin.

The activities of this area are clearly seen on both sides of the river. Here the orchards are greatly improved, but the percentage of arable land has also considerably increased in spite of the high percentage of soil salinity in some portions. The area under palm-trees and other fruit-trees have increased within recent years; barley, wheat and other minor grains have remained fairly constant. Rice in particular has shown a considerable increase, especially in the southern parts of the Hindiya gadha. Cotton crops do not thrive, and they cover only a limited area, less than other crops. This is partly due to the damage caused by the attack of pests, and partly to the lack of water supply away from the marsh areas of rice growing. Vegetables are a less important crop in the area.

It is noticeable that the fields in this area are of medium size, except for a few large estates, yet they support a higher density of cattle than the larger fields have of sheep in the same district. In this part of the valley, there is the double aspect of cattle rearing (both cows and buffaloes), mainly for milk products, but partly for meat. The dairying aspect has increased slightly because of the proximity of densely populated areas. One group of farms sells its milk to the Karbala, Hilla, Najaf centres whilst other farms sell to the towns of Tuwairij and Abu-Skhair.

In spite of the general similarity and uniformity of production in the area, the western parts, within the Karbala province, specializes in orchards more than any other crop. The author has thus chosen three farms, one of which is typical of the farms situated in the Levee area (hamid Al-Rashid farm), the other of orchard farms in the western margin (Haj Mahdi al-Hamid farm) and the third is of mixed arable farms in the eastern margin (farm No. 9).

IIA. Hamid Al-Rashid farm (Diagram 10) is typical of the mixed farms in this region. It is situated on the right side of the Hindiya branch, just a few kilometres south of Hindiya Barrage. It covers a large area, extending from south of the Hindiya Barrage in the north to the Saifi - Syad Habib estate in the south. In the west its border is a private road, and in the east the Shatt-Al Hindiya (Hindiya branch).

The land tenure system of this farm is Miri Lazma. It occupies 2,038 mesharas are usually wheat, with an average yield of perhaps 176 kilogrammes per meshara. The barley area is three times that of the wheat, and gives an average yield of about 145 kilogrammes per meshara (photo. 69). About 240 mesharas of rice usually grown with an average yield of about 420 kilogrammes per meshara. There are at present 840 mesharas of orchards, including palm-trees and fruits, and 50 mesharas of vegetables, 20 mesharas of cotton are usually grown, with an average yield of about 100 kilogrammes per meshara. There are approximately 150 mesharas of waste saline land and about 450 mesharas of fallow fields.

Normally, Hamid Al-Rashid farm carries 50 to 70 head of cattle, and about 6 head of buffaloes. There are 4 horses kept on the farm, and usually 80-90 breeding sheep. There are about 70 poultry, kept only for domestic needs. Almost without exception, the livestock products of the farm go to the grading centres at Karbala and Hilla, whilst the wool is sold to the wool market in Baghdad or Basrah. Cereals, such as wheat, barley and rice, are sent to Baghdad or Basrah by rail. Livestock is transported in vehicles; wool and cereals are collected by the buyer from the farm. Dates are sold to the Date Association in Basrah, whilst fruits and vegetables are sold to local markets mainly in Hilla, Najaf and Karbala.

There are a hundred full time male workers employed on the farm.

The income received from this farm has, however, to be shared by both the landowner and the fellahin. According to the flow-irrigation system, the landowner receives three-fifths of the annual income, whilst the fellahin share the remaining two-fifths. But under the pumping system, they would share equally with the landowner. In this case while the pumping system is more demanding of capital to the landowner, the resulting perennial water supply calls for considerably more labour from the fellahin.

The farm is watered partly by flow-irrigation from the Beni-Hassan canal and partly by a 35 horse-power pump.

The soil on this farm varies from light-brown to greyish-brown clay loam to silty clay but it has a considerable element of salinity. It is roughly typical of conditions in the Middle Euphrates basin. The type of agriculture best suited to such soil, would, under normal circumstances, be based on, livestock products, with the emphasis probably on milk production. Under present circumstances, there are probably less arable mesharas than the soil could carry on a permanent basis. The normal rotation upon this farm is between cereals and orchards.

IIB. Haj Mahdi Al-Hamid farm (Diagram 11 and photo. 70), is a typical orchard farm in the intermediate valley. It is located in the Auarah estate on the left side of the Husseiniyah canal three km . east of Darawish hamlet in the Karbala gadha. It covers 800 mesharas, 340 mesharas of which are orchards, including palm-trees and fruit-trees, especially pomegranates. There are 40 mesharas of vegetables, including Okra, eggplants, tomatoes and cucumber, and 10 mesharas of Alfalfa, which is used as a fodder crop.

Of the Shitwi crops, barley covers 160 mesharas and wheat 30 mesharas. The rest of the area, which accounts for about 220 mesharas, is fallow land.

The land tenure system of the farm is Miri Lazma. The farm employs 35 men. The production here is divided into two halves, one of which is the landowner's share, the other the fellahin's share. According to this, the fellah who has an average size family of 6 gets his share of the 50 per cent of farm production. (see also p. 336).

This farm is watered by means of the flow-irrigation system from the Husseiniya canal (photo. 43).

IIC. Below the administrative boundary between the gadhas of Musayib-Hilla, and as far as the rice zone (which is mainly on the left side of the Hilla canal north of Hashimiya), the agriculture of the intermediate valley presents a slightly different aspect from district A and B. It includes the best soils of the area which are only slightly affected by salinity as a result of the regular irrigation, and in addition, the district has easily served flow-irrigation land. Arable farming is more important here, with barley and beans being of major importance and other grains of secondary importance. Cotton is grown as a cash crop. Cattle, buffalo and sheep rearing is also important and a considerable number of donkeys are used for carrying loads, especially fruit and vegetable crops to the market centres of the district.

A typical farm is farm No. 9 (Diagram 12) situated on the Mahawil canal, west of Mahawil village and on the right side of the main road between Hilla and Baghdad. The land tenure of the farm is Miri Lazma. It covers 710 mesharas, 355 of which are fallow land. The remainder are under the shitwi crops, as follows: About 280 mesharas of barley, 38 mesharas of wheat, 18 mesharas of beans, lentils and alfalfa, 19 mesharas of orchards, including palm-trees, oranges and apricots.

The saifi fields are usually cultivated immediately after the shitwi area has been harvested. There are between 35-70 mesharas of rice, 10 mesharas of cotton (photo. 71), 3 mesharas of sesame, 50 mesharas of which are tomatoes. About 60 per cent of the shitwi production is transported by means of rail to Basrah, and from there barley and dates are exported by ships to the foreign markets. The remaining 40 per cent is sent to Hilla market. The fruits and a large proportion of the vegetables are sent in vehicles and trains to Hilla, Baghdad, Musol and Najaf. The cotton crop is sent to the Iraqi cotton gins in Baghdad. Rice production is mainly consumed locally in the Hilla province. There are altogether 70 head of cattle which belong to the fellahin, 40 of which are milk cows, the others being bulls, heifers and beef cattle. The total number of sheep and goats which are kept on this farm is 2,000, about 5 per cent of which are goats owned by the fellahin. Usually sheep and goats are kept on the fallow land during winter and summer, whilst in the later winter and spring seasons, the herds move partly throughout the Jezireh and partly into the Arabian desert to obtain food (photo. 58). About 100 head of buffalo are bred by a semi-settled people (Mi'adan) who live in this area. 14 horses are bred for the purpose of riding and cultivation, while there are 50 donkeys used for carrying loads and crops.

The income received from this farm has, to be shared by the landowner, who gets three-fifths from the fields under the flow-irrigation system, and the fellahin who receive two-fifths. With regard to the pumping system, the income has to be shared between them equally.

There is another share to a person called the "Dihdar" (photo. 40(b)) who usually gets one per cent of the rice crop from the fellah's share only. The Dihdar's duties include the distribution of water supply among the several rice fields, not only on this farm but also on estates, situated within the one area, but belonging to other landowners. In addition to this, the fellah has to pay the expenses for all the agricultural processes such as thrashing and harvesting, as well as the cost of seeds.

The sirkal, who is the agent of the landholder is another sharer, this time of the landowner's profit, traditionally receiving a 4 per cent share of the crops from the landowner.

According to the water-wheels system, the landowner gets only a fifth, whilst the fellah gets four-fifths, of the production. Usually the water-wheel is owned by the fellah so that he has to receive a higher proportion than the landowner.

Generally speaking, it can be said that the area under discussion is a typical farm, especially from the point of view of means of irrigation and the sharing system of crops. About 90 per cent of it is irrigated by the flow-system, and 10 per cent is watered by the pump and water-wheel systems.

There are 50 full-time male workers employed on the farm. On the basis of the landowner's statement, the annual income of the fellah who has an average size family of 6, is 60 I.D. The estimated total number of the fellahin who enjoy this standard of annual income (according to the landowner's report) is about 90 per cent, whilst 10 per cent earn about I.D. 300. This estimate seems to be true for the whole intermediate region.

III. Jezireh Zone.

The Jezireh area extends from the southern border of the Great Musayib project between the Hilla canal to the west and the natural drainage of the Tigris-Euphrates outfall as far as the Kut-Nasiriya boundary in the south. This district consists of two main divisions, the eastern and southern Jezireh, and is orientated in a north-western to south-eastern direction. Its soil is composed of wind blown materials, river overflow deposits and lake sediments, or a combination of these. There are large sand drifts, some of high salinity derived from the blowing of salty silt. Generally the agriculture is similar to that of the intermediate region, but there is much less arable land, partly because of the lack of irrigation projects and partly for economic reasons. It has a high proportion of underdeveloped land so that most of it has been put on the Development Board's programme for establishing new projects like the Musayib and Babil schemes. It has been found by the people less economical to work in agriculture and livestock. However, there is a tendency for more attention to be paid to sheep breeding at the present time, because of the rough grazing land available especially during the spring season. Typical crops for its cultivated areas are barley, other minor grains, rice and vegetables.

IIIA. East of the district: Haj Atiyah farm (Diagram 13; photos. 72, 73) is a typical farm of the eastern part of this region. It is situated in the estate of Haur Hjab, in the Madhatiya nahiya of the Hashimiya gadha. It covers 1,000 mesharas and its land tenure system is Miri Lazma. About 485 meshara of it are fallow land, 30 mesharas are orchards, and 485 mesharas are under arable cultivation. Large quantities of winter barley are grown, about 383 mesharas of which are used partly as a cash crop and partly as fodder crop. There are 30 mesharas of beans; 50 mesharas of garlic; and 22 mesharas of alfalfa which is used as fodder. Summer crops include 50 mesharas of rice used mainly for local food consumption, 5 mesharas of cotton which is grown as a cash crop and 25 mesharas of vegetables which are mainly sold in the local central markets of the district.

There are 20 cows, 180 sheep, 20 goats, and 3 horses for general farm work. The barley crop is sent to Basrah by train, while the cotton is sent to the cotton gins in Baghdad. The milk products of the cattle and sheep are sold mainly in Hilla and Diwaniya but the sheep themselves and their wool are usually collected by the buyers.

There are 12 full-time male workers employed on the farm and an average family of each fellah is five. The system of sharing production here varies from the previous districts, which have already been discussed. The fellah receives two-fifths of winter crops and a half of the summer production whilst the landowner claims the rest. The farm is watered entirely by means of the flow-irrigation system from the Badah canal which branches off from the Hilla canal.

The predominant type of holding in this region is large, for instance 70 per cent of the land property belongs to four landowners.

IIIB. South of the Jezireh: The southern reaches of the district occupy the area south of the city of Diwaniya as far as the Nasiriya-Kut boundary. In places it has lowlying lands, such as the Ifaq depression; there are also some swamps here and there. In any case, much of the region has poor soils, so that, with all factors combined, the district is not very productive agriculturally. The arable farming around the Rumaitha project is on a small scale so that the size of the farms is generally small. The large estates are to the north of Rumaitha where the high lying land is situated. This part of the area is owned only by the Sheikh Khawam and Sheikh Shenshil. There are two farms, one typical of the former district (Abdul-Aziz farm) and the other is typical of the latter (Abu-Tabiakh farm).

Abdul-Aziz farm (Diagram 14) is a typical farm of the southern Jezireh area. It is situated below the settlement of Rumaitha, on the left side of the Shatt Al-Katsha which is one of the Rumaitha canals system. It is characteristic of the unspecialised small scale farming hampered by relative shortage of water and traditional and social factors.

The farm covers 60 mesharas, which are divided into three areas, each devoted to one type of crop. The first of these three divisions is winter land, an area of 25 mesharas of barley and 10 mesharas of wheat. The produce of this gives an annual income of I.D. 63.990. The second type of land is saifi land, whose area is 15 mesharas, 10 mesharas of which are rice (photo. 74) and 5 mesharas, sesame and millet. The income of this summer crop amounts to about I.D. 29. The third division, 25 mesharas, is fallow land.

The table below shows I.D. 92.990 as the annual income of this farm.

Farm crops.	Annual Income of the Farm (Iraqi dinar).
Winter wheat and barley	63.990
Saifi rice, sesame and millet	29. -
Total.	92.990

According to the table above, the fellah with an average size family of seven, gets either a third of this income, or a third of the crop itself.

Abu-Tabikh farm (Diagram 15) is a typical farm of the district between the city of Diwaniya and the village of Rumaitha, and is characteristic of specialised cash crop production based on availability of capital and water. It lies just south of the settlement of the Hamza Nahiya along the Diwaniya-Rumaitha road in the estate of Al-Aksha, and consists of 300 mesharas of summer vegetables. The vegetables include 100 mesharas of tomatoes, 100 mesharas of all kinds of water-melon, 50 mesharas of eggplants and 50 mesharas of bamia. This farm has a different rotation system compared to the farms which have already been discussed. The whole farm is devoted to summer vegetables, and it depends on artificial fertilizers, so that the fallow system is almost absent. There are altogether 13 full-time male workers employed on the farm, (photo. 75). The total farm income according to the statement of the tenant is about I.D. 6,000. Therefore the man who owns both land and pump gets 65 per cent of this total amount, whilst the farmers altogether obtain 35 per cent. In accordance with this, the farmer who has an average size family of seven gets about I.D. 161. In addition, he receives extra income from cow's milk-products. There are 20 head of cattle on the farm, which is irrigated by means of a 70 horse-power pump (photo. 60). The vegetables and the milk products are sent by vehicles to the local central markets in Samawa, Diwaniya and Rumaitha.

To the west of Rumaitha there is Shinafiya-Samawa district. This area, which stretches, below the rice zone, has a number of arable fields distributed along both sides of the river, and confined by the desert edge to the west. This district lies on relatively high land, compared with the rice areas to the north. In any case, much of the area has good soil and natural drainage, so that all factors combined, the district is agriculturally productive, except for the shortage of water in the summer season when the river level falls. Typical activities of this area are seen particularly well on the east side of the river. Here the majority of arable land is very productive. The area under barley are twice as great as those under wheat.

It is noticeable that the holdings in this area are comparatively small as a result of pressure of population on this limited area of attractive land, so that the farmers have taken up dairying on a small scale to supplement their annual income. There is some sheep rearing because there are extensive areas of rough grazing on the marginal desert, accessible to the cultivated lands. This grazing zone is used as natural pastures for sheep breeding in late winter and in the spring. The sheep are allowed to roam the same area during the summer to get dry hay.

A good typical farm of this type is Al-Haj Awad farm, which lies to the left bank of the river a few kilometres south of the settlement of Samawa. The land is mainly flat and the soil chiefly composed of clay and sand. The farm covers 200 mesharas and employs three men. About 15 mesharas are orchards, 70 mesharas barley and 25 mesharas wheat. The summer crops include 10 mesharas of rice and 6 mesharas of millet, sesame and vegetables which are used for the domestic demands of the farmer. There are, an average, 200 sheep, 4 milking cows, 3 horses, and 10 donkeys.

The produce of meat, milk and minor grains are sent in vehicles to the markets at either Samawa or Diwaniya whilst the barley and dates are sent by train to Basrah.

The produce from the farm is divided among three sharers. The landowner's share is a seventh of the crops whilst the remnant is divided again between the tenant who gets two-thirds of it, and the fellah, who retains the other third. According to this share cropping system, the table below shows 30,380 I.D. as the annual income for the farmer with an average size family of 7.

Crop	Annual mesharas of Farm Crops.	Annual Farm Income. (Iraqi Dinars)	Sharers of Income.	Value of Share.
Orchards	10	51	Landowner	45 3/7th
Barley	70	75	Tenant	182 2/7th
Wheat	25	37	for 3 farmers	91 1/7th
Rice	12	75	for 1 farmer	30.380
Millet	6	14		
Animal produce	-	67		
Total		319		

It may be noted that in the system of sharing produce in all the farms which have been already discussed, there is no fixed system for sharing, but, rather, a variation from one area to another throughout the country. The size of the farmer's share depends on the quality of the land. As a working rule, the better the land, the smaller his share.

The means of irrigation followed in this farm depends upon pumping-system and water wheels.

IV. Rice Zone.

This includes two types of agricultural fields, the rice areas, and the orchards which are grown on high reaches of the district.

Below Kifl and a few kilometres south of the town of Shamiya, the rice farms extend south as far as the village of Shinafiya. The agriculture of this region is mainly devoted to rice cultivation, particularly in the lower reaches. The physical features of the land, together with the silty soils around the swamps have made the district a favourable environment for the growth of rice. Beside the rice fields, there are considerable areas of orchards grown on the higher reaches of the district, particularly in northern sections. Rice in this district occupies the highest proportion of marshes. Barley and wheat cover only a few mesharas, whilst palm-trees and other fruit trees cover considerable areas.

Shamiya No. 20 farm (Diagram 16 and photos 39, 76) is typical of the rice farms in this district. It is situated mainly on the left side of the main road between Diwaniya and Shamiya, where it occupies the southern part of the Haur Ibn Najim (photo. 77). Its land tenure system is Miri Lazma. It covers a gross area of 2450 mesharas, 358 of which are fallow. The rotation system here differs from the other farms because the land has more fertility, which is annually added to by flooding. The summer crops are dominant, including 1400 mesharas of rice, and 30 mesharas of green grams.. The winter fields consist of 230 mesharas of barley and 150 mesharas of wheat, which are distributed on the higher reaches around the rice cultivation areas. There are about 262 mesharas of orchards, most of which are palm-trees. It may be noted that cotton plantations and vegetables are absent because of the existence of permanent water-logged conditions in the rice fields.

The total numer of farmers who are employed on the farm is 200. According to the traditional system of sharing the produce, the fellah's share is two-fifths whilst the landowner's share is three-fifths. There are seven lift-pumps, with a combined horse-power of 207, which work together to irrigate this farm by the flooding-irrigation system. The farm breeds a total of 400 head of cattle and 600 head of buffalo only. The suitability of the swamp environment for buffalo accounts for the farm breeding so many of them, particularly since they are little used for work purposes and almost their sole value lies in their milk. Almost without exception the milk products of the cattle and buffalo and the minor cereals of the farm are sold to the local market centres in the town of Shamiya and Diwaniya, whilst rice and dates are sent mainly to Basrah and Baghdad by train.

Summarizing the agriculture of the valley, it may be said that the farms are generally mixed farms and the average size of the farm unit varies from the north to the south of the country, according to many factors which will be discussed in the next chapter.

The agricultural characteristic of the valley would appear to be not its homogeneity, but in the differences between the agricultural sub-divisions. These differences are the result the varying influence of the river and topography have had on aspect, climate, topography, soils and artificial drainage. In the Upper valley, north of the Hindiya barrage, there is a distinctive valley farming unity. The linkage of this part appears to be the kind of crops grown as a result of these factors. The physical conditions together with the agricultural methods employed and the type of holdings give a characteristic agricultural pattern to the upper region, primarily based on the growing of wheat and vegetables.

The distribution and kinds of agricultural crops, the type of holdings and the system of share cropping give a distinct agricultural character to the lower valley. But the lower valley itself has slight variation in different parts of it. This variety, of course, is based partly on the physical factors and partly on the social traditions. However, this slight variation in different parts has led to specialization in different farms of production; dates and other fruits in the intermediate areas, rice in the Shamiya-Abu-Skhair district. Barley, other minor grains and livestock, are distributed over all the country.

CHAPTER VIII.

RURAL SETTLEMENT AND FORMATIVE FACTORS.

Excluding the inhabitants of the largest towns, the term settlement, here concerns scattered rural population on the agricultural land. These people living in the settlements of the area of the Middle Euphrates live either by stock-breeding or by cultivation, and their habit of life varies accordingly from the semi-settled to the settled condition of peasantry or fellahin in agricultural districts. There is however, a considerable number of stock-breeding fellahin who live in tents for either part or the whole of the year, and would revert to sheep breeding and nomadism if their water-supply failed. These are called Shawiya or donkey tribes because they use the donkey instead of the camel. Though tribes may be wholly Shawiya or wholly fellahin, many tribes, particularly the larger ones, contain sub-sections both of Shawiya and of fellahin, and the two ways of life are intermingled in various parts of the country.

Map 51 illustrates the distribution of the settled and semi-settled tribes in the Middle Euphrates. This region includes the most turbulent tribal area in the lower Iraq. It is inhabited by a complex mass of some fifty-five tribes or tribal sections which are mostly independent and do not form coherent groups like the great tribes of the Upper

Euphrates and Tigris. The tribesmen are generally cultivators and stock farmers, settled or semi-settled, living in villages of mud-brick or reed huts, or less frequently, in tents (photo. 78). The tribal section and the village sheikh in his mud-brick tower usually forms the effective unit in the settled districts and in many tribes the federal sheikh or head of the whole tribe has little authority. But the following major groupings can be distinguished, each of which may contain 2,000-2,500 families, or 7,000-11,000 persons: Khazail, Fatla, Bani Hasan, and Bani Huchaim. Other less well-defined groups of equal or smaller size exist, usually in a vague relationship of mutual alliance or hostility, such as the Jubur and Albu Sultan, and there are many small groups of 500 to 1,000 families. The Bani Hassan live mostly west of the Hindiya channel, between Karbala and Kufa, and include some semi-settled tribesmen among their numerous and very independent sub-sections. The Khazail, whose dira (see p. 277) is west of the Euphrates, are the principal tribe of the area between the two channels from Kifl to Shinafiya and Rumaitha. They also range into the Jezireh east of the Hilla channel. They are cultivators, stock-breeders, and shepherds. Their allies include the Shibil and the Chabsha. The Shibil inhabit the west bank of the Hindiya channel in the region of Shinafiya, on the desert edge, and many also are found scattered throughout the Diwaniya province. All the semi-tribes between Musayib and Beni Huchaim belong to their confederation, but many are now independent.

The second group, the Beni Huchaim are a confederation of settled tribesmen inhabiting the lower reaches of the various branches of the Hilla and Hindiya channels and canals between Rumaitha, Chamcha (27 Km. above Samawa), and Darraji (48 Km. below Samawa). The Fatla and the tribes associated with them, the Jaliha and Qurait, live around the upper reaches of the Hindiya channel between Hindiya and Kifl. The Fatla are settled agricultural and cattle-breeding tribesmen. Two sedentary tribes of the Hilla branch, the Jubur on the right bank and the Albu Sultan on the left between Hilla and the Daghara barrage, have almost lost their cohesion and have broken up into separate sections.

The third group includes the settled and semi-settled tribes of Dulaim who occupy the area between the northern border and Falluja. The group occupies sections of Albu Dhiyab on the left side of the river and Albu Rudaimi on the right side. To the south of Falluja there are several sections which are not Dulaim by origin, for the tribe has attracted sections from other groups, notably the Zoba, which have now settled along the canals of Saqlawaiya and Abu Ghraib.

The final group is composed of Zobaid tribesmen. It is a large group, lying between the Euphrates in the Musayib-Hilla areas and the Tigris south of the Dulaim tribe. Among the Zobaid tribes are the Jannabiyin, Al-Bu Sultan, the Khafajah, and the Masud. All of these are cultivators and stock-breeding fellahin.

In all these tribes and tribal groups, settled life predominates. Although, the characteristics of the settlements vary along with variations in the degree of semi-nomadism present, fundamentally they, unlike the towns are all assemblages of farmers residences i.e. villages. In each of those there exists a village community or tribal section who still keep more or less within their tribal organization, but in some of the most highly cultivated areas, tribesmen belonging by blood to several different groups may be present. In this study, attention is mainly confined to an examination of the villages, and the towns, since the number of nomad or semi-nomadic people is small.

(a) <u>Classification of Settlement.</u>

The present-day settlement pattern (map 50) is discussed in accordance with three criteria, the morphology, function and size of the settlement.

Settlement morphology and function: The form taken by the various settlements may be classified into main types as follows:

(1) Village Communities.

The villages have a number of characteristics in common. The usual type of village is a cluster of huts huddled together without any orderly design. These human shelters are found in the countryside in one of the following shapes:

1. The Sarifas (reed huts), are made in the marsh areas. This type is of two patterns, either curving to a vault or built with an eaved roof above straight walls, and may be of great size (photo. 79).

2. The second type of hut which is built of mud, is the home of the settled fellahin. The walls are built in the Biblical style out of balls of mud mixed with straw by a master builder and several assistants. The roof beams are made of palm branches on which reed mats are laid and covered with mud. The house consists of a single room with thick walls and a doorway, which usually opens on to a small enclosed yard that is used for both cooking food and keeping draught animals (photo. 67).

Villages consist of a huddle of from 30 to 300 mud huts surrounded by a mud wall. There are no communal facilities or open spaces for the children's recreation. They are of necessity located near a source of water, by a canal or on the river bank. The water is not piped, but must be carried from its source to wherever it is used.

(2) Urban Communities.

The municipalities of the Middle Euphrates valley are found in the central provinces such as Najaf, Hilla, Karbala, Diwaniya and Ramadi cities with populations of 74,889, 47,000, 45,000, 28,000 and 13,000 respectively (photos. 82, 83, 84 85). The other towns of the central gadhas and Nahiya are smaller with less than a thousand inhabitants (photos. 86, 87).

Despite differences in size, function and form, they have a number of characteristics in common. The older parts are usually congested with narrow streets and alleys. Houses are built around courtyards, the only opening to the street being the main doorway.

The houses usually have a flat-roof or a partially open second storey for sleeping outside in the summer. Some of the houses in the towns were built fifty or more years ago, while others are more recent construction is still going on. Most of the doors and windows are made of wood but a few, about two per cent, are made of steel. Newly-built houses for the most part have wooden doors and window-frames, except for a few which have steel window-frames and doors.

Stone-built houses have external walls of from 20 inches to 30 inches in thickness.

The other houses are of two types, those which are built of unburned bricks who have a standard shape and those which are built of burnt bricks. The latter is the commonest type of building material. There are also a few modern concrete and steel buildings, mainly in the central capitals of liwas and gadhas. An important section in every city and town is the Suq or bazaar, a network of alleys, often covered by crude roofs forming a series of arcades. These alleys are lined with the small shops of retail merchants and handicraft workers in textiles and metals.

In the largest cities and towns, the new boulevards and the main streets are paved. In the other, however, the streets have merely been grated.

Most towns with a population of over 6,000, and a few smaller ones have both a pipe water supply and an electricity system. The water, however, is not always purified, and the electricity is invariably expensive.

Variety in size of settlement. A survey of the settlements of the valley from the point of view of size can be made, relating the grouping of the population to the total number of houses in each settlement. Thus the settlements as a whole in terms of size fall into four categories, farmsteads, hamlets, villages and towns and cities (see map 50).

(1) The farmstead, a residential house, of which the average number of occupants is 6 to 7, is the smallest unit of settlement (photo. 75). The farmsteads are scattered

through the valley districts but their distribution in the upper and middle parts of the valley is rather more dense.

(2) The hamlet is a collection of farmsteads, and usually consist of huts, serifas and tents. From table 22, it will be seen that there are 216 hamlets of less than 15 houses each (photo. 52). Altogether these contain 1988 houses and have an estimated population of 11,928 persons or 6 persons per house.

This type of settlement normally covers a wider area in relation to the first type. These agricultural groups are chiefly dispersed through the upper and lower valley, especially in the Mahmudiya and Abu-Ghuraib districts. In addition, there is another type of settlement similar to this, and which may be classified under this heading. This is associated with the semi-settled tribesmen who usually live in tents woven from goat hairs (photo. 78). There are altogether about 83 semi-settled tribes, inhabiting approximately 7,555 tents, (the figures being those given in the Housing Census of Iraq, 1956). The majority of these tribal units are concentrated in the upper region, and less than 30 per cent of them are scattered over the intermediate and lower valley.

(3) Thirdly, Table 22 illustrates that there are 1,329 villages composed of more than 15, and less than 360 houses in the valley. These have an estimated total population of about 699, 675

inhabitants. The total number of residents in each village is between 100 and 2,000 and the average number of people living in each house is about 7.

The villages are spread throughout the entire valley, but the majority are concentrated in the intermediate region, in the Karbala and Hilla provinces. Some cover a small area, while others occupy a considerable area of land (see photog. 80). The villages of Al-Budair, Kurma, Mahawil, Jadwal Al-Gharbi, Mulaiha, Kadisiya and Salahiya (photo. 81) represent some of this category in the country. It may be observed from Table 22 that the population for the smallest community in this group is 392 inhabitants, in Salahiya, with a total number of 56 inhabited houses. Mahawil is the largest among this group (Diagram 12) with a population of 1,987 and a total number of 331 residential houses (see photo. 40(a)).

(4) As regards large and small towns (table 22), they have a higher functional status, and a larger population and greater number of inhabited houses than the villages described above. However the difference between the small town and the village is mainly one of size since under functions are developed only to a limited extent. The population of these villages ranges from 392 to 1,987 and of the towns from 2,250, such as Kifl, to 88,809 as in the case of Najaf. The total number of dwelling houses in Kifl, which is the

smallest town in this group is 371, whilst Najaf, has 10,163 houses. This group contains 28 towns, 15 of which have a population of over 6,000 and 13 of which have a population of over 2,000 and less than 6,000 inhabitants.

The pattern of settlements as outlined above has an obviously close relationship to the distribution of population (see pp.202-206and map 50) and to the extent of irrigated cultivable land. In the northern districts the farmsteads and hamlets lie alone the relatively short flood irrigation canals and the river. In the intermediate zone, when the network of canals is best developed, true villages predominate, but at various nodal centres, agricultural trading and marketing have produced the more specialised towns. Lower in scale, are the relatively few small hamlets. In the Jezireh to the south and east settlement becomes sparse and the least specialised types i.e. the hamlets become more important until permanent settlement disappears altogether.

(b) Land Tenure and Land Holdings.

We find in the settled areas of this region that the majority of the rural population is made up of people who work and toil for someone else, possessing none of the land they till, and not tied to it by ownership. It can, therefor be said that in general the rural population is unsettled, because the land is dominated by the landholders so that the fellahin tend to move each year in order to find land to cultivate.

In order to clearly understand the social and economic status of these deprived people, we have to understand what is meant by the share cropping system the system which is dominant in Iraq. Although the amount of land cultivated directly by the landowner has increased since the last war with the use of modern machinery, the great bulk of the land is still tilled for the landholder by fellahin in return for a share in the crop. The share-cropper is not a tenant in the sense that this word is generally used in the western world. He has no decision in the use of the land and does not lease a special piece of land for a definite period from the landholder for a fixed rental. The landholder or his agent (a sirkal) assigns to the share cropper each year the land to be cropped, determines the type and quantity of seed to be sown and prescribes the time and methods of ploughing, watering, harvesting, etc. He generally makes an initial advance to the cultivator and often provides the fellah with seeds, draft animals and other means of production. Under the Law, the landowner has the right to keep the fellah on the land as long as the latter is indebted to him. Thus the fellah is in reality a labourer who works with his family, not for a fixed wage, but for a share of the crop.

The portion of the crop taken by the fellah varies widely. In flow-irrigated areas it is half or two fifths but drops to about one third when the landholder provides the seed. Although, under the law, the landholder is not allowed to charge interest on his advances to cultivators, his share of the crop when he provides the seed increases out of proportion to the cost of the seed he furnishes. When the land is pump-irrigated, the fellah's share is generally only two sevenths or three sevenths of the crop. In date and fruit groves, where the landholder must make a heavy investment and the value of the output is high, the fellah may receive only a fifth to an eighth of the crop. His share of summer crops which can only be grown with water furnished by the landowner may range from two thirds to a half. In this case, he supplies his own needs and implements.

The size of the area cultivated by each fellah and his family varies widely according to the quality of land, the means of irrigation, availability of waters, the type of crops and their yields, and the season. But, the fellah may plant an average of about 20 mesharas of winter crops, but owing to the shortage of water, only about 15% of this area in summer crops. In rice areas, he generally has only about four to five mesharas. and in date and fruit groves, his allotment is likely to be equally small. In each of these cases, however, the output per meshara is more valueable.

Lack of sufficient draft animals and implements, low yields and the necessity of turning over a share of the crop to the landlord or pump-owner all combine to depress the economic status of the share cropper. His position can only be improved by his raising his output or by increasing his bargaining power, through the creation of alternative opportunities for employment and the opening up of new lands for settlement.

Forms of Land Tenure. Table 21 shows the land under the different systems of tenure in the gadhas districts of the alluvial plain of the Middle Euphrates. From this table and map 52 the following types of land tenure may be recognised:-

Mamloukah or mulk-land held in absolute private ownership.

It is mainly confined to urban property and orchards, occupies just 0.3 per cent of the total area of all the ownerships of the valley. Map 52 shows a low percentage of mulk land at Ramadi, Hindiya, Falluja, Mahmudiya, Hilla and Hashimiya and its absence in the remaining gadhas of the country.

Matrouk - land reserved for public purposes. This type of land covers a limited area which does not exceed 0.03 per cent of the total property in the region.

Mawqufa or Waqf - land which is administered in trust (1) for the benefit of religious institutions by the state Waqf Administrations, or (2) for the benefit of private persons by mutawallis appointed by religious courts. This type of Waqf was property from which the taxes or revenue were in the past assigned to religious institutions by the Turkish Government. It also occupies a limited area about 0.55 per cent of the total ownerships of the region.

Miri tapu - land held in permanent tenure from the state under conditions enabling the holder to sell or mortgage it and leave it to his successors. Proof of such tenure may be supplied by documentary or factual evidence that the land has been used productively by the holder or his predecessors for 10 years during which no land rent was paid or that it has been planted with trees meeting specified conditions. Tapu land originated in the land reforms of 1868 by which large areas of miri were first sold to private individuals in this form. Table 21 shows that 28.2 per cent of the total cultivated holdings of the region come under this type of land tenure. Map 52 shows a high percentage of Miri tapu at Karbala, Najaf, Hindiya, Mahmudiya, Hilla and Musayib, but the rest of the gadha districts of the valley have a lower proportion of this type of tenure.

Miri Lazma - land held under generally the same conditions as Miri tapu, but with the stipulation that the government may veto the transfer of such land if it tends to disturb the peace, a precaution designed to prevent, where necessary, the transfer of tribal lands to people outside the tribe. Lazma land originated in the tribal occupation of simple Miri lands, and grants are made upon proofs that a person has made productive use of the land during the preceeding 15 years. They are also granted in special river areas to people who erect pressure-pumps for irrigation, provided that there is no better claim from tribesmen. Lazma gives the right of "dwelling and agriculture". Lazma rights are inheritable and transferable by testament, may be ceded to another person (by a form of sale or gift), and may be mortgaged, but such transactions must be registered with the State, which retains some control over them. Table 21 illustrates that the percentage of lazma lands in the gadhas districts is 46.61 per cent of the total ownerships of the Region. Map 52 indicates that the highest percentage of land in the region under consideration is Miri Lazma. This type is found over the whole country but most of it is concentrated in the six gadhas of Shamiya, Diwaniya, Hashimiya, Ifaq, Mahmudiya, Hindiya and Falluja.

Tapu and Lazma lands are still recognized as miri or state land. Indeed there is no practical distinction between tapu and lazma tenure, except as regards the formal requirement of official approval for the transfer of lazma land. In theory, possession of these lands may lapse if they are not productively used for three successive years in the case of lazma, and four successive years in the case of tapu, but apparently this happens rarely, if at all. According to the system of tapu and lazma land, the government must get one fourth of the land-price as its share when the land is sold by the owner.

Miri Sirf - land is absolute state property, and covers a large area in this Region. Table 21 illustrates that this category accounts for 24.31 per cent of the total ownership in the valley. Approximately 71 per cent of it is situated in the Jezireh Zone of the Musayib, Hashimiya, Diwaniya, Ifaq, and Samawa districts. This category includes what used to be called Mawat, "dead", or waste land, which has been regarded as useful neither for agriculture nor for building, but much of which should be classed as uncultivated. The Miri Sirf involves areas actually in the possession of sheikhs or other landowners who, in fact, enjoy undisturbed rights of possession. These occupiers pay a light tax on their holding. The Miri Sirf lands also include all uncultivated lands which are not registered. In regard to these lands, the state's power of disposal is important, because it gives the Government the right to grant title to land which will become cultivable through the new irrigation projects already discussed (see pp. 281-284). Miri Sirf is a dominant type of land tenure throughout the three gadhas of Samawa, Ramadi and Ifaq, whilst Falluja, Mahmudiya, Karbala, Hindiya, Hashimiya, Najaf and Abu-Skhair have low proportion of this type of land as indicated by the map 52.

Distribution of holdings by size and ownership.

Middle Euphrates Valley, 1957.

Source: Report on the Agricultural and livestock Census of Iraq, 1952-3.

Distribution of Agricultural Holdings by size group.

Mesharas	Hectares	Acres	Total Holdings.
Under 4	(under 1)	(under 2½)	4,763
4 and under 20	(1 - 5)	(2½ - 12)	4,231
20 " " 100	(5 - 25)	(12 - 60)	4,804
100 " " 600	(25 -150)	(60 - 360)	2,475
600 " " 1,000	(150 -250)	(360 - 600)	302
1,000 " " 2,000	(250 - 500)	(600 -1,200)	394
2,000 " " 5,000	(500 -1,250)	(1,200-3,000)	252
5,000 " " 10,000	(1,250-2,500)	(3,000-6,000)	84
10,000 " " 20,000	(2,500-5,000)	(6,000-12,000)	33
20,000 and over	(5,000 & over)	(12,000 & over)	24

In classifying the agricultural holdings by size, one hundred mesharas may be adopted as the upper limit for small holdings, and six hundred mesharas as the upper limit for medium size holdings and anything above the latter figure is regarded as a large size holding, as shown in the table above. Najaf, Abu Skhair, Hindiya and Karbala where date cultivation is carried on, are small holdings. These gadhas have the highest frequency of small holdings and they are nearly void of large holdings, with the exception of certain properties which are owned by a small number of landholders. The table below shows that the size of holdings in the Najaf is low, the average being 4.0 mesharas, while in Karbala it is 22.3 mesharas. Ramadi, Falluja, Hilla, Hashimiya, Shamiya and Samawa gadhas units fall in the second category, where the proportion of medium holdings in Hashimiya (which is the smallest average) is 41 mesharas, whilst the highest average size of this group in Shamiya is 104 mesharas. The final and largest category comprises Ifaq, Musayib, Mahmudiya and Diwaniya. These four gadhas have an average size of 116 mesharas. Ifaq is the smallest, and Diwaniya the largest, with 616.1 mesharas.

Most of the gadhas are practically void of large holdings, and the Majority include the second category of the medium size, while the other two groups are equal in number of gadhas but vary in the size of the holdings.

Middle Euphrates
Valley 1957
Directorate-General of
Land Settlement.

Average size of holding by gadhas.

Gadhas	No. of holdings.	Total area (mesharas)	Average size of holdings.
Ramadi	7,616	532,340	70.0
Falluja	3,855	334,276	86.8
Mahmudiya & Abu-Ghuraib	2,532	582,959	230.2
Karbala	8,015	178,750	22.3
Najaf	2,968	11,879	4.0
Hilla	7,461	376,568	50.5
Musayib	2,308	320,991	139.0
Hindiya	30,829	396,121	12.8
Hashimiya	10,738	533,091	41.0
Diwaniya	1,290	794,785	616.1
Shamiya	16,816	1,758,604	104.0
Abu-Skhair	18,269	128,241	7.0
Ifaq	8,993	1,051,793	116.0
Samawa	24,021	1,174,082	48.8

It is noticeable from the table above that the small holdings are concentrated in the river orchards, whereas the largest holdings predominate in the Jezireh Zone which is chiefly uncultivated land. Underlying this pattern of distribution of holdings is the fact that most of the gadhas which contain a high proportion of big holdings have a considerable proportion of non-arable land which is not intensively exploited. These non-arable lands are either uncultivated land (dead land) or marsh land, which lie mainly in the Jezireh Zone or in the low-lying reaches of the lower valley.

The ownership of land appears to differ according to the size of the holding. Thus the gadhas which do not include any holding of more than 100 mesharas, such as Najaf, Abu Skhair, Hindiyah and Karbala, are almost exclusively exploited by the fellahin who represent the small landholders. The gadhas that include the medium size holdings are managed by their owners or under the tenancy system as used by the pump-holders. The third group of gadhas, which are composed of the largest sized holdings, are owned by wealthy townsmen or by tribal sheikhs, and so are owned on a peculiar system of share-cropping by the fellahin. There are very few farm labourers paid in cash wages and organized in groups.

It is noticeable that in Hilla, Karbala and Hashimiya large holdings predominate, but the average is reduced by the large numbers of small holdings in these gadhas.

The census results do not show the existence of the very large properties exceeding 20,000 mesharas. Figures compiled from the data in the possession of the Directorate of Land Settlement, covering private land to a total area of about 2 million mesharas, show that in these gadha units there are five properties of between 20,000 and 800,000 mesharas.

Three landowners are commonly reputed to have three properties embracing 1,800,000 mesharas altogether. These include Sheikh Abu-Tubikh, (in Diwaniya Gadhas), Naif and Muhsin Al-Jarian, (in Hashimiya), Abdul-Razzak and his relative Abdul-Abbas Merjan, (in Hilla). Two others are credited with properties of about 200,000 mesharas. These are Abdul-Razzak Sharif, (in Kifl Nahiya of Najaf Gadha), and Ibrahim Al-Harbah, (in Mahawil Nahiya of Hilla Gadha).

Tenancy and Owner cultivatorship.

In the Middle Euphrates district, the major types of land tenure and use can be classified as follows;

(1) Tenancy (or landlord-tenant system).

(2) Owner-cultivatorship (the family farm).

These two classes are usually found side by side. However, in some countries tenancy may be the rule, as in the region under consideration, while in others it is the exception.

Tenancy is that form of agricultural tenure in which the actual cultivator has no rights, or only limited rights, in the land which he works and upon which he lives. The functions of ownership and operatorship are separated. Ownership may be in the hands of a private individual, a group of individuals, a Corporation or the State.

The author is mainly concerned here with the relationship of farm operatorship between private landholders and their tenants.

The process of allocating the rights to any land involves the transfer by the owner to the tenant of certain rights of possession and use for a given period of time. Such a transfer is usually accompanied by an oral or written agreement stipulating the conditions under which the property may be used. The allocation of the responsibilities or duties of each party involves the supply and contribution of labour, capital and management as well as costs, and the sharing of income. It should be noted that tenancy covers heterogeneous forms. There are cash-renting arrangements; share and cash. In this country the widely practised form is share-cropping (see pps. 327-329, 336).

As for the owner-cultivatorship, the owner himself manages and cultivates the land with the help of his family labour and enjoys the full rewards of his efforts. This is, however, not altogether an adequate or precise definition, which could be used for analytical purposes or for policy formulation.

Here the family farm may be analysed in socio-economic terms and the primary characteristics of both terms, "farm" and "family" are used.(1) "The farm is basically a production unit; in economic terms, it is a firm, a going concern. The family is a sociological entity, as related to either production or consumption. As a firm, the basic elements of a farm are land, labour, capital and management." Thus "a family farm is one in which these four factors reside wholly within the family that works the land".

Management "must reside largely in the family that supplies the labour, for otherwise the family would have little tenural relationship to the farm as a going concern". Also "the amount of land and capital must be sufficient to absorb efficiently the labour of a typical family". In reference to size, therefore, the floor must be no lower than to permit the efficient use of the labour resources of the farm family, and the ceiling must be no higher than the amount of human effort that can be supplied by the family, with the addition of such supplementary labour as may be necessary either for seasonal peaks or during the developmental stages of the

(1) The standard terminology now in use may be exemplified in the statements of A.S. Alwan; "The process of Economic Development and special references to land problems and policies in Iraq". Thesis for Doctor of Philosophy, 1956. University of Wisconsin.

family itself. Finally with reference to control, "the farm family must direct its destiny in the use of all the resources on a unit that meets the foregoing standards".

The above explanations of the concept of the family farm, which require that a farm, in order to be classified as a family farm, must satisfy the conditions of ownership, enterprise, management, and size, excludes many small subsistence farms and particularly all sharecroppers and tenants, since the later groups lack either ownership, security of tenure or the economic size of farm, or all of these.

(c) Social and Economic Life.

The Merits and Demerits of Tenancy and Owner-Cultivatorship.

In discussing the merits and demerits of these two-types of agricultural organizations, we will view the problem from the economic and social standpoints.

It has already been indicated that land tenure conditions influence not only the economic sphere but determine the social aspect of life. Hence, it is necessary that the merits and demerits of either system must be measured in economic and social terms. For convenience we will take up the social aspects first and the economic aspects next.

Most of the arguments against, and the demand for, the abolition of large - estates which give rise to tenancy are based on social considerations. Likewise most of the exponents of the family farm system base their arguments more on social grounds than purely economic grounds.

Above all else, it is the share-cropping system of tenure which has been regarded as having the most considerable effects on social life.

This share cropping system has many bad effects, both socially and economically, which tend to lead to a deterioration in the community of the region. The most important of these bad effects is that a large proportion of the population, on which the economy of this country depends, remains unstable and shifts from one location to another according to the sort of treatment they get from the landholders of feudal lands. This unstable status has in turn produced its bad effects on the agricultural system of the region. Unless the fellah remains stable and feels that the land belongs to him, he will not do his job seriously and improve the land. On the other hand, this state of affairs does not encourage the fellah himself to take good care of the land or to take long term measures to conserve the fertility of the soil, because he would feel that the yield does not belong to him alone. Moreover, this share cropping system tends to limit the freedom of the fellah and in order to decrease his debts he has to stay in one area and work all the year to pay the debt.

All this has led to a lower standard of living among fellahin to a degree quite disproportionate to the great potentialities of production in this area. The research which has been carried out by the author in various parts of the country indicates that the average annual income of the region depends partly on the types of the occupations, and partly on the nature of the community (i.e. extent of urbanisation). The annual income of the fellah in the upper region is slightly higher than in the lower valley, and in the cities and towns it is higher than in the rural areas (see pps. 319/21,332/33,335/36,368/69). The average annual income for a person who has a family of 7, is 34.555 I.D.

The fellah's income is usually spent on food, clothing and possibly some domestic tobacco. Two of the most important items of food expenditure are sugar and tea. Dates, (particularly in the south), and a few vegetables such as onions are also purchased, but on the whole most fruits and vegetables are beyond the reach of the fellahin and are sold in the towns. Meat is eaten only occasionally, although fish is available in the marsh areas of the south. Nor does the fellahin who owns no animals other than his draught animals consume much milk or leben. Clothing consists of some cheap cotton sheeting. Few fellahin wear shoes. Hardly anything is spent on housing or furniture. The living quarters are small mud huts without windows and with hardly any furnishing except a few mats and cooking utensils. Soap is undoubtedly a form of luxury. Life is not far above the minimum subsistence level and must often be below it.

There are, of course, fellahin who have additional sources of income, the most important of which is raising a few cattle or sheep. So, the fellah who has a number of such animals, in addition to tilling the land, is considered comparatively rich. But such people are not common, and probably do not exceed 10 per cent of the total number of fellahin, as has already been mentioned in the agricultural sub-regions section.

Therefore it is easy to see why the emigration of farmers to the city increases every day, when we have seen how low their standard of living is, and how loosely they are tied to the land. This leads to shortage in manpower in the rural districts and to the increase of unemployment in big towns and cities where industrialization is still in its embryonic stage. Accordingly, the vitality of the rural community and its productive capacity grows less, although the country is very badly in need of an increase in agricultural production.

In the towns, the way of life varies from that in the country both socially and economically. The towns are usually the administrative and market centres of the provinces and the minor political subdivisions such as gadhas and Nahiyas, many being little more than large villages. In many respects they form a semirural category, intermediate between the larger towns and the villages.

Many of the inhabitants of the smaller, and even some of the larger towns, are also engaged in agriculture. After agriculture, trade is certainly the most important occupation, especially in the large centres of the provinces and gadhas. These urban settlements serve as centres of retail trade for the surrounding countryside and as collection centres for its produce. Even in the smallest towns, rows of small shop-keeper's booths can be seen, and the larger towns usually have extensive bazaars.

Private and public services form another important group of occupations. Besides domestic service, it includes such occupations as laundering and catering.

Workers employed in manufacturing goods such as tobacco, wearing apparel and footwear, leather, building materials or engaged in metal-work, machinery repair, electricity and water supply and miscellaneous other occupations, form the majority of the town's community. Those workers have a much higher standard of living than the poor fellah. Although, according to the current rate of wages for casuel labour (about 200 to 250 fils a day), a man might theoretically earn an annual income of I.D. 75 or more, there must be many who work irregularly, and earn less than I.D. 50.

However, the higher income of the town-dweller with regular employment enables him to purchase a reasonable diet, better clothing and better housing.

Above these various classes is the small, rich group of landowners and merchants. No estimate of the proportion of the national income accruing to this group is possible, but some indication can be gleaned from the fact that a landowner normally gets as rent at least half the value of the output from the land.

Thus we can see how it is that most critics of the position in the countryside are hostile to landlord tenent systems as now practised.

This is not to say that all the exponents of the family - farm theory of tenure overlook the importance of economic efficiency in farming. Rather, most of them are firm believers that a well-planned family farm system may prove more productive. It is, however, still true that even if there is conclusive evidence that concentration of management and ownership in fact increases agricultural production efficiency, the family farm theory is not invalidated by that proof. Distribution equity, opportunity, status, security and individual dignity and freedom are the social values upon which the theory of the family farm is based.(1)

The great emphasis on the distribution rather than on the production aspects in the family farm theory is not misplaced, for such emphasis is not entirely an uneconomic matter. Beside the direct social benefits, there are indirect economic advantages to be derived from mitigating the very uneven distribution of income and wealth which results from the concentration of land property in a few hands. Thus it has been argued that "policies which tend toward a more equitable distribution of the national income and offer wider opportunities for individual development are not only expressions of the democratic way of life, but through their effect on better health and broader markets actually contribute to more economic development."(2)

Tenancy is not necessarily an unsatisfactory form of tenure where rents are not excessive and tenants have recourse to law, as in England and other Western countries.

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(1) R. Schiekele; "theories concerning Land tenure". It has been quoted from the thesis for Doctor Philosophy of the process of Economic Develop. of Iraq. By A.S. Alwan, 1956.

(2) United Nations, Fao, Report on the Latin-American Seminar on land problems (Rome, Nov. 1953, p. 32).

The term "agricultural ladder" is used to describe the steps by which a farm labourer can become a tenant, and, in due time, owner of the land he cultivates. Accordingly, tenancy provides a means by which the young farmer can acquire experience in farm operation and accumulate the least part of the fund of capital he needs to become an owner. Tenancy is thus viewed as a temporary phase, as young farmers climb the agricultural ladder to ownership and a retiring farmer passes his farm on to the next generation.

Tenancy may also afford a means to obtain the use of land without having to purchase it, especially in cases where the amount of rent is less than the interest of an investment. Furthermore, it has been said that tenancy "enables the prospective farmer to determine safely whether farming is an occupation in which he may happily spend his life, and also to test whether or not a particular farm is the one which he should buy."

However, tenancy systems in the Middle Euphrates district are characterized by exhorbitant rent charges, by a lack of legislation governing landlord-tenant relationship, and by the great difficulty of enforcing even such legislation as exists. Furthermore, the negligence of landlords in the country is commonly known, while the apathy towards, and ignorance of, modern methods by the fellah will be discussed in more detail later.

Owner-cultivatorship may encourage conservation in many ways:

(1) Unlike the large landowner, the owner-cultivator is likely to be a resident- and not an absentee-owner, and his property is smaller. Thus he is better able to discover the kind of conservation necessary on his farm.

(2) Since the owner-cultivator has a small income he cannot afford to allow any deterioration in the fertility of his fields.

(3) Unlike the tenant, the owner-cultivator enjoys full security of tenure and is certain that he himself will get the full benefits and returns from whatever he spends in money or in labour for conservation projects.

(4) The owner-cultivator has a long-term interest in the productivity of his land, and full control over the managerial aspects involved in social conservation projects and programmes.

(5) Unlike the landowner, who in this region usually imposes on the tenants the cultivation of a given crop just because it is easier to control or easier to divide into shares, the owner-cultivator has greater latitude in the selection of crops.

All this presupposes that in towns, villages and hamlets, social and economic education in the ways of using resources can be effective.

(d) Communications and Effect on Settlement. (map 53).

The region of the Middle Euphrates is remarkable in this context for the way in which communications and settlements have developed in relative isolation. Isolation, that is from the Fertile Crescent routeway lying to the north between Baghdad and Damascus, and from the parallel north-south alignments of the desert routes to the west, and the Tigris valley to the east.

This isolation is already qualified not complete. Baghdad, a commercial and governmental centre has its own web of communications which serve it, and this framework extends into the north-east of our region. While there is no first class communication to the west of the valley from the Desert, some caravan routes link it with the Arabian area. Contact with the Euphrates valley, particularly important with Kut, is limited by the negativeness of the intervening arid Jezireh.

Within this region, Hilla is the nodal point, a route focus towards which comes traffic from the whole region and from which goes produce north to Baghdad, south to Basra. There are, as will be seen, smaller regional route focuses such as Diwaniya but these serve only their own hinterlands, while Hilla as a regional route centre associated with a riverine string of rural settlements. Away from this riverine zone the Jezireh and the marsh areas are characterised by poor communications inadequately linked with the main valley corridor.

Historical Review.

A review of the communications of the Middle Euphrates Valley and the present state of the transport routes stresses the importance of physical and geographical features which have rendered the valley basin a distinctive unit, and which underlying the significance of varied economic activities. The combination of these two factors, physical and human has created the communication system in this district.

The dominant elements of the physique are sufficiently simple. The aridity and difficult topography of the desert to the west and Jezireh to the south have discouraged all but north-south movement throughout history, while no economic, or physical forces have existed at any time which could change this pattern i.e. transverse east-west is only relatively difficult but this has been sufficient to prohibit all but very minor movement.

The quality of routes ranges from rough roads which join the rural settlements such as the Jezireh and marshes settlements and well-maintained road systems between towns of the middle and upper regions to the earliest route of importance, the Euphrates river the use of which on modern lines organized during and after the war of 1914-1918. The Euphrates is too shallow for steam navigation, but small native sailing craft carry a total tonnage of between 20,000 and 50,000 tons a year. There is shakhtur(1) and raft traffic on the River between Hindiya and Hit north of Ramadi, and between Hindiya Nasiriya, south of Khidhr. The principal obstacles to navigation are the swamps between Abu-Skhair and Samawa, where channels were dredged through both during the 1914-1918 war. Navigation conditions were adversely affected by the construction of the Hindiya and Ramadi barrages, because of building work going on, as well as by the fact that the water-level in the course of the river was made less deep for navigation, as a result of the irrigation projects.

As for roads, there was an almost complete lack of cart roads or permanent bridges in the Region before 1900, and even in 1914 wheeled traffic was confined almost entirely to the roads from Baghdad to Karbala, Najaf and Hilla. There was hardly a motor-car in the country and tracks were used almost exclusively by travellers with pack transport. During the

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(1) Shakhtur is a boat made of a strong wood. It is about 8 metres long, 5 metres wide and has a draught of 2 metres.

first War many roads were made possible for cars. Roads and tracks have been greatly improved since 1918, and today there is a noticeable network of routes.

Present-day communications.

Road transport (map 53): The roads of the valley, except in certain sections, are today still in a somewhat unsatisfactory condition. The communications through this district radiate roughly from Hilla, which is regarded as the centre of the valley routes, because of its geographical location. Thus the main valley road is the important one in the network of routes through the region, crossing Hilla and running northwards to Baghdad, and south along the Euphrates river to Nasiriya and Basrah via Diwaniya and Samawa.

Other routes radiate from Hilla to Samawa via Diwaniya, and others to Karbala through Tuwairij, and to Kut through the Jezireh. It is a feature of the communications of the valley that the main routes through the central part of the valley to Baghdad were developed only at a comparatively late date. Hence the natural linking of the district as a geographical unit came late, so that transport difficulties retarded development as an economic entity. The late construction of the valley routes may have been due to the rather difficult surface of the alluvial silt of the plain, which becomes a morass after rain; large areas are liable to inundation when the river is high, and there are numerous irrigation channels to cross. The paved roads together with earth roads in this region, when carried along the tops of embankments, are suitable for heavy vehicles even in winter, whilst earth roads which have not been so constructed cannot endure continuous traffic.

The various routes which run through the valley can be divided into the following classes according to quality:-

1. The first class category includes the valley road which links the Region with Baghdad via el Kir Bridge - From Hilla to Kufa the main road follows the valley floor keeping its way between the Hindiya-Hilla channels towards Kufa. At Kufa the road divides into two branches; the first leaves the valley floor, taking its direction through the Desert to Najaf, while the second runs southwards parallel to river as far as Abu-Skhair. There, the road radiates into two branches, one going east of Abu-Skhair to Diwaniya, the other continuing parallel to the Hindiya channel, until it reaches Kadisiyah village. Between Hilla-Najaf the road is good, but its branches south of Kufa are not metalled, so it is not good enough for transport traffic. In other places the only metalled road is the one which runs between Karbala and Baghdad crossing the Euphrates via the Musayib Bridge. These two metalled good

main roads, together with the Ramadi-Baghdad road through Falluja, connect the most important settlements of the valley, and receive feeders from the valley sides, taking most of the Baghdad traffic.

2. The second category is composed of poor sections, of unmetalled roads, but they are, however, fit for a limited amount of heavy motor-traffic, except after heavy rain, which make them useless for mechanical transport.

They generally cross numerous channels by small bridges and culverts. Usually this group crosses the region in a west-east direction, and joins the main north-south road of the valley at many points.

In the southern part of the valley, where the land is not encumbered by marsh or intersected by water-cuts, at times when the surface is dry, the earth roads are usually more or less passable by light wheeled transport, and even by light motor-lorries and other vehicles. But patches of soft sand may cause difficulty in places, and even where the surface is good at first it soon cuts up and becomes heavy if a succession of vehicles attempt to make a track. Difficulties are also caused by the alluvial soil of the plains and the lack of made roads. Anything heavier than a 35 cwt lorry will probably break through the plain crust and get bogged in the mud beneath. Where the ground is soft, solid tyres cut into it from the outset, so that pneumatic tyres are almost essential. In wet weather it has been found that mechanical transport is quite unable to move anywhere. The majority of these second class roads which suffer from the landscape features of the valley and the wet weather, comprise the following routes:-

Hilla	-	Karbala via Tuwairij.
Yusufiya	-	Suwaira on the Tigris river.
Hashimiya	-	Kut through Naamaniya on the Tigris.
Karbala	-	Najaf through the Desert.
Najaf	-	Kadisiya.
Kufa	-	Diwaniya via Shamiya.
Diwaniya	-	Hilla via Hashimiya.
Diwaniya	-	Shinafiya.
Diwaniya	-	Al-Hai via Ifaq.

3. The third division comprises the network of lesser roads and footpaths which link the main routes. The roads of this category, however, are rough and narrow, but they have been used sometimes by cars and other vehicles, though they are mainly only fit for pack-animals. This class can be found in the cultivated country along the banks of the river and canals. Some of these routes between the villages and towns across the countryside are used only by animals.

On the whole, the road pattern within the area is very much influenced by the topography and geographical position of the valley. The general alignment is in two directions, north to south and north-west to south-east, crossing each other roughly at right angles throughout the valley.

Map 58 - shows the main bus and other motor-vehicles routes of the area and the frequency of services, which illustrates the importance of Hilla as the centre of the Region. The omnibus services throughout the valley district are divided between the two main Government bus companies, as well as a small private one.

(a) The Local Administrative authority of the Hilla country operates on routes linking Najaf city and Kufa town on the one hand, and Mahawil village on the other.

(b) The Local Administrative authority of Karbala country operates on routes between Karbala and Najaf via the Desert and joins its suburbs by other operated routes.

(c) The third one is a private company of taxis which operate along the route between Baghdad-Hilla, and runs over this road every half-hour.

The Hilla Administrative service operates on a route between Hilla -Najaf-Mahawil which extends for 90 kilometres, and a bus service runs over this road every half hour. In the case of the Karbala bus service which comprises the route between Karbala centre and its surrounding suburbs, the bus services run over these roads every half-hour.

The passengers who travel by these bus-services may be classified according to their occupation.[1] 50% of them deal with farm concerns; about 30% are business people in different concerns; about 10% officers and officials, and almost 10% pilgrims.

Proposed Roads:

The basis of the road programme was laid down by a Departmental Committee of 1950 to construct five main roads, of a total length of 305 kilometres in a period of 10 years.

According to this scheme, work was carried on for the building of the Hilla-Kufa-Najaf road, which was completed in 1954. The second includes the Hilla-Diwaniya section, the contract for which was placed in 1954, but which is still under construction. The third, which consists of Karbala-Najaf road, has been incorporated in the current programme, but is still mainly for pilgrim traffic. The two other proposed routes include the road between Karbala-Hilla via Tuwairij, whilst the other links Kufa and Diwaniya through Abu-Skhair. These latter routes have already been brought into the current programme and tenders have been prepared for

(1.) These figures are derived from estimates made by the administration of the bus organizations.

their construction.

In spite of the present and the proposed road network system, the road traffic is still extremely light in the country. The number of motor vehicles operating nowadays has increased so that the development of good and sufficient routes is still required. The personal observation of the author confirms that traffic density even on the most travelled roads is very low.

The improvement and construction of roads will undoubtedly bring about a rapid increase in road traffic in the future. It will then become necessary to regulate the usage of the roads. At present both the condition of the vehicles using the roads and their loading can only be described as extremely dangerous. Vehicles unfit to operate endanger the safety of all road users as well as their passengers and cargoes. The expected increase in road traffic makes it imperative that appropriate measures of control be devised without delay.

It is noticeable that the agricultural development areas need suitable feeder roads to the nearest railway stations or main roads, or both, and provision of them should be made in development schemes for these areas. For the most part, this could probably be done by improving existing country roads or tracks by grading, and sometimes raising them. Good maintenance of these feeder roads is essential and might appropriately be assured by the provincial governments.

Railway transport (map 53). The railways were opened principally for goods traffic, with the carriage of passengers coming second. The railways are the principal means of inland transport, carrying the greater part of the country's imports, exports, and internal traffic. The chief commodities carried in bulk are oil, bricks, cement and other building materials, grains, dates and animal products between the Middle Euphrates central market towns, Baghdad, Mosul, and Kirkuk situated to the north of the valley, and to the port of Basrah in the south.

The first railway of standard-gauge line was completed in 1918 and ran south from Baghdad to Hilla, with a narrow-gauge extension to Kifl, to control the Euphrates region south of Hindiya barrage, and to transport local supplies to Baghdad. The complete section of this line has been extended from Hilla to Basrah through Diwaniya-Samawa and was brought into operation in 1923. The network of this railway system includes a small branch coming from Karbala across the Euphrates over a bridge which has recently been built south of the Hindiya barrage, joining the main line of the Euphrates valley at Mufraq-Karbala station. The main line and its Mufraq-Karbala branch has not the capacity for helping further the agricultural development of the country. The Mufraq-Karbala, branch line carried the great pilgrim traffic to and from Karbala, Najaf and the other parts of the country.

Indeed, the present network system of railway lines would be needed to connect with the agricultural areas of the whole region, particularly the lower valley. Most of the railway network, consisting of metre-gauge lines, was first constructed at the end of World War I when only metre-gauge rolling stock was readily available. This railway system limits the capacity of the lines and increases the operating problems. There is no doubt, however, that the system's capacity is ample for present demands. However, this network would undoubtedly be in a better position if the Railway Department would provide the required secondary branches and stations throughout the country. Such a scheme would make passenger traffic easier and would actually offer advantages in concentrated operations for the safe and easy circulation of passengers, luggage, agricultural and livestock production, communications between the rural settlements and central towns of the region itself on the one hand, and between the whole settlement of the valley and the surrounding centre which are situated out of the valley, such as Baghdad, Kut and Basrah, on the other. Finally the traffic demand, and the physical conditions of the country, clearly suggest that railways (plus river transport) should constitute the backbone, and roads the ribs, of the transport anatomy.

Marketing of agricultural produce.

The Development of road and railway transport facilities throughout the plain of the Middle Euphrates is the one essential condition for the success of any policy of increased agricultural production, whether in areas already cultivated, or in new ones. The object of increased production is not to enable the farmer and his family to eat more of the food he produces. They usually have enough as it is. Its object is, by the sale of the extra amount, to enable him to buy other kinds of food, tea for example, or other commodities, such as clothes. Only in this way can the standard of living be raised. This means passing from a subsistence to a cash economy, and all that is involved in reaching and retaining a market for saleable goods. It cannot be too strongly emphasized, that without this, extra production may bring, not a higher standard, but lower prices, with food destruction as a frequent consequence. The ultimate end, which is the sale of produce through a market which the food producer can reach, must always be kept in mind and everything adjusted to it. In particular, as has been pointed out in this chapter, a substantial expansion of food production is of little value unless there are feeder roads connecting the areas of production with a main transport system by which the extra produce can easily reach its markets.

In the light of these facts, it can be seen that the present services are not carefully graduated according to the needs of the people and have not been augmented latterly, especially in the Jezireh and the lower parts of the valley. Nowadays, a journey by motor vehicle is relatively difficult, and conditions do not enable the inhabitants to travel on regular journeys, except between the main towns already described. Even so the development of road transport has had an almost revolutionary effect on the lives of the inhabitants of the valley as a whole. The effect on agriculture is already well marked, as is evident from the increased dairying activities and vegetable and fruit crops which need frequent transport services to reach the consumer market. It is obvious that these increased transport facilities have had some stimulating effect on the more isolated parts of the rural districts, and this effect could be further strengthened.

It must be borne in mind that transport and improved roads result in the production of more and cheaper goods to be sold abroad at prices which can compete in world markets. It also helps the movement of the various internal materials. So that better roads could make an enormous contribution to increasing the volume of production and reducing the cost of transported commodities. Road transport would be cheaper if the area had better roads. The price of almost every article includes the cost of road transport. The carriage of the various materials to the markets makes the price which the customer has to pay for his purchases dearer. In the case of poor roads, they increase the cost of transporting goods, and of carrying passengers. More people than every before now have to travel to and from their work by motor-vehicles, and these fares are a noticeable item in the average family budget. Indirectly, poor communications raise costs and hinder development in that they prevent or abstruct the movement of many ideas particularly technical and make self-development virtually impossible.

A network of modern roads in the region under consideration should be enlarged, corresponding with the increasing agricultural settlement circle, to link the villages and towns with each other and at the same time to link these better with the main central markets and ultimately to connect the region as a whole with neighbouring territories and with the world markets abroad.

In this region the main pattern of communications and the quality of the media reflects variations from place to place in economic activity, population density and ultimately physical conditions. The significant point is that in those parts of the region which can be made valuable to man there are no serious physical obstacles to communication development. The obstructions come from those some human factors which have hindered the intensive exploitation of resource. Good agriculture needs good communications; in the socio-economic circumstances portrayed above (see pp. 360-361) neither could have appeared.

CHAPTER IX

ECONOMIC DEVELOPMENT AND THE USE OF AGRICULTURAL RESOURCES

The Middle Euphrates valley as we have seen is basically an agricultural country. Enough arable land and irrigation water are potentially available to support a prosperous farming population, but the actual conditions of rural life are far from being satisfactory. The need for water, drainage, and land reform schemes, (which have been already discussed), together with an improvement in technological and scientific methods, the mechanization of modern farming, and the organization of agricultural credit, must be the basic requirements for the building up of a new rural community, with a sounder basis of resource exploitation and a better appreciation of the ecological situations. Succinctly the basic requirements for the achievement of a new position in rural communities in the Middle Euphrates Region can be grouped as follows:-

(1) Technological and scientific methods of farming.

(2) Mechanization.

(3) Organisation of agricultural credit.

(4) Irrigation projects.

(5) Land reform measures.

The last two requirements have already been discussed above, and have attention is confined to the remaining three.

(1) Technological and scientific methods of farming.

An important obstacle in the development of agriculture in the region under consideration is the lack of technical knowledge necessary to ensure that the best use is made of the land. The country has inadequate administration, managerial, professional, and technical personnel, and these qualified experts and technicians who exist lack facilities for extending their research work beyond the laboratory or experimental station into the countryside. The shortage of technicians, experts, specialists, skilled and semi-skilled labour, and the use of backward and primitive methods and techniques, have an adverse effect on the agricultural development and the social changes of the rural community. Backward methods of cultivation and husbandry, a generally inadequate irrigation system, inefficient ploughs, inadequate rotation of crops, and lack of mechanical equipment, tools, improved and classified roads, and fertilizers, are crippling the economy of the rural life of the country.

To rebuild a rural community on a new foundation, it is essential, in the long run, to change the old agricultural techniques for proper technological methods which will undoubtedly result in the satisfactory development of agricultural economy. The types of farm technology may be classified into three groups:-

(1) These which mainly increase the productivity per meshara, such as the introduction of a rotation system, of a new breed, or a new variety of crops.

(2) These which mainly increase the productivity per man-hour, such as the application of power machines and other forms of farm equipment.

(3) Those which increase both productivities such as the use of chemical fertilizers, the control of plant and livestock diseases and pests, and the adoption of new methods for preventing erosion and maintaining soil fertility.

The Department of Agriculture has made some efforts in introducing most of these types of farm technology into the country, but since the hampering effects of land tenure have undergone little change, the process of adoption has been too limited to have a noticeable effect on the productivity per meshara or per man-hour. In any case, the complete improvement of agricultural productivity will depend on the use of these efficient technological advances, which the country still needs in order to mould the backward rural community into a modern agricultural system.

The use of fertilizers and a proper crop-rotation system should make possible much larger yields from each unit of land than is possible at the present time. If the high cost of the fertilizers prevent their being used by the farmers at the moment, the adoption of a suitable crop-rotation system may provide an economic basis for the maintenance or increase of soil productivity. Increased income will later make possible expenditure in fertilizers etc. Soil productivity likewise is increased or maintained by avoiding excessive erosion, by increasing the organic matter and nitrogen content, by replenishing or increasing the mineral content, and by water control. Experience has shown that a proper crop-rotation and the use of fertilizers contribute materially in increasing soil productivity and the production of larger yields. Experiments conducted over a period of years in the United States(1) have shown the reaction of wheat yields to fallow land, fertilizer, and crop-rotation. Yields under these various conditions were as follows, in terms of bushels per acre:-

1.	Continuous wheat, without fertilizer	12.33
2.	Continuous wheat, with fertilizer	23.58
3.	Wheat after one year of fallow	22.00
4.	Wheat in a four year rotation, without a fertilizer	24.00
5.	Wheat in a four year rotation, with a fertilizer	32.00

(See also pps.422,425-426).

These results show clearly that yields respond most favourably to a crop-rotation scheme used in combination with

(1) "The Economic Development of Iraq." Report of the Mission organised by the International Bank, 1952, p. 235.

fertilizers. Similar experiments are needed in the Middle Euphrates Region to discover how similar results can best be obtained.

Other adverse factors affecting the quantity and quality of yields are insect pests, such as locusts, and plant diseases; it may be possible to use chemical methods to stop the damage of these pests and diseases. The locust plagues in 1952-53 and 1957-58 were of an unprecedented gravity; more than 600 swarms coming from South Saudi Arabia and Kuwait invaded this country and caused very severe damage to the crops. An insufficient supply of poison materials and spraying instruments at the time was the reason there was only partial eradication of these locusts. It is essential that there should be regional international co-operation in locust control, involving the whole Middle East.

Besides locusts, there is the problem of plant pests and diseases, rust and smut are problems in cereal growing in the present day agriculture of the country. The spring bollworm is the major cotton pest in most of the cotton-growing areas in this region (photo. 42(c)).

Many of these insects and diseases can be controlled by spraying or dusting crops, by selecting good seed and cleaning and treating it before planting, and by crop-rotation designed for insect and disease control.

(2) Mechanization.

The alluvial plain of the Middle Euphrates valley is suited topographically for mechanization on a large scale, but, at the same time, it is divided by irrigation canals and ditches, and in many areas is cultivated in small plots, each of which individually contains insufficient land to justify expenditure on machinery. Moreover, the farmers themselves are unlikely to be able to pay for such machinery. Table 15 shows that the increase in the flow of machinery into the country began in 1953, when the figure amounted to 88 tractors, 82 ploughs and 19 combines. In 1957 the number of used tractors, ploughs and combines rose to 90.91 and 55 respectively. This increase in the flow of different types of improved machinery rose to about twice the number imported in 1950. It has been stated that the whole supply of farm machinery and equipment in the country can only properly supply one or two per cent of its farms, but, the machinery is distributed far and wide and is only just beginning to have an effect on farm production and methods. However, in spite of improved types of land and animal-drawn tools and implements, the majority of farmers are still working almost exclusively with their traditional wooden plough, winnowing shovel and sickle, and using donkeys, mules, horses or cattle as draught animals for pulling the plough and treading out the grain. The lack of mechanization and of non-animal power still has an important impact on the economic progress of the agricultural production of the rural population. The reliance on animal and human energy goes with unscientific and poor farming husbandry. Only where there are incentives ti improve husbandry and use extra energy can mechanization develop. As a result of this, much stress has been placed in the past on agricultural mechanization in the upper and intermediate zones, particularly in the Mahmudiya, Abu-Ghraib and Latifiya districts where land is controlled by commercially minded townspeople and companies.

In the future, further demands on mechanization will be necessary to maintain and expand output (see below). The Agricultural Machinery Administration maintains a monopoly for the importation and distribution of agricultural machinery, and a pool for its rental. In the field of mechanical technology, the A.M.A. has been fairly active in encouraging the use of modern farm machinery and equipment since the end of World War II, although some of this machinery had been imported before the War, but only in insignificant quantities. Such a policy needs to be followed for a long time to come, however, before the great majority of the country's farmers will be able to afford to purchase or rent power machinery, even on a deferred payment basis. Many others on small holdings and with no technical training would find mechanized farming unprofitable, particularly as long as the cost of machinery remained so apparently high in relation to the cost of labour. The provision of a simple tool, as well as more and better draught animals, offers a more practical answer to the needs of most farmers at the present time. The estimate of the Department of the Agricultural experts in the district has shown that tractor ploughing increases yields by 20 to 50 per cent, largely through the more effective killing of weeds, and partly through the better preparation of the soil. Much the same effect could, however, be achieved by having better animal-drawn ploughs to replace those which, for the most part, barely scratch the surface and fail to uproot the weeds. Means for the acquisition of such tools and improved draught animals should be provided by the co-operative organizations and better credit facilities. These will be discussed later on.

Mechanization will, nevertheless, play an increasingly important role in the future of rural reconstruction, as labour becomes more scarce and additional land becomes available for cultivation in the central gadhas more than in the other parts of the country. Whilst certain areas in the Levee Zone are undoubtedly fairly populated in relation to the land currently available (see maps 25(a), 50), in other areas, particularly in the Jezireh Zone, labour is scarce in relation to the supply of land. Development schemes are being launched and new land is being opened up for settlement, such as the Latifiya, the Great Musayib and Babil project areas. In any case, the use of tractors, threshing machines or combines has been shown to have the advantage of producing a far cleaner grain than that obtained by using animals. Most farmers do not have sufficient land or money to warrant the purchase of a tractor or combine, and co-operative ownership will inevitably develop rather slowly. Therefore, the government should pay at least as much attention to the task of getting simple, inexpensive tools into the hands of the cultivators as to the much more ambitious programme of agricultural mechanization.

The rental service itself performs a useful function and should be continued until private enterprise can provide the same service on the basis of a reasonable return or until sufficient co-operatives are organized to provide machinery for their members. Many landowners cannot now afford to buy a machine, and others will not risk buying until they have had a chance to test its value by renting one.

Government rental of machinery should be considered at least as a temporary expedient. Private and co-operative ownership of machinery should therefore be encouraged. One step in this direction would be to enable the Agricultural

Bank to lend money for this purpose on the security of the machinery. Another important measure would be to encourage the establishment of co-operative organisations for the collective ownership of machinery, especially in the new agricultural areas to be opened up. At present, the producer's co-operative in the Latifiya and the Great Musayib project own a few tractors. Because overhead costs are relatively low it is possible to rent them out at a lower rate than the A.M.A. while still apparently covering the cost of operation and depreciation. There are some problems associated with mechanization.

First, modern farm machinery and equipment requires capital outlay in excess of the scanty resources of an under-developed country ready for balanced development. These machines may cause balance of payment problems unless the country has large reserves of foreign exchange. Moreover, modern farm machinery requires properly trained operators, machines and fitters, as well as an adequate supply of replacements for parts of the machines. The experience of this country in farm machinery has been one of frequent breakdowns, poor repair facilities, lack of trained operators and skilled repairers, and very short-lived machines.

The Directorate General of Machinery has undertaken a ten-year programme for training a reasonable number of people who have completed an elementary school education and are between 17 and 30 years of age. Secondly, the introduction of machinery into agriculture gives rise to the rural under-employment and unemployment. As indicated in (the social and economic) section, the very low level of wages in urban communities, the meagre share of the fellah in the produce in rural areas, and the migration away from farms, all illustrate that labour is abundant. If labour is scarce, its cost must rise. But despite the fact that the country is under populated in relation to its available resources, labour has never been fully or efficiently utilized and therefore its abundance is more apparent than real. It seems that in most under-developed countries, no matter whether they are sparsely or heavily populated, labour will remain numerically abundant and of low cost, and mechanization will not be desirable, until the under-developed country has attained a sufficient degree of industrialization. Until then, any large-scale mechanization will cause an irremediable problem of unemployment.

However, as noted on p. 395, there is in our region an effective scarcity of labour in relation to potential land supply. In the development areas(pps.93/9,246 et seq.) machines can be used for cultivating new land without displacing labour. In the most densely populated zones, some labour needs to be displaced in order to raise productivity per head of the remainder and to make possible more scientific farming on larger holdings. Thus plant of the problem of farm mechanization is that of marrying these two sides of the labour question - i.e. resettlement.

Thirdly, the effect of mechanization and other forms of technological advance on the prices of farm products may in primitive marketing conditions raise problems of lowering the income of farmers. Mechanization tends to the increase of farm production, and will eventually bring a decline in prices and even may produce a glut of unsaleable commodities. Therefore, if Iraq's Government wishes to push the process of mechanization in spite of present low rate of industrial growth, improved market outlets and a farm-price support programme may be necessary to keep up farm income in spite of falling prices. This is what has been done in some other countries, such as Turkey, along with the introduction of mechanical agriculture. But, if policies do not encourage expansion of consumption at home or export abroad, price maintenance neutrlises the advantage of improved productivity. The problem here is of combining the economic advantages of mechanization with retaining economic stability of the farm. This policy, also, would substitute scarce capital for a labour supply already excessive in some districts, and would make the distribution of income more uneven by benefiting most a relatively few medium to large landowners.

Fourthly, mechanization may require land to be levelled on a large scale, especially in the lower reaches of the valley where the paddy system of irrigation is the prevalent one. The paddy system gets water to all fields fairly evenly and only requires that land should be level within small fields. It leaves the land so divided by canals and bunds that combine harvesting and cultivation of row crops is almost impossible, though tractor ploughing is feasible. Thus, huge amounts of labour are needed to level the land before mechanization can be introduced, and, unless the prices of farm products remain high enough relative to potential increased yields, the farmer may not have the incentive to level the land and introduce machinery into the farm.

(3) Organization of Agricultural Credit.

A dearth of credit, especially in agriculture, is characteristic not only in the area under consideration but in all the underdeveloped areas in Iraq. The lack of an adequate supply of credit at reasonable rates has been one of the major impediments to agricultural development, and to an increase in the well-being of farm people. A good agricultural credit programme is an essential element in increasing agricultural production, and in enabling farm people to take better advantage of their capabilities and opportunities, to improve their welfare by means of their own efforts.

The farm population in the rural country can be divided into three classes according to the need for credit and the sources from which they can get loans, as follows:-

(1) Large landholders' class.

(2) Medium and small landlords' class.

(3) Fellahin (landless peasants') class.

The first class of large landholders is composed of big sheikhs and a group of wealthy absentee landholders. This group needs credit least, for most of its members are themselves money-lenders. Among this group, however, there are the spendthrifts, who, despite large incomes, are always looking for credit. These can get their credit from professional money-lenders, from produce dealers, from the Agricultural Bank and from other sources.

The second class of borrowers is that of small and medium landlords. These are generally not wealthy and most of them are in dire need of credit. Their financial situation depends upon the area and the quality of the land they own, as well as upon fluctuation in agricultural price and production. The above mentioned sources of credit available to large landholders may also be available to this group; taking into account that the latter group is considered less credit-worthy, the cost of loans may be higher. In certain areas, the individual lenders require the farmer to give them a first mortgage on their lands, with very high interest rates. A farmer may pay fifty per cent interest and his debt grows larger year by year. Very frequently farmers cannot pay their increasing debts. As a result, their lands are taken over by lenders who cultivate the land and take the proceeds in lieu of the interest. Moreover, there is virtually no long-time credit available for these farmers. The greater part of long-term loans is actually the consequence of the consolidation and renewal of short term and intermediate loans.

In areas where pump irrigation has expanded, pump owners usually become masters of the lands. The installation of pumps is very costly. Small, and most medium, landowners cannot afford to buy pumps. In return for the use of pumps for irrigation, a large portion of the farm production is usually assigned to the pump-owners. Hence, farmers (third class) do not have a surplus sufficient to repay their loans. Indebtedness very frequently leads to the loss of land to the creditor.

Furthermore, the lack of adequate credit to these farmers often leads them to undertake the selling of crops in advance, at prices which are from a half to a fourth of the eventual value of the crop.

The third class of those who need credit are the non-landowning fellahin. This class constitutes the overwhelming majority of the farm population of the country and is the least credit-worthy, from the standpoint of the lender. The principal source of credit to the fellah is the landlord, some money-lenders and village shop-keepers.

The Agricultural Bank's Door is closed to the fellah; the bank makes loans only on mortgages, and the fellah has neither land nor valuables to offer as a security. Generally speaking, most of the fellahin are indebted to their landlords who make advances to them at the beginning of each season. The greater part of these advances are given in kind, as seeds, draft animals and implements; and only a small amount is paid in cash which is usually spent on consumable goods.

According to the Law of Rights and Duties of Agriculturists, the advances made by landlords to their fellahin are to be free of interest. But this law is enforced much more on the poor fellah than on the landlord. The interest is charged; "the return to the landlord is in the form of a larger share of the crop which conceals a very heavy interest charge". (see P.p.327/28). The fellah usually cannot repay the loans and the interest is taken from his meagre share of the crop; so he gets deeper and deeper into debt and servitude to the landlord. The fellah is prohibited by the above-mentioned Law from moving from his landlord's land unless he repays all his debts. By this law, the rights of the fellah are violated by his being tied to the land, regardless of how he is treated by his landowner, and in spite of the meagreness of the income he may get from his landlord.

The predicament of the fellah is even worse if he turns to other money lenders in his locality, or in the cities, for a loan. Interest charge here is often more exorbitant. The investigation of the author about the conditions of farmers in the country under consideration, reveals that:-

(1) Monthly rates of six and ten per cent are common, and it is very rare for the fellah to get a loan with less than these rates. Such exorbitant rates amounting to 220[1] per cent a year are usually charged by professional Jewish money lenders. Moreover, many innocent and ignorant farmers often fail to ask for a receipt, or to make sure that their papers are cancelled upon repayment of their debt; it goes without saying, some ruthless money lenders have used the ignorance of farmers to their full advantage, and fater repeated repayments demands are made for the same debt.

Interest rates are high mainly because capital is scarce. Capital is scarce for many reasons: (1) the highly uneven distribution of wealth and income in agriculture is a discouragement to saving and investment. The overwhelming majority

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(1) J. Khayyat; "Al Qaryah Al-Iraqiyya (In Arabic, Beirut: Darul Kashaf Press)" 1950 p. 65.

of the farm population has no surplus earnings to save. Those few in whose land the wealth and income of the agricultural section is largely concentrated are, by and large, spendthrifts. Most of their income is spent on unproductive or less productive matters outside agriculture. Very little is made available for investment in agriculture; and this is largely in the form of small loans advanced to fellahin which are, in turn, mostly spent on consumable articles. (2) Capital is scarce and costly in this country because financial institutions in Iraq have not yet been developed and organised, so as to provide an efficient mechanism to facilitate the collection of savings into the various fields of investment. The inadequacy of existing banking institutions and their absence in most parts of Iraq accounts in part of this lack of saving. (3) the third set of factors which makes capital scarce and costly for the agriculture of many countries, (Iraq generally, and the Middle Euphrates district is no exception), are those which result from the nature of agriculture itself. The dangerous situation of financing agriculture is that, unlike industry or other urban enterprises, agriculture is subject to many unpredictable hazards due to unfavourable weather, drought, floods, pests, diseases and so forth. Hence, the return is uncertain, since the risk of crop failure is probable. Moreover, the long period of production, and the consequent failure of the supply to adjust itself readily to demand, results in frequent fluctuations in crop prices; hence, the farmer is never sure, under usual loan terms, that he can meet his obligations when they become due.

Furthermore, agriculture is generally undertaken in small-sized units on a private enterprise basis, a fact that deprives the farmer of the benefits of many financial instruments and techniques. Again, the fact that a farm is a home as well as a business, makes it difficult to draw a line between the farmer spending the money received from loans for production or domestic purposes. If the largest portion of the loan is spent on domestic goods with little being invested in production goods, the productivity of the farm may not be increased enough to enable the farmer to repay the loan systematically.

Governments in many countries of the world have recognised that agriculture is subject to unfavourable conditions, and that there are many financial problems which make it necessary for them to assist agriculture by establishing special credit agencies providing farmers with various types of credit on easy terms.

In the Middle Euphrates region and in other parts of Iraq, there is so far only one public agency dealing with farm credit and this agency, the Agricultural Bank, has been handicapped by lack of funds and thus has not been able to extend credit to all those farmers badly needing help.

The Agricultural Bank, when first established in 1935, was provided with a nominal capital of I.D. 500,000. The capital in 1953 was further raised to two million dinars.

Since the Bank is the only farm-credit institution, it was set up as a general purpose agricultural agency. By an Act of 1940, the Bank was authorized to undertake the following operations: (1) making loans to meet the expenses of cultivation and harvesting; (2) making loans for the purchase of agricultural implements and livestock; (3) making loans for land improvement and reclamation upon recommendation from the respective department (4) selling agricultural implements, livestock, fertilizers, and seeds on an instalment basis; (5) making loans for certain agricultural purposes upon agricultural demand and guarantee ..... in cases such as the assistance of farmers suffering from floods and other natural hazards; (6) encouraging and aiding the establishment of farm co-operative associations and providing them with credit.

Law Number 26 of 1954 authorized the Bank to undertake the purchase of pumps for irrigation, and the institution and maintenance of these machines on developed State Land.

When the lands are distributed to settlers, co-operative associations will be established and the Bank will be required to grant the co-operatives the capital needed, (with a government guarantee), to purchase and maintain the machines so installed. The co-operatives would repay the

Bank the loan on an instalment basis.

In spite of this grant, handed over for the improvement of farming, the Agricultural Bank credit does not reach the level of small and landless farmers because the number of loans is very limited in relation to the great number of farmers. Because of this the Bank has been able to extend credit to only a very small number of the farmers in the country. Of course, it is impossible for one small public credit agency, with insufficient capital, to cure the chronic credit problems in a predominantly agricultural country. Indeed this country will need to have many specialized farm credit agencies to provide landowners, tenants and farm labourers with various types of farm credit on favourable terms. The need for credit extension will be greater if the Government launches a programme of further and wider distribution of State lands for rural reconstruction.

In order to make sufficient amounts of funds available to the needs of agricultural production and particularly to the needs of small farmers, it may be suggested that the credit system in the country should not only be based on the Government funds, but should also use private capital as well. The Agricultural Bank could be authorised to accept private deposits; or it may be desirable for it to be owned jointly by the Government and by commercial banks or insurance companies, as is the case in Egypt. Such a system would make it possible to provide credit for landless fellahin and for other eligible farmers, to enable them to acquire and improve family-size-farms.

The basic philosophy of supervised credit is the simultaneous provision of credit and education. It is based on putting combined farm-and home-plans and technical guidance into operation.[1] Its purpose are (1) to raise the standard of living of low-income farm families for the reform of the rural community, (2) to improve their financial security, (3) to stabilize their land tenure status, (4) to protect the interest of credit agencies and (5) to some extent, to control the production of the basic agricultural crops. The effectiveness and success of a supervised credit policy depends however, on having qualified and capable administrative personnel for borrower selection, farm and home planning, loan-making and supervision.

However, the Agricultural Bank is now attempting to introduce a programme of credit supervision including not only the Middle Euphrates district but the whole of Iraq. This policy will undoubtedly face many obstacles in its initial stages (such as the lack of an adequate number of trained farm supervisors and advisers, and the fear of the farmers of too

(1) Sam Dameron; "Supervised Farm Credit" in Documentation Centre on Land Problems in the Near East".

much government intervention in their home and business affairs) but in the end it should help to furnish a way for farm people to gain a feeling of social and financial security that will create among them an admiration and determination for a more useful life.

In the light of the previously discussed factors, it seems apparent that they form the basis of rural reconstruction. They are the foundation for the future policy of agricultural improvement. To apply this programme in the field, it requires a well-directed, adequately staffed government service that can effectively assist the cultivator and the livestock keeper. Within this service, the primary emphasis in the future must be on a field organization equipped to work directly with the producer in improving his methods and management, supported by a properly focused principal research programme.

Such a service is positively lacking in the region under consideration. This region has 14 gadhas districts and each has a large agricultural staff, but the local official authorities are not qualified to direct research or extension work. For instance the trained staff of the Veterinary Department is greatly restricted.

One of the principal tasks of the future policy should be to organize an extension or advisory service to farmers and livestock keepers. Such a service, adequately equipped with transport, would devote itself entirely to assisting the farmers and shepherds in the field. Its main emphasis would be on education through demonstration. For this purpose it would need to establish crop, livestock and poultry demonstration units in all parts of the country. Suggestions for such livestock units have already been made. In many cases it will not be necessary to establish government-owned farms, for it should be possible to stimulate the more enlightened landowners to lead the way in adopting better methods and permitting those in the neighbourhood to come and see for themselves the results achieved. The ultimate goal should be to make some practical demonstration of the value of improved methods accessible to nearly all cultivators. In addition, the officers of the extension service would need to work intimately with the rural, primary and secondary schools in a programme to educate children in a knowledge of the principals of good agriculture and animal husbandry from as early an age as possible.

Obviously, such an extension service cannot be created overnight. The first step should be to appoint an expert who had considerable experience in extension work to train the necessary staff and take other preparatory measures. These officers, together with the candidates for the extension service, who could be educated at the secondary agricultural school and more advanced institute at Ab-Ghraib, would join the existing service and carry on the extension work. Consideration should be given, however, to establishing a full-time extension service as soon as possible within one or two areas limited to a few selected gadhas, so that different methods of working with farmers could be tested.

Ultimately, it will be desirable to separate the extension service into two sections; one dealing with the control of injurious pests and diseases, the maintenance of standards for agricultural and livestock products, fertilizers and insecticides and surveys of production and land use; the other concerned with the production, processing and distribution of pure agricultural seed and nursery stock. The first of these sections should have adequate laboratory facilities for identifying plants, insects and diseases, and for analysing chemicals, pesticides, fertilizers, feed and food products. The second section would need better equipment than is now available at Abu-Ghraib, to set, clean and process seed. It would also require at least two nurseries - one each for the upper and central zones, and one for the lower region - to operate where needed, on fruit and citrus stocks. Seed stocks or proven strains would have to be either imported or produced locally, either on government farms or on private farms under contract. Experience indicates that the soil and climate conditions are favourable for the production of the seeds of the most important fields crops, as well as alfalfa, berseem, clover and many of the grasses.

Through practical and realistic experimentation and demonstration, much progress can undoubtedly be made in persuading farmers and livestock keepers of the value of more modern methods. Throughout the country, however, the farmer and shepherd tend to be conservative. Even though he sees other methods yield good results on experimental farms or even on his neighbour's land, he may still be reluctant to try them himself, particularly if it involves him in higher initial costs. The government cannot, after all, prescribe what he should do, except perhaps on land which it allots for settlement. If it cannot persuade him, the government may find it necessary to give him some financial incentive to induce him to experiment with new crops or fertilizers. The use of such an incentive to bring about the adoption of new crops, or better methods of cultivation to construct a new rural community has, on occasions, proved effective in other countries.

Lastly, the whole problem of credit is tied up with the availability and use of capital within the region as a whole. We have seen that present water-control and land-management policy is tending towards large-scale integrated development of resources (pp. 246 et seq.). In these circumstances, it will be difficult for Iraq to find quickly capital for large-scale construction and resettlement work and also to develop facilities outlined above. Yet without both, the particular environment of the Middle Euphrates valley will not be utilized fully or efficiently. The geographical unity of all elements associated with agriculture needs emphasizing.

CHAPTER X

COMPARISON OF THE MIDDLE EUPHRATES WITH ANALOGOUS REGIONS.

Many of the features examined and discussed are necessarily common to all environments with similar physical characteristics in that climate aridity and the availability of river water for irrigation are the dominant factors. Other features are peculiar to our region. A short comparison with analogous regions will help in the appreciation of the geography of the Middle Euphrates valley. The areas considered are the lands around lower reaches of the Nile, the Indus and the Colorado.

Studying these four arid regions shows that they are similar in many respects. They are all arid areas which rely on one big river to supply irrigation water and furthermore they usually grow the same type of crops.

The physical basis of comparison:

The study of land forms, types of soils and the problem of salinity in these four regions illustrates their close similarity. Their plains are partly built from the alluvium brought down by their rivers and partly formed by the arms of seas which are known to have covered the regions in past geological ages. The sedimentary soils are derived from this alluvium are composed of various layers of sand, loam, clay loam, silty clay and clay. Since these areas are watered by irrigation the dissolved salts have tended to accumulate in the soil where drainage conditions are poor. In such areas the salt content of the subsoil produces a characteristic feature common to all these regions.

The essential unifying factor to these areas is their arid climate. They have little rain, and the little they do have is often exceedingly irregular. Generally speaking, summers are hot and dry, although the mean daily maximum in July does not exceed 110°F. Winters are mild with some cold periods with average temperature of not more than 68°F. The annual average rainfall is not more than 120 mm. except in the Indus valley where it is about 200 mm. The higher rainfall of the Indus plain is due to two rainy periods; the winter rainfall of the Mediterranean-originating depressions and the summer monsoon rainfall; the latter type of rains not being experienced in the other valleys. Since the four regions lie in warm temperate latitudes on the fringe of the great hot deserts their problem has always been aridity. The Western and Eastern deserts which represent the extension of the Sahara region border the Nile of Egypt on both eastern and western sides while the Euphrates valley is bounded to the west by the Arabian desert. The Thar and Arizona deserts lie on the eastern margin of the Indus and Colorado plains respectively. With dry conditions prevailing in all areas, irrigation is necessary for any agricultural development, and it is fortunate that larger rivers are available to supply water.

The main difference concerns the river's regimes. The Nile seasonal flood is between July and December while the Euphrates flood starts in March and lasts till May. Apart from this the Nile floods are comparatively less catastrophic than those of the Euphrates. In the case of the Indus, the river regime is governed by a monsoonal climate resembling the summer tropical rainfall of the Nile and accordingly has its seasonal floods during summer strengthened also by snow-melt in the Himalayan region of its catchment basin. The flood season in the Colorado river, which is fed mostly by melting snow, occurs during the spring and is comparable to that of the Euphrates.

Cultural factors. Agriculture and its associated modes of life reflect the interaction of physical and cultural factors of these regions. With the exception of the Colorado district these countries resemble each other very closely. Historical influence, present life and culture have all combined to produce a similar system of land-ownership and tenure. Furthermore, the traditional cultivation methods and the attitude to progress may also be regarded as other fundamentally identical problems. For instance there are 65%[1] of the owners in the Indus basin who possess about 7.4 million acres of land in holdings of less than 5 acres each whilst 0.1% of people own as much as 75 million acres in properties of more than 500 acres each. This system of ownership is much the same as that in the Middle Euphrates valley (see section on the land tenure). In Egypt also the small size of holdings is the dominant feature, where in 1952 90%[2] of the owners had 33% of the cultivated land. The area of their holding averaged 0.8 acres. After the 1952 there was some redistribution of land following the revolution and the introduction of the Agrarian Reform Law.

In the Colorado Valley[3] the average number of acres per farm is about 266.9[4]. The fact that the Colorado is a newly settled and developed region probably gives rise to

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(1) All recorded figures concern the Indus valley have been taken from the "Pakistan News, No. 42." London, March, 23, 1959.

(2) D. Warriner; "Land Reform and Development in the Middle East". 1957 pp. 31-6.

(3) The study is confined to the irrigated areas of the lower basin states of Arizona, Nevada and southern California.

(4) United States Census of Agriculture, 1950.

the difference in the size of the agricultural holdings. Apart from this it is an advanced area where a high standard of technical methods and equipment is used in various aspects of the agricultural undertakings. Moreover, this area has the advantage of being part of a much larger, more wealthy and technically advanced unit under a democratic constitutional government.

The three muslim countries until quite recently have been under British influence for many years. The contact of these eastern regions with the West, has led to an increase in population and a slow improvement in all aspects of agriculture. The present densities of population on the cultivable land of these regions are 63, 287, and 668 per sq. km. in the Euphrates, the Indus and the Nile valleys respectively. In the Colorado area the figures for population density are not available but are certainly lower than those for the Nile and Indus. The improvement of the standard of living in the Nile and Indus areas is made exceedingly difficult by the high density of the population. Small holdings prevail in these two countries as was mentioned before. In the Euphrates and Colorado valleys the major types of farm holding are either large or of medium size, hence the natural standard of living is correspondingly higher especially in the Colorado region.

Irrigation. As indicated earlier in this chapter, these regions are arid so that the extent to which cultivation is possible depends on the irrigation system, which in all four areas is a network of canals drawing water from their respective river systems. It is worthwhile to survey the chief irrigation constructions in order to compare the various systems and their influence on the agricultural crops in each country.

The main network of irrigation projects on the Indus valley consist of five barrages, Kurram Weir and Weska reservoir. In the case of the Nile Valley the main irrigation projects include three dams of the Aswan in Upper Egypt and the Gabal al-Awlia and the Sennar dams in the Sudan, plus barrages that have been erected north of the Aswan dam as far as those at Edfina on the Rosetta branch of the Nile. In all four regions dams, weirs, and barrages have been supplemented by an elaborate network of irrigation canals which lead to the fields in order to irrigate them either by free flow or, during low water-level in the rivers, by means of pumps. Primitive methods are also still used for this purpose in irrigated areas of the Indus, the Nile and the Middle Euphrates plains.

The Colorado Valley can be divided into two regions, upper and lower. The present discussion is confined to the lower reaches of the basin where there are large scale flood control and irrigation schemes. These projects on which cultivation is dependent are the Hoover dam, which backs up the word's largest artificial lake, Lake Mead, and the dams of Davis and parker. To the south of the latter dam there is the All-American Canal, an artificial river that supplies water to irrigate the southernmost part of California. The storage waters irrigate the lower basin states of Arizona, Nevada, and southern California. These states which include large irrigated lands are located at great distances from the sources of water supply. They are fed by main conveyance canals, varying from a few km. to more than a hundred km. in length. Many hours, and on some projects days, are required to convey the water from projects of storage or diversion to points of use. According to J. Wiley(1) about one-third of the water diverted for irrigation in some projects is lost between the points of diversion and delivery. The water distribution systems in irrigated areas of the lower Colorado make use of tunnels, drops and inverted siphons which are not yet employed in the Middle Euphrates, the Nile and the Indus areas.

(1) J. Wiley; "California and the Southwest." 1956. p. 15.

Crops and Crop yields.

All the above countries, though they are closely similar in physical conditions, vary in the balance between the crops they produce e.g. in the Middle Euphrates valley, barley, wheat and dates are the major crops while cotton, rice and fruits together with market gardens represent minor crops. The contrast with the Nile is complete. Cotton, maize, and berseem (Egyptain clover) are main crops whereas wheat, barley, dates and rice hold second place. Barley, wheat and dates occupy 76% of the total yearly crops in the Euphrates whilst cotton, maize and berseem represent 61% of the total acreage of annual crops in the Nile. This difference in the distribution of the type of crops results not only from the variation in natural conditions but in also due to the needs together with agricultural tradition of the country. For example cotton which comprises 21% of the yearly crops in the Nile forms the basis of the country's income and is regarded as the traditional export crop. The reason for its popularity, in addition to its returns, are that it is not consumable by fellahin, and thus admirably suits absentee landowners. Moreover, the banks have always been eager to lend against cotton, which can be easily graded and does not deteriorate, and exporting firms have been ready to advance to growers the funds necessary for cultivation. During the early period of British control the growing of cotton for the English industrial market was strongly encouraged. Furthermore, the depth of the soil, the warmth and regularity of the climate, and the abundance and reliability of the water-supply are favourable factors for cotton-growing in Egypt. Cotton growing also has very large demands for labour which could be met from the large population, such as that extending in the Nile area. In the Euphrates, barley which occupies 50% of the yearly total crops is dominant. This agricultural aspect is due to the natural conditions of the high proportion of salts in the soil and the need for only a small quantity of water. In addition to this it is considered the traditional export crop. During the mandate period British encouragement of cotton cultivation came up against greater economic and physical difficulties than earlier it had done in Egypt.

The distribution of master crops which have been considered in the two former regions are different to that in the Indus basin. The main crop here is ~~rice~~ wheat while ~~wheat~~ rice comes as the second in order. Both of them cover over three quarters of the total annual crops. Rice occupies 26% of the yearly total food crops whereas wheat represents 56%. The minor food grains which come in order of importance are millet, maize, barley and grain. The cash crops which occupy a limited cultivation area consist of cotton, sugar-cane and tobacco. Rice is the dominant crop because of the abundant water-supply from irrigation canals and the extensive wide marsh areas in Lower valley. Apart from this rice represents the staple food of many people in the Indian-Sub-continent.

The main types of crops in the lower Colorado areas are fruits and market garden produce. These two crops cover about 30%(1) of the total acreage of yearly crops. They are grown commercially in this region while in the former three countries they are planted on a limited scale mainly for home consumption. The dominance of fruits and vegetables in the cultivated areas of the lower Colorado valley are not only due to the fact that they give a high value per acre but also they produce a large yield per acre. The high productivity contributes to intensive management and a high standard of skill in the technique of production and other agricultural processes. The high price is owing to the existence of a sound transportation system which facilitates the movement of production from field crops to the city markets all over the United States during all seasons of the year. Most of the acreage in the fruit orchards is composed of citrus and grape products. Fresh fruits are popular items of the national diet and are supplied widely abroad. Vegetables are produced in late fall, winter, and early spring

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(1) P. Griffir and R. Robert: "Atlas of California", Living Geography, 1966.

for shipment to northern cities of North America for consumption in fresh form. In addition to the fresh market, some are produced for commercial processing-canning and freezing. These crops mainly include tomatoes, potatoes, watermelons and other type of vegetables. The subsidiary crops which comprise barley, alfalfa, cotton and sugar beets cover a considerable acreage of the yearly total of crops and are regarded as a valuable group. About 25% of the yearly total crops of this group are represented by barley and alfalfa. These fodder crops, occupy a similar position in the agricultural economy as does berseem in the Nile area.

With regard to the productivity of land for the main crops, Table 24 compares yields per hectare for wheat, barley, maize, rice and cotton in the four countries under consideration. From Table 24 it may be noted that all yields per hectare in the Nile and the Colorado regions are higher than those of the Euphrates and the Indus area. For instance barley yield amounted to 910 and 740 kilos. per hectare[1] in the Middle Euphrates

(1) Hectare = 2.471 acres = 4.12 mesharas.

and the Indus respectively whilst the same crops produced 1960 and 1950 kilos. per hectare in the Colorado and the Nile valleys respectively. The low yields per hectare in the two former countries is a result of low levels in technical methods used as well as the existence of adverse natural conditions. There are three main factors which affect the yields of crops in the Middle Euphrates and the Indus regions. Firstly, the variations of monsoon rainfall in the latter and the low level-water in the former during summer affect water-supplies for the canal systems, exposing even irrigated areas to occasional danger of draught. Secondly, the uncontrolled play of wind and water has brought soil-erosion to millions of acres while the rising sub soil water-table and salt-accumulation are lowering the fertility of thousands of acres of good land. Finally, the peculiar conditions created by foreign rule over the centuries have led to neglect of agriculture and the farmer has had little opportunity to share in techniques which have so markedly improved the productivity of the land in technically advanced countries such as the Colorado and even some other poor countries like the Nile area.

Agricultural methods in the Euphrates and the Indus also suffer from restrictions on productivity. Today the ordinary cultivator uses the primitive plough of his ancestors, which often does little more than scratch the surface of the soil. The farmer needs things such as fertilizers which in the absence of credit facilities are too expensive for him.

The problem of salinity associated with a high water-table and bad drainage, which in common in the Euphrates and Indus valleys, is scarcely encountered in the Colorado and the Nile valleys; this is another factor promoting high yields in the latter two areas. In addition to this the technical methods used in the Nile have been improved recently while in the Colorado they are employed on the highest level. According to Issawi,[1] the number of tractors in Egypt rose sharply from 1,200 before the war to over 7,000 in 1952. Apart from this, one important respect in which the Egyptian agriculture is one of the most advanced is the utilization of chemical fertilizer. The consumption of chemical material before the war averaged about 500,000 tons per annum. This figure at the present amounts to over 800,000 tons of fertilizers each year. This gives an average of 44 kilos. of nitrogen per cultivated hectare.

In the cultivated land of the lower Colorado machine power is in common use on farms, especially tractors with accompanying harvesting machine, ploughs, and other tools.

(1) C. Issawi; "Egypt at Mid-Century; An Economic Survey 1954, pp. 106-7.

Generally speaking, nearly 90%[1] of all fieldwork is done with machines and equipment operated by tractor power. Many farmers who do not have tractors hire them from their neighbours or from "custom operators" who go from farm to farm, selling such services.

The farmer in the Colorado area makes use of great flexibility in the choice of crops from year to year. In planning production for the year, the small farmer considers, of course, his equipment, the soil types on the farm and his own experience with certain products. In addition to this he, as a literate commercial producer is able to take into account market outlook, which may be affected considerably by Government farm programmes.

Development prospects

Recently all the above countries have planned to develop their extensive cultivated lands through agricultural schemes. For instance the Iraqi Ministry of Agriculture has started to develop the Jezireh district and Great Musayib project area, which still uncompleted, is the first important one among the planned irrigated projects in the Middle Euphrates (see pp.254-255).

(1) "Guide to Agriculture of U.S.A." Bulletin No. 30, 1955. The figure given above covers all of California of which the lower Colorado area is a part.

In the Nile area the expansion of new cultivated lands has been in progress since the revolution of 1952. The Liberation (Tahrir) province, which is similar to that of the Jezireh of the Middle Euphrates valley, represents a new major project area in Egypt. The Liberation which is regarded as a typical land for such a programme is a community creation in the western margin of the Delta and south of Alexandria. Work first began on it eighteen months after the revolution, in December 1953. The area covered by the province is 1,200,000[1] acres; it includes twelve divisions, each to contain eleven villages. In fifteen years' time, when the addition water from the High Dam is available, there should be 800,000 acres of reclaimed land. At present there are 10,000 acres in process of reclamation, of which 5,000 acres are already under cultivation, water being supplied by pumps from the Rashid branch of the Nile.

The crops now grown are chiefly beans and berseem as reclamation crops; but for melons and strawberries Tahrir already has a reputation. It is intended to concentrate on fruit and vegetables, and to centralize marketing so that exports can be directed to the best markets. Success really depends on whether the Egyptians can do the same with these new crops as they have been able to do with cotton.

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(1) High Committee; "Egyptian National Association Report" 1955, pp. 70-3.

The completion of this scheme and the reclamation of the whole area of the province will depend on the additional water which will be provided by the High Dam. There are four villages being completed and supplied with all facilities. The new settlers will receive ownership of a house and a small garden, but will not receive ownership of land. All farming will be mechanized, in large units and managed co-operatively.

The expansion of the Thal project area is regarded as a good example for the development of the new cultivated lands in the Indus basin. This project which was started in 1949 and is still being developed, is similar to those of the Musayib and Tahrir projects of the Euphrates and the Nile respectively. The purpose of this scheme is to divert the water from the Indus River to serve the district which lies between the rivers Indus and Jhelum. The Thal Development Authority(1) started buying tractors and other equipment to clear and level land, to construct artificial drainage system and to build new settlements. By the end of 1955 a great number of families especially the refugees who came from India had been settled. The result which this project has had after all of these operations is the production of many types of crops. The main ones include the food-grains of wheat, grain, cotton and sugar cane. According to the Thal Development Authority,

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(1) A.H. Sheikh; "A handbook of Thal Development Authority". 1954, pp. 18-22.

this project when completed will form a large part of the acreage of improved cultivated land.

With regard to the system of lending ownership, the project is more similar to the Musayib project than that of the Tahrir scheme. In the Tahrir area the new settler is given only the ownership of the house whilst in the Musayib and Thal irrigated schemes the settler owns both a house and the land.

The Imperial valley extension project is a typical area for the expansion of cultivated land in the lower Colorado valley. The Imperial valley of California occupies the southern end of the Colorado area extending southwards as far as the Mexico boundary. This district in the Imperial valley before 1940 was an arid and lifeless desert scrubland. But when the irrigation project of the All-American Canal was opened the valley started to become one of the important agricultural areas among the California irrigated districts. The expansion of the new cultivated land in the Imperial project area is still going on. The main field crops which are grown in the reclaimed land include cotton, sugar beets, alfalfa, barley and market gardens. The number of farms increases yearly so that the additional settlers rise correspondingly. For example, between 1954-55, 1,628[1] new farms began production in the project area and there was increase in population of 10,000[1] permanent residents.

(1) The Economist, February, 25, 1956.

From the above discussion it may be concluded that these schemes as a whole have the same aims as the Musayib project area of the Middle Euphrates. Both of them have been established to create new land and in addition to this a new society which hopes to have better living conditions and a more satisfactory economy. Moreover, these new productive lands expect to increase the national income as well as either to promote exports or to decrease imports of certain agricultural products in each country.

The agricultural study of these areas suggests, therefore, that it is possible to extend certain type of crops in the Middle Euphrates valley. For instance conditions for extensive cotton growing are much the same as those of the Egypt particularly asregards the physical setting. Furthermore, the strong demand for cotton on the world market is the most important factor to encourage an expansion of cotton cultivation in the Middle Euphrates area. As for fruit growing and market gardening on a large scale the standards attained in the Colorado valley could be achieved. But this development will raise the difficulty of finding consumer markets. For fruits and vegetables of the Middle Euphrates markets are more restricted than in the case of the Colorado. While the development of such crops continues to depend on consumer markets in the Persian Gulf countries and Saudi

Arabia expansion in sale must be limited. The other important crop which is easy and profitable to grow is sugar cane. This yield must be taken into consideration because it is the main home-consumed item. Iraq at present imports yearly a great quantity of sugar so an extensive planting of this crop within the Middle Euphrates valley would reduce the dependence on foreign supplies.

This brief examination of the salient characteristics of these regions emphasises several points. First, they all need heavy capital investment. In Iraq this implies the proper organisation of the national economy and particularly of oil revenues. Secondly, unlike Egypt, Iraq is not forced by high population to expand at all costs the area under cultivation. Therefore, and as considered earlier, as far as the Middle Euphrates valley is concerned, development implies the overall improvement in the control of resources and the reform element is particularly marked in policies i.e. the avoidance of salinity increases, the replacement of ruined land by new, and redistribution. All this would easier with an expansion of area. Thirdly, the physical conditions are sufficiently different between the regions to produce different agricultural reactions but the human factor is of over-riding importance. Lastly, of our region in Iraq it can be said that, capital is theoretically more

CONCLUSIONS.

The culminating part of this research is to discuss the future prospect of the area, in the light of the previous assessment of its present character and in brief comparison with analogous areas. This research has provided a realistic picture of the regional life of the area, built upon the foundations of a field-study and broad analysis of the pattern of the physical environment, the population structure, and the interplay between man and environment represented in the various human uses of land.

The desirability of better living conditions, greater economic security and the best use of available resources, has come to the fore, and these must now be recognised as powerful factors behind any regional planning. There is thus a sense in which the research needed for planning purposes is one justification for geographical study of a regional nature.

The major planning issues of the area concern the solution of the population problem and the complete exploitation of the agricultural development of the area. The enquiry about the future prospects of the area will be thus confined to these major policies.

Physical conditions, and the study of man's reaction to them in the area under consideration, has been logically divided into the recent alluvia of the Levee Zone, and, sloping down to the east, the alluvia of the Interfluve and Jezireh.

Each part has its characteristic cultural landscape. The former is a densely-populated agricultural area owing to the limitations and centrals imposed by relief, soil characteristics, access to the water resources of the river and its canals, route network, and climate. The distinctiveness of this zone within the region as a whole can readily be seen from a glance at the population density map (Fig. 25(a)), which illustrates the notable difference between the sparsely populated eastern reaches of the Interfluve and Jezireh on the one hand, and the relatively densely-settled Levee parts of the valley along the river and the network of perennial irrigation canals on the other.

The unfavourable conditions imposed by environment have resulted in a sparseness of agricultural activities in the Interfluve and Jezireh. Whilst the Levee Zone is best suited for the growth of mixed crops which sustain a high proportion of the livestock population, the upper parts of both the Levee and the Interfluvial areas are better adapted to cash cropping (cotton and vegetables) and the wheat system; and the lower districts are suited for rice cultivation in the marshes and depressions whereas barley, millet and other minor grains distributed in irrigated areas of Jezireh. The practice of growing vegetables as a cash crop is more markedly remunerative in localities adjacent to local consumer markets, where it is feasible to capitalise this proximity in securing substantial incomes.

The aims of the national agricultural policy, announced in 1950 and placed under the Development Board for carrying out, were to guarantee an expansion of acreage and the increased production of crops and livestock. Amongst the means essential for realising this policy are necessary improvements in the living conditions of the farmers, (such as the provision of good agricultural housing), and sufficient supplies of piped water. Easy provision of such facilities will undoubtedly help to encourage adequate production and will lead to an increase in the standard of efficiency of the fellahin, who would live contentedly under better physical and social circumstances.

Agricultural policy, and the organization necessary to obtain the effects which are mentioned above, must be based upon the successful solution of the problem conditions associated with population, water schemes, technological methods and credit and land tenure reform.

The most important factor in the course of agricultural development in the region under consideration is the human factor. According to the population census of October 12th, 1957, the country has a population of 1,345,531. With an area of some 23,016 square kilometres, there are about 58 persons per square kilometre. The country may thus be termed relatively under-populated as discussed in Chapter 5. (see pps. 199 - 200 and pps. 206-210).

Shortage of man power will be a problem. When the development scheme is initiated, both cultivation and the labour position will be improved. Thus, there is no immediate fear of population pressure against land and food supplies. However, agricultural development must be carried out with wise planning and timing.

More than two-thirds of the population depend directly or indirectly on agricultural activities for their livelihood.

The major part of the population of the country is poverty-stricken, disease-ridden and illiterate. This affects the quantitative and qualitative aspects of labour hours, which have a significant effect upon the labour supply.

Regarding the water scheme, when reasonable security against flood disasters, on the one hand, provision for the expansion of agricultural activities on the other, have been attained, the justification of reservoirs, barrages, main irrigation and drainage outfall work will be seen in the increased agricultural production which they will make possible. They are only the servants of agriculture, and their scale and timing should therefore be logically based on agriculture's needs. The immediate objectives of this policy, in a region with so small a population in relation to its large area, should be to open up new land as, and when, it is actually needed for available settlers, to ensure that what is cultivated is used to the best human and ecological advantage, and to provide whatever is needed for this purpose. It is more urgent to do this than to provide irrigation for all that is potentially cultivable.

Schemes for special settlement have been begun, as in the Latifiya; and a beginning made with a Miri Sirf Organization for arranging new settlements on Miri Sirf land to be made cultivable by the new water schemes. It would be worthwhile to apply this scheme in the Great Musayib, Babil projects and other proposed areas in the future.

Besides these, the main task remains of forming and putting into effect an agricultural policy adjusted to the needs and the opportunities of the present time. It is an infinitely intricate and complex task. Given the help that the new water system will provide, the cost of the measures to increase production by improved agricultural methods is very small in terms of money - but very high in terms of administrative difficulty. Indeed, the need for an efficient, technically well qualified, imaginative and patiently persistent staff to handle agricultural policy is much greater than that required by any other form of development.

Ultimately, more attention should be given to the improvement of agricultural methods (including farming techniques, the use of fertilizers, the conditions of intensive cultivation, the rotation of crops etc., tools and mechanization, the control of pests, animal breeding, with a view to improved quality, the improvement of poultry and eggs and all that concerns such a range of products already grown in the country, which includes cotton (potentially of great value), barley and wheat, dates and many other fruits and vegetables.

It would seem to follow that agricultural development should from the beginning, include the improvement of production from the existing cultivated land. At this point development policy touches upon the general problem of land tenure which has in other countries played so large a part in recent history (see pp.417-419). Most of the land now under cultivation is either privately owned or held on leases (tapu or lazma) which approximate to private ownership. Table 21 shows that about 75 per cent of the land held in the valley is of these types. Some of the private estates within this group are of a very great size, and there are striking variations in the size of ownership units in different districts.

Ideally, any future proposal for land redistribution should be accompanied by a law limiting the size of holdings. Such a procedure, would no doubt, bring about an immediate change in the social status of the farm population and would lessen the unwelcome and strongly corruptive influences of the sheikhs, landlords, and city notables on the government and social affairs of the country. Accordingly, the break-down of the semi-feudal system of landownership is urgently essential for equalitarian purposes. The redistribution of land may result in an immediate decrease in production and may lead to economic and social dislocations. The maintenance of order and security in towns and in rural areas depends largely on the solution of land-ownership and the settlement of water rights. This will not only save water and irrigate more land but will also save money, effort and lives.

The National Government of Iraq has given the question of land settlement the highest importance. In accordance with the intention of the government, the settlement and distribution of land and the redistribution of large estates may bring about better agricultural production and improve the general economic and social conditions of the country.

The obtaining of credit by farmers, especially for short terms, must be facilitated with reasonable interest rates. Loans should represent a fair return to the lender for the use of his capital and for the risks and costs involved, but they should not be a drag on the efficient development of the borrower's business.

The Agricultural Bank should extend credit to the farmers throughout the country. The period of a loan should not exceed the life of the improvement which it is intended to finance. The total amount of money required for the service and repayment of loans should never be so great as to hamper the efficiency of production or to prevent the progressive development of the enterprise. However, the loan should, in combination with the borrower's own available resources, be sufficient to fulfil the needs of the situation.

Ultimately, the future changes represented in the possible solution of agricultural problems will profoundly affect the prospects and the population distribution, together with the standard of living in the area. Problems arise from lack of population, as measured by the available potential natural resources of the country. It is under-developed when measured against the potentialities of the generating factors in economic development.

One may add to these the low state of technology, the very low standards of education, nutrition and health, the ignorance among the overwhelming majority of people, the high rates of deaths and births, the short life expectancy, and above all, the extremely insufficient socio-economic institutions and, in particular, the semi-feudal landholding system.

There are large resources of land and water in the country. But the contribution of these to the economic welfare depends largely upon whether they are rationally, efficiently and fully utilized. Not only are natural resources not fully nor efficiently utilized, but inefficient human institutions have resulted in large damages to the resources. Land and water have been so misused that the soils of the country have been damaged by salt-accumulation, water-logging, soil erosion and fertility depletion.

Approximately one quarter of the country's total area is under annual cultivation. This is about two million mesharas, whilst the total cultivable area amounts to about eight million mesharas. Table 23 shows the productivity of the cultivated land of the area has been very low compared to those of many other countries. Crop yields per hectare of land are from 19 per cent to 64 per cent lower than those prevailing in the United States, Australia, United Kingdom and Denmark. They are also lower than the yields of the neighbouring countries of Turkey and Persia and much lower than the Nile Delta where geographical conditions are similar. Wheat, for instance, yields 785 kilograms per hectare in the Middle Euphrates Valley, while comparable figures in other countries are 4,070, 2,850; 1,290 and 1,230 for Denmark, the United Kingdom, Australia and the United States of America respectively. In the case of the neighbouring countries the following are figures 1,850; 1,190; and 1,020 for Egypt, Turkey and Persia respectively. (see Table 23). There are numerous reasons for the very low productivity per hectare. In addition to scanty rainfall, there is the problem of shortage of irrigation water in the river especially during the summer. There is the problem of teaching the farmer how to use the water supply. Also the construction of drainage facilities to draw off excess water would reduce the hazard of salting and water-logging, and contribute materially to improved conditions. Drainage facilities are gradually being provided on salt lands, but in order to provide them equitably on privately controlled lands, some land reform is necessary.

Moreover, low productivity also results from primitive and crude methods of cultivation and the absence of planting of soil-building crops. All these problems are in turn aggravated by the lack of an efficient system of land tenure and use. Regarding the means of production used, it is safer in the present situation not to push mechanization too far. Necessary and important conditions are lacking for the economical introduction of machinery in agricultural activities already mentioned and, if techniques are poor, mechanisation can lead to ecological damage.

According to the preceding discussion the most beneficial national policy to adopt in this country at present and in the future, therefore, is (1) Research for improved techniques, which save labour because the scarcity of labouring hands is a persistent problem in the area; (2) A search for biological innovations such as new varieties of crops, new crop rotations, cheaper sources of fertilizers, improved stock farming, the adaptation of new methods for preventing salt-accumulations and soil erosion and for ways of maintaining soil fertility; (3) Lastly, the reform of land-ownership, together with the provision of necessary credit for farming, is another critical factor for agricultural improvement.

The agricultural economy of the country has suffered from all the above-mentioned obstacles which need to be overcome if rapid progress is to be achieved. It is our considered opinion that some of these limiting factors are not at present being tackled effectively under the present economic development programme. In several places in this thesis the suggestion was made that development rests largely on human resources. Economic progress depends on such intangibles as the provision of knowledge and skill, the elimination of ignorance and debilitating diseases and the creation of efficient socio-economic institutions. Such development is not measured by the mere construction of tangible assets; it is measured largely by the extent to which the productivity of manpower in the country is raised. Capital projects such as irrigation, roads, bridges, new settlements, plants and machinery are important aspects of a healthy economical state.

The final need is therefore for an efficient stable and just human society which understands the potentialities and needs of the physical environment in which it lives. The study of this inter-relationship is geography. For this reason a geographical appreciation of the situation has made in this thesis.

A study of a country such as this demonstrates the fertility of the soil and the possibilities of irrigation in the heart of this Delta of Iraq. It also demonstrates the need fully to understand the physical conditions in a human context and vice-versa.

BIBLIOGRAPHY

General.

Admiralty War Staff: "Handbook of Mesopotamia (4 vols)" London, 1916-17.

Ali H.M: "The land reclamation and settlement of Iraq" Baghdad, 1955.

Bonne A: "State and economics in the Middle East". Second edition, London 1955.

Blanchard P: "La Rute du Desert de Syria" (Damas-Baghdad) vol. 34, 1929.

Chesney F.R: "The expedation to the rivers Euphrates and Tigris" vol. II. London, 1850.

Delaport L: "Mesopotamia, The Babylonian and Assyrian Civilization" London, 1925.

Fisher W.B: "The Middle East" Methuen and Co. Ltd., 1952.

Gregory J.W: "The structure of Asia," Methuen & Co. London, 1929.

Huntington H: "Through the Great Canyon of the Euphrates River" Geog. Jour. vol. XX, 1902.

Lloyd S: "Twin rivers" London, 1950.

King L.W: "A history of Sumer and Akkad" London, 1923.

Knappen-Tippetts-Abbett-McCarthy, Engineers, "The Development of the Tigris and Euphrates river system" New York, 1952.

Musil A: "The Middle Euphrates" New York, 1927.

Naval Intelligence Division: "Iraq and the Persian Gulf, Geographical Handbook Series" 1944.

The Geographical Jour., vol. III, part 1, 1952.

Sousa A: "The administrative atlas of Iraq" (Arabic), Baghdad, 1952.

Physical Background.

Ainsworth, W: "Research in Assyria, Babylonia and Chaldaea" London, 1839.

Beke C.T.: "On the geological evidence of the advance of the land at the head of the Persian Gulf" philos. Mag. vol. 7, 1835.

Beke C.T: "On the alluvia of Babylonia and Chaldaea" philos. Mag. vol. 14, 1839.

Buringh P.: "A Report on the Soils Survey of the Hilla-Kifl Drainage Project". (Unpublished), 1958.

Blanchenthorn M: "Syrian, Arabian and Mesopotamia" geol. vol. V part IV, 1914.

Cole F.E: "Dust Storms in Iraq" 1938.

Development Board, the Ralph M. Parsons Co. Engineers, "Ground Water Resources of Iraq" vols. 1-8, 1955.

Directorate General of Meteorology: "Monthly Weather Report for Iraq" Baghdad, 1956.

Directorate General of Meteorology: "Meteorological Charts for Iraq" 1956.

Danasouri G.E: "Qualiobia Province of Lower Egypt". Ph.D. University of Durham, 1955.

Directorate General of Meteorology: "Dust in Iraq" Professional Notes No. 48, vol. 6, 1938.

Directorate General of Meteorology: "Report No. 11 on rainfall" 1956.

Directorate General of Meteorology: "Report No. 10 on the climatelogical Means for Iraq" 1936-1954, Baghdad, 1954.

Geology of Mesopotamia and its Borderland: Compiled by Geographical section of the Naval Intelligence Division, Naval Staff, Admiralty, London 1916.

Green H; "Using Salty Land". Food and Agriculture Organization of the U.N., Rome, Italy, 1953.

Hot A.L: "The future of the north Arabia desert" Geog. Jour. LXII, 1925.

Hanna, A.G: "The Nature of the Saline soils of Iraq and their desalination" M.Sc., University of Arizona, 1956.

Ionides M.G: "The regimes of the Tigris and Euphrates" London, 1939.

Ionides M.G and Meade G.E: "A Report on the Euphrates Flood Discharge Observations No. 6". 1929-30.

Ionides M.G. and Smith: "Recent Tectonic Movement in the Mesopotamia Plains". Geogr., Journ., vol., 120, 1954, p. 569.

Ibn Serapion: "Description of Mesopotamia and Baghdad". A.D. 903.

Loftus W.K: "On the geology of the Turk-Persian frontiers, and the district adjoining" quat. geol. Sec. vol., XL. 1855.

Lewis A.D: "Silt Observation of the Tigris". Minutes of Proceedings of the Institution of Civil Engineers. vol., CCXII., 1921, part 2.

Lees G.M.: "Some Structural and Stratigraphical Aspects of the Oilfields Congress, 1948.

Lees and Falcon: "The geographical history of the Mesopotamia Plain" geog. jour. vol. CXV III, 1952.

Macfadyen W.A: "Water supplies in Iraq" published No. 1 geol-olgical department, Baghdad, 1938.

Morgan J.De: "Delegation en perse, Memoires" Paris. vol. I. 1900.

Morgan J.De: "Mission Scientifique en perse". vol. 2, 1904.

Mitchell R.C: "Notes on the Geology of Western Iraq and Northern Saudi Arabia". Geologische Rundschau, 1957.

Mitchell R.C: "Physiographic Regions of Iraq". Bulletin De la Societe De Geographic De Egypte. 1957.

Normand C.W.B: "Mesopotamia Conditions affecting Aviation in Mesopotamia". Royal Meteorological Society. Vol. 44, 1918.

Noble A.H: "The sub-surface water resources of Iraq" Baghdad, 1927.

Pallis S.A: "The Antiquity of Iraq". Compenhagen, 1956.

Powers W.L: "A preliminary report on the soil and land-use capabilities in Iraq" 1954.

Royal Meteorological Society: "Human Body" Quat. Jour. vols. 32, 45 and 46, 1906, 1919 and 1920.

Symon's Meteorological Magazine: vol. 54, 1919.

Sharif I: "Geographical Situation of Iraq" Ph.D., University of Cairo, 1952.

Sousa A: "The Iraq Irrigation Handbook" The Euphrates Valley, (Arabic) Part 1, 1944.

Thomas E: "Reclamation of White-Alkali Soils in the Imperial Valley of California". July, 1936.

The Pakistan High Commission: "A Bulletin on the Indus Basin". 1954.

Willcocks (Sir William): "Mesopotamia, past, present and future" The Smithsonian Institution, Annual Report, 1909.

Willcocks (Sir William): "The Irrigation of Mesopotamia" London, 1917.

Willcocks (Sir William): "Irrigation of Mesopotamia". (2 vols.), 1917.

Willcocks (Sir William): "The Garden of Eden to the Crossing of the Jordan". 1929.

Wilson, pt. cal, (Sir A.T.): "The Persian Gulf" Oxford, 1928.

Wilson, (Sir A.T.): "The Delta of the Shatt al-Arab and proposals for dredging the Bar". Geog. Jour. vol. LXV., 1925.

Winchester J.W: "Memoir on the River Euphrates and during the late expedation of the H.C. Armed Stream Euphrates" Bomb. geog. Soc. vol. ii, 1828.

War Office: "Quarter Inch Map of Iraq" (3rd edition, 1949).

Woolley (Sir ~~Woolley~~): "Ur of the Chaldaeas, Pelican Books" 1938.

Woolley (Sir ~~Woolley~~: "The Sumerians". 1951.

Zohary M. "The Flora of Iraq and Its phylogeographical Subdivisions". Dept. Agr. Bulletin No. 31, 1950.

Settlements, Population and Communications.

Al-Azawi A: "The Iraqi tribes" 4 volumes (Arabic) 1950.

Ali H.M: "The Miri-Sirf land" Baghdad, 1955.

Directorate General of Census: "Population Census 1947 and 1957".

Directorate General of Census: "Monthly Statistical Bulletin" 1956.

Directorate General of Census: "General Guide of Population", 1957.

Adams D.G: "Current Population Trends in Iraq". Middle East Journal, vol., 10, 1956.

Development Board: "A report on housing Census of Iraq" 2 volumes, 1956.

Field H: "The Anthropology of Iraq" 1951.

Keith A: "Arabs of Central Iraq, their history, ethnol. physiol. characteristics" vol. 4.

Khayyat J: "Possibilities of tribal settlement in Iraq, in present and future, and their social and economic effects" 1956.

Lebon J.H.G: "Population distribution and agricultural regions of Iraq" economic geog. 1953.

Lloyd S: "A brief history of Iraq from the earliest times to the present day" London 1950.

Ministry of Communications and Works: "1/1,000,000 Map of present and future of transport - scheme in Iraq" 1956.

Ministry of Economics, Principal Bureau of Statistics: Statistical Year Book" 1949-1956.

Ministry of Development: "The Reclamation and Settlement of land in Iraq" (Arabic) 1956.

Sousa A: "The Irrigation in Iraq Handbook" part 2, 1945.

Summer W.G. and Keller A.G: "The Science of Society" vol. I, 1927.

Agriculture and Irrigation.

Alwan A.S: "The process of Economic Development in Iraq with special reference to land problems and policies" Ph.D. University of Wisconsin, 1956.

Baquir T: "Introduction in the ancient cultural history Ancient Iraq" (Arabic) part 2, 1955.

Dowson E: "Land Tenure and Related questions" 1931.

Damerson S: "supervised Farm Credit" in Documentation Centre on land problems in the Near East.

Directorate General of Date Association: "Iraq Dates, Culture, Industry, trade and Delicious Recipes" Baghdad 1953.

Eaton F.M: "Irrigation and Agriculture along the Nile and Euphrates" Sci. No 69, 1949.

Griffir B. and Robert N: "Atlas of California". Living Geography, 1956.

Guide to Agriculture of U.S.A.". Bulletin No. 30, 1955.

Heady E.O: "Basic Economic and welfare aspects of Farm technological advance" Jour. of Farm Economics, vol. XXXI 1949.

High Committee: "Egyptian National Association Report". (Arabic), 1955.

Hoarth D.G: "The Ancient East" 1958.

Haystead L. and Fite G.C: "The Agricultural Regions of the United States". 1955.

International Bank: "The Economic Development of Iraq" 1952.

Issawi C: "Egypt at Mid-Century; An Economic Survey". 1954.

Ministry of Agriculture: "Majallatu-ZZIRA ATIL - Iraqyiah" (Arabic) vols. 1950-7.

Ministry of Agriculture, Statistics Branch: "A Graphic Summary of Agriculture in Iraq" Baghdad, 1956.

Ministry of Agriculture; "Unpublished agricultural statistics of crops" 1957.

Ministry of Agriculture of Pakistan; "Agricultural Economics and Statistics". Section Government of Pakistan". 1955.

Sheikh A.H: "A Handbook of the Development Authority of Pakistan". 1954.

Salter (Lord S): "The Development of Iraq" Baghdad 1955.

Sousa A: "A bulletin on the Iraq Dates and their story" Baghdad 1936.

Sousa A: "A bulletin on irrigation in Iraq, its history and development" 1945.

The Pakistan High Commission: "Pakistan News, No. 42." London, March, 23, 1959.

Thamir H: "Agricultural Policy in Iraq" Ph.D. University of California, Berkely, 1954.

United Nations: "Land Reform" op. cit. 1951.

"United States Census of Agriculture". 1950.

"United Nations: "Yearbook of Food and Agriculture Statistics". vol. 5, 1951.

United States: "Agricultural Statistics". 1958.

Unesco Report: "Development of Arid Land". April, 1952.

Wiley J: California and the Southwest". 1956.

Warriner D: "Land Reform and Development in the Middle East". London and New York. 1957.

Reports and Official Publications:

Development Board: "A report on the Great Musayib project" 1957.

Development Board: "The Irrigability land classification of the Babil extension area report" 1953.

Development Board: "A report on the Diwaniya-Dagarah Extensions" 1955-56.

Directorate General of Agriculture: "Saqlawiya Experimental Salts" unpublished report.

De Grurler P: "Unpublished paper on the salinity in Iraq 1953.

Directorate General of Veterinary Services: "A report on the chief animal products section" 1956.

Directorate General of Geology: "A Report on the International Geological Congress (Unpublished) " XX the session, Mexico 1956.

Development Board: "An article on the distribution of land ownership in Iraq and its effect on tribal settlement and expanding agriculture" (Arabic) 1956.

Development Board: "Land Classification, Musayib project" April 1957.

Directorate General of Irrigation: "Statistics of pumps (Unpublished)" 1949-1957.

Directorate General of Irrigation: "A report on the irrigation scheme in Iraq" (Arabic) 1954.

Directorate General of Irrigation: "Methods of Irrigation in Iraq" (Arabic) Report No. 6, 1955.

Directorate General of Land Settlement: "Statistics of land tenure (Unpublished)" 1957.

Development Board: "The preliminary land-classification report on the Diwaniya-Dagharrah Extensions" 1955-56.

Development Board: "A report on the Babil extension" 1955-56.

Directorate General of Irrigation: "The evaluation of Irrigation in Iraq" Report No. 2 (Arabic) 1955.

Directorate General of Irrigation: "Characteristics of the soil of Iraqi Delta" Report No. 1 (Arabic) 1955.

Directorate General of Irrigation: "Artificial Drainage in Iraq" Section 1, 1954.

Development Board: "A report on the drainage in Iraq" Baghdad, 1953.

Irrigation Department: "Reports No. 3 and 6 on the characteristics of the Iraqi Delta" Baghdad 1955.

Directorate General of Geology: "An article on the topography of Iraq" 1954.

Development Board: "A report No. 22 on the drainage in Iraq" Section 1, 1954.

Directorate General of Machinery: "Statistics of new agricultural machines and implements (Unpublished)" 1946-1957.

Haigh F.F: "A report on the Control of the Rivers of Iraq and the Utilization of their waters" 1951.

Hardy F.S: "A report on the Development of Irrigation on Hilla canal and its branches" 1952.

Ministry of Economics, principal Bureau of Statistics: "A report on the agriculture and livestock Census of Iraq" 1952-3.

Ministry of Agriculture: "A report of the Iraqi Delegation to the 8th session of the F.A.O. Conference" Rome No. V, 1955.

Ministry of Agriculture: "The 7th Session of the F.A.O. Conference" Rome, 1953.

Russell, J.C: "Historical aspects of soil salinity in Iraq" an unpublished report, 1956.

United Nations, F.A.O: "A report No. 189 on the investigation and development of ground-water resources" Rome, 1953.

Watenpaugh H.N: "A paper on the land classification work in Iraq" Sept. 1956.

TABLE I

Mean Monthly Maximum and Minimum temperatures(in centigrade)

Habbaniya

	Jan.		Feb.		Mar.		Apr.		May.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Means	16.9	5.4	21.3	6.6	21.8	7.8	27.3	14.4	33.6	17.5
Normal	16.0	3.9	18.6	5.9	22.6	9.1	29.6	12.8	36.6	20.0
Period of normal	1936-56		1937-56		1937-56		1937-56		1937-56	

	June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Means	39.9	23.0	43.1	25.8	43.0	25.8	38.4	20.9	32.5	14.3	24.0	8.2	15.3	3.9
Normal	41.4	23.1	44.0	25.7	43.9	24.7	40.3	21.7	33.2	16.3	23.5	10.6	17.3	5.5
Period of normal	1937-56		1937-56		1937-56		1937-56		1937-56		1937-56		1937-56	

Diwaniya

	Jan.		Feb.		Mar.		Apr.		May.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Means	18.1	4.7	22.2	7.2	22.9	8.6	28.0	14.2	34.3	17.7
Normal	16.7	3.3	19.3	4.9	23.4	8.5	30.2	13.7	37.0	19.3
Period of Normal	1936-56		1937-56		1937-56		1937-56		1937-56	

	June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Means	39.8	23.1	41.2	23.9	43.1	24.9	39.4	20.3	33.9	14.2	25.9	7.7	18.0	4.4
Normal	40.9	21.9	42.8	23.6	43.0	22.7	40.0	19.5	34.5	14.9	25.7	9.8	18.3	5.0
Period of Normal	1937-56		1937-56		1937-56		1937-56		1937-56		1937-56		1939-56	

Source: "Monthly Weather Report for Iraq" Meteorological Department, Baghdad, 1956.

TABLE 2

Mean Monthly Temperatures for Babil and Habbaniya (in F°)

Month	Babylon(German)1908-1913 Mean	Mean Max.	Mean Min.	High -est Max.	Low-est Min.	Habbaniya 1936-1956 Mean	Mean Max.	Mean Min.	High -est Max.	Low -est Min.	Mean Monthly range
January	56.5	57.2	36.9	75.4	20.8	48.3	59.9	38.9	79	16	21.9
February	63.5	66.7	42.1	81.7	25.9	51.8	65.0	42.1	87	24	
March	73.3	75.4	48.7	95.7	32.9	59.9	72.9	48.3	97	27	
April	83.2	85.6	58.8	105.3	41.7	70.0	85.7	54.2	106	38	31.5
May	93.5	97.7	68.7	114.1	57.7	83.0	97.9	68.0	116	50	
June	99.2	106.3	72.7	120.7	61.3	89.9	106.5	73.4	116	60	
July	101.7	110.5	75.4	119.3	60.1	93.9	108.8	73.3	122	70	35.5
August	102.2	110.7	74.5	121.3	63.0	93.2	111.2	76.4	123	67	
September	97.1	115.8	69.4	116.1	57.2	87.0	104.8	63.7	119	52	
October	81.3	93.0	61.4	104.4	46.0	76.2	91.4	61.3	107	42	30.0
November	71.5	75.7	47.8	90.9	27.1	62.7	76.6	51.0	95	34	
December	60.9	62.4	39.4	80.8	18.9	51.9	63.6	42.1	79	2 0	
Year	88.8	87.2	57.9	121.3	18.9	72.3	87.2	58.1	123	16	
Min.No. of years	5	5	5	5	5	20	20	20	20	20	

Source: Climatological Means for Iraq No.10,1954, and Monthly Weather Report for Iraq, 1956. Meteorolggical Dept.

TABLE 3

Mean Monthly Temperature for Diwaniya (in F°)

Diwaniya (D.I.MS) 1936-56.

Month	Mean	Mean Max.	Mean Min.	Highest Max.	Lowest Min.	Mean Monthly range
January	49.8	61.8	37.4	78	17	24.4
February	53.5	66.3	39.8	88	19	
March	61.4	74.3	46.9	97	28	
April	72.7	87.6	56.0	107	35	31.5
May	84.7	98.4	66.6	114	46	
June	91.9	105.6	71.6	116	58	
July	95.5	109.6	76.4	121	65	33.2
August	92.6	110.6	72.2	119	61	
September	86.0	104.1	66.4	116	53	
October	77.8	93.8	58.0	111	37	35.8
November	64.7	78.7	49.1	97	27	
December	58.3	65.5	40.8	82	22	
Year	73.7	87.5	56.6	121	17	
Min.Nol of years.	20	20	20	20	20	

Source: Meteorological Means for Iraq No.10 Report, 1954.

TABLE 4

Wind - average frequency from specified directions at Habbaniya and Diwaniya stations., 1936-56.

0300 G.M.T.

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	56.1	15.2	22	20.5	13.4	12.5	88.5	88.6	48.2	5.9
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

0600 G.M.T.

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	63.0	12.1	17.2	24.5	16.2	17.0	78.1	109.8	27.2	8.0
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

1200 G.M.T

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	65.4	8.9	15.6	26.0	14.0	15.3	85.3	112.5	21.4	9.2
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

Habbaniya
(D.IM.S) 1936-56

0300 G.M.T.

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	27.8	12.1	22.3	16.1	11.3	8.8	33.6	135.6	78.0	4.7
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

0600 G.M.T.

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	56.4	16.6	18.1	17.2	15.2	10.9	21.2	171.3	39.4	7.4
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

1200 G.M.T

direc -tion	N	NE	E	SE	S	SW	W	NW	C	VK
Mean Year	54.4	17.1	15.6	17.6	30.6	26.1	39.5	148.1	16.3	8.2
Min. No. of years.	20	20	20	20	20	20	20	20	20	20

Source: Meteorological Means for Iraq No.10 Report, 1954.

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TABLE 5

Habbaniya 1936-56.

Month	Mean Pressure (Milli -bars)	Mean Relative Humidity (per cent.)	Mean Vapour Pressure (Milli -bars)	Mean Total Cloud (Amount Coktas)	Rainfall in Millimetres Mean	Rainfall in Millimetres Max. Fall in 24 hrs.	Mean Number of Days. Rain	Snow	Thunder	Fog	Dust	Clear	Cloudy
January	1021.0	70	8.2	3.0	22.0	30.5	5.6	0.2	0.9	2.2	1.6	12.6	3.9
February	1017.0	63	8.4	3.0	16.7	20.6	5.1	0.1	0.8	1.1	2.0	11.4	3.3
March	1014.7	54	8.9	3.3	26.6	30.6	5.1	0.0	2.3	0.3	1.9	11.5	4.0
April	1012.1	44	10.7	2.9	7.2	11.4	2.9	0.0	1.4	0.1	2.9	11.4	3.9
May	1009.0	33	10.9	9.6	3.2	10.8	1.6	0.0	2.1	0.0	3.2	12.7	1.8
June	1003.8	22	10.6	0.3	tr.	tr	0.0	0.0	0.0	0.0	1.2	29.1	0.0
July	999.3	22	12.3	0.4	tr	tr	0.0	0.0	0.0	0.0	2.3	29.1	0.1
August	1001.0	22	12.1	0.3	tr	tr	0.0	0.0	0.0	0.0	0.5	30.0	0.0
September	1007.2	29	11.4	0.4	0.5	6.4	0.2	0.0	0.2	0.0	0.4	27.8	0.1
October	1013.6	38	10.8	2.1	2.3	15.2	1.1	0.0	0.9	0.1	1.0	19.2	1.6
November	1017.3	59	11.1	3.2	15.5	23.1	4.3	0.0	1.7	1.3	0.8	13.4	2.8
December	1020.0	71	9.1	3.2	18.9	28.2	4.9	0.0	1.4	2.6	0.4	11.1	4.9
Year	1011.2	45	10.4	2.1	112.9	30.6	32.8	0.3	11.7	7.7	18.2	219.3	26.4
No. of years.	20	20	20	16	20	20	20	20	16	20	20	20	16

Diwaniya 1928-1939

Month													
January	1019.6	71	8.5	3.0	23.5	32.9	5.8	0.0	0.3	2.3	1.0	13.2	5.9
February	1016.0	66	9.1	2.8	20.7	51.1	4.2	0.0	0.2	0.5	1.9	12.9	3.8
March	1014.1	52	9.1	2.7	5.0	7.0	3.1	0.0	0.8	0.3	3.4	14.0	4.0
April	1010.5	43	11.0	2.7	12.4	58.6	2.6	0.0	1.7	0.2	3.2	13.8	3.4
May	1007.9	36	11.8	2.4	18.1	113.6	1.3	0.0	1.3	0.6	3.1	15.7	2.5
June	1002.7	27	11.7	0.3	10.5	5.3	0.1	0.0	0.1	0.0	3.6	27.9	0.1
July	998.3	28	12.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.9	28.7	0.1
August	999.5	27	12.8	0.4	0.9	9.7	0.1	0.0	0.2	0.0	2.3	28.8	0.0
September	1005.5	30	12.5	0.4	tr	tr	0.0	0.0	0.1	0.0	1.1	27.5	0.5
October	1012.8	36	10.7	1.7	0.5	1.5	0.5	0.0	0.0	0.1	0.6	19.5	2.5
November	1016.9	53	10.7	2.6	14.7	42.4	3.3	0.0	0.6	0,7	0.5	15.4	4.9
December	1019.5	70	9.4	3.2	24.5	24.2	4.9	0.0	0.6	3.8	0.6	12.2	5.9
Year	1010.3	45	10.8	1.9	121.2	113.6	25.9	0.0	5.6	8.4	24.2	229.6	33.6
Min. No. of years	20	20	20	13	20	20	20	20	13	20	20	20	13

TABLE 6

Evaporation at lake Habbaniya, Abu-Dibbis and Ramadi stations.

(in millimetres)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
No. of years.	7	6	7	3	3	5	8	9	9	10	9	8	
Total of evap.	62	63	134	129	114	216	216	275	188	176	132	79	1830
% annual	3.4	3.5	7.3	7.1	6.2	11.8	14.3	15.0	10.3	9.6	7.2	4.3	100.0

Abu-Dibbis Evaporation Data

No. of years.	1	1	1	1	2	2	4	3	3	2	4	2	
Total of evap.	103	92	165	130	142	249	318	204	272	93	177	125	2170
% annual	4.8	4.3	7.6	6.0	6.5	11.5	14.7	14.0	12.5	4.2	8.2	5.7	100.0

Ramadi Evaporation Data

No. of years	1	1	1	1	1	1	1	1	1	1	1	1	
Total of evap.	21	42	149	195	320	465	527	543	440	300	157	44	3200
% annual	0.7	1.3	4.7	6.1	10.0	14.4	16.4	17.0	13.7	9.4	4.9	14	100

Source: Government of Iraq, Development Board, Report on the Development of the Tigris and Euphrates river system(New York: Knappen-Tippetts-Abbett-McCarthy, Engineers, 1952)pp:III-13 -

TABLE 7

The analysis of soils for Jezireh Zone.
Shamiya and Southern Jezireh extensions.

Dagharra exten.			between Diwaniya-Shamiya exten.			Southern Jezireh extension					
						Fawar extension			Khar extension.		
total No. of soil profile	depth cm.	average total salt per cent.	total No. of soil profile	depth cm.	average total salts per cent.	total No. of soil profile	depth cm.	average total salts per cent.	total No. of soil profile	depth cm.	average total salts per cent.
80	0.30-150	1.1%	60	0.30-150	2.0%	50	0.7-250	2.92%	80	0.25-150	1.52%

Source: Ministry of Development: "A report on the Land classification of the Diwaniya-Dagharra Extensions" 1955.

TABLE 8

Soil texture and chemical analyses for class 1, 2 and 3.

	Class I			Class II			Class III
Location Sample No. depth cm. Series.	Garden 22km. SE of Hashimiya(1 No.11 0-25 - 0-45 Young alluvial.	5 km NE of Abraham Tomb. (2 VI, 492) 0-45 - 65-100 Young alluvial.	20km SW of Hillah (3,VII,492) 0-25 - 50-100 Young alluvial.	2km.E. of Hilla 5(III, 173) 0-25 - 60-100 Hillah.	12km. E of Abraham Tomb. 6(IV, 201) 0-25 - 50-100 Hillah.	5km W. of Rumaitha 7(XI, 666) 0-25 - 90-100 Babil.	Ibn Hajim Lake bed 2(1, 82) 0-25 - 45-100 Hammar (Lacustrine)
Physical Properties.							
Coarse sand %	0.1 - 7.7	1.2 - 1.4	0.4 - 1.6	0.0 - 0.2	0.2 - 0.5	0.2 - 0.6	0.5 - 1.2
Fine sand %	6.6 - 33.3	11.0 - 53.7	27.5 - 37.5	21.3 - 35.3	40.5 - 76.5	48.0 - 72.5	62.5 - 65.7
silt %	3.2 - 36.9	26.7 - 52.9	24.4 - 28.5	18.1 - 29.3	13.2 - 29.5	14.0 - 28.4	16.4 - 18.5
clay %	20.1 - 29.3	18.2 - 36.1	16.5 - 45.3	43.2 - 52.7	19.0 - 31.8	12.6 - 23.4	16.7 - 18.7
total sand %	6.7 - 33.8	11.0 - 55.1	28.1 - 59.1	21.5 - 35.5	41.0 - 67.7	48.2 - 73.1	63.0 - 66.9
textural class.	heavy clay	silt loam	light clay	light clay	clay loam	sandy loam	loam
Chemical Properties.							
pH	8.0	7.3 - 8.3	8.2 - 8.4	8.0 - 8.2	8.0 - 8.4	8.0 - 84	8.40 - 8.60
organic matter	0.25 - 0.66	0.39 - 0.51	0.18 - 0.55	0.53- 0.36	0.30 - 1.14	0.20-0.75	0.33 - 0.42
cl, %	0.585- 0.745	0.037- 0.099	0.007- 0.184	0.014- 0.21	0.09 - 0.42	0.005-0.007	0.035- 0.070
total salts %	2.475-2.625	0.240- 0.450	0.115- 0.808	0.083- 0.248	0.14 - 0.42	0.109-0.863	0.195- 0.360

Source: "Report on the Development of the Tigris and Euphrates River Systems", 1952. by Knappen-Tippetts-Abbott-McCarthy, Engineers.

TABLE 9

Population trends in the Middle Euphrates Valley.

Year	Number of Population.	Intercensal change.	Percentage average rate per annum.
1919	677,500		
1935	830,587	+ 153,087	1.41
1947	951,716	+ 121,129	1.21
1957	1,345,531	+ 393,815	4.1

TABLE 10

Qadha Units (U.D) population of the Middle Euphrates Valley, 1919-57.

liwa	Qadha unit.	1919	1935	1947	1957
Dulaim	(Ramadi Qadha			64285	88642
	(Falluja "	30000	77800	48809	71472
Baghdad	Mahmudiyah & Abu-Ghraib.			92053	107240
Karbala	(Karbala Qadha			59021	90449
	(Najaf "			68573	121566
Hilla	(Hilla "	173000	211666	79903	111827
	(Hashimiyay "			52289	72294
	(Hindiyah "			82356	100048
	(Musayib "			45412	69445
Diwaniya	(Diwaniya "			50249	94688
	(Ifaq "			45747	53537
	(Samawa "	394500	416831	83398	119226
	(Abu-Skhair			75254	86515
	(Shamiyah "			104367	153517

TABLE 11

Sex Ratio - females per 1,000 males.

Year	females	males	females to 1,000 males.
1947	516,570	435,187	1,187
1957	681,021	664,510	1,025

TABLE 12

Sex ratio by age groups (per 1,000 population) in the Middle Euphrates Valley, 1947.

age groups	male per 1,000	female per 1,000
0-19	458.6	541.4
20 -39	412.3	587.7
40 -59	485.7	514.3
60 +	438.4	561.6

TABLE 13

Density of rural and urban population on one square kilometre of cultivatable land in the Middle Euphrates Valley, 1947-1957.

Gadha units	1947 Population per square kilometre.	1957 Population per square kilometre.
Ramadi	48.3	66.5
Falluja	54.4	79.8
Mahmudiyah and Abu-Ghraib	63.1	73.5
Karbala gadha	132.0	202.3
Najaf	259.3	459.8
Hillah	84.7	118.7
Hashimiyah	33.0	45.7
Hindiyah	24.2	29.7
Musayib	56.6	68.5
Diwaniyah	27.1	51.1
Ifaq	17.0	20.3
Samawa	26.2	33.2
Abu-Skhair	237.5	273.1
Shamiyah	237.0	348.0

TABLE 14

The total number of mesharas of cultivated crops for the year 1918-1957.

1957	1956	1955	1954	1953	1952
2,213,910	1,074,002	1,008,771	1,009,771	1,061,900	1,686,912

(1) The estimated figure of the cultivated land in 1917-1918 has been taken from "The Irrigation in Iraq" Handbook, 1945 pp:17 by A Sousa.

(2) The figure between 1949-1956, according to the Statistical Abstracts, does not include the cultivated areas of fruit trees, vegetables and the minor cereals because they are unavailable.

(3) The figure for year 1957, according to the Ministry of Agriculture, Statistics Division, includes the various crops of cultivated land in the Middle Euphrates valley.

cont'd.

1951	1950	1949	1918.
1,042,464	1,384,630	1,095,000	879,243.

TABLE 15

Installation of new agriculture machines and implements in the Middle Euphrates.

Year	tractors	ploughs	combines.
1946	6	13	1
1947	12	20	-
1948	24	37	-
1949	36	55	10
1950	49	63	-
1951	55	75	-
1952	71	75	-
1953	38	82	19
1954	54	69	22
1955	76	83	35
1956	91	99	49
1957	90	91	55

Source: Directorate General of Machinery of Iraq Government.

TABLE 16

Number of pumps and total horse-power in the Middle Euphrates.

Year	No. of pumps.	Horse-power.
1929	400	-
1940	654	20660
1950	1090	376500
1957	1864	52176

Source: Directorate General of Irrigation, Statistics division, 1957.

TABLE 17

Present and proposed Irrigation project areas in the Middle Euphrates valley, 1957.

No.	Project Areas	Existing areas (present project areas) - in mesharas -	New project areas (proposed projects) - in mesharas -
(1)	Saqlawiya	167,000	
(2)	Yusufiya	278,000	
(3)	Latifiya	122,000	24,958
(4)	Iskandariya	30,000	34,081
(5)	Musayib	60,000	246,000
(6)	Hilla-present system.	2,222,000	
(7)	Kifl	144,000	
(8)	Beni-Hassan	162,000	
(9)	Husiainiya	141,000	
(10)	Shinafiya-Samawa	150,384	
(11)	Marsh areas	173,000	
(12)	Lower Kifl barrage projects.	include the extentions of:- Shamiya, Bahr Najaf, Between Shamiya - Diwaniya, and southern Jezireh.	2,201,666
(13)	Hilla - New System	includes the extension of: - Babil, Eastern Jezireh and Dagharrah.	1,538,000
	Total -	3,907,384	4,044,705.

6

Source: - Irrigation Department, Statistics Division, 1957.

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TABLE 18

Agricultural Statistics.

The total number of mesharas of cultivated crops in the gadha units of the Middle Euphrates.

Area planted meshara.	Ramadi	Falluja	Mahmudiya & Abu Ghraib	Karbala	Najaf	Hillah
barley	16,000	41,800	115,000	510,100	5,020	100,000
wheat	20,000	70,000	89,500	5,250	3,642	5,400
rice		150			3,000	1,700
broad beans				650	1,200	4,250
subsidiary grains.	11,182	11,564	28,503	1,122	13	2,452
cotton	110	2,757	16,795	64	69	5,387
vegetables	4,850	8,400	26,100	4,439	846	8,079
dates	1,834	1,077	8,461	21,466	6,061	16,070
No. of date palms.	91,680	53,830	423,077	1,073,276	303,050	803,522
fruits	4,000	6,000	8,500	20,000	15,000	20,000
Total area of crops.						
Fallow land						
Total.						

Area planted meshara.	Hashimiyah	Hindiyah	Musayib	Diwaniya	Afaq	Samawa	Abu-Skhair	Shamiyah	Total	%
barley	8,675	77,000	39,000	73,050	21,500	43,596	9,692	43,500	1,103,933	50
wheat	10,300	5,040	27,000	66,8000	28,000	23,237	11,267	8,500	373,736	17
rice	1,850	10,735	1,242	12,000	4,800	6,000	22,067	30,000	93,544	4.2
broad beans		2,250	500		1,000				9,850	7.4
subsidiary grains.	3,021	406	12,822	23,763	26,007	9,627	2,778	21,557	154,815	
cotton	1,264	44	1,242	250	140				28,122	1.2
vegetables	8,510			5,425	3,105	2,200	2,705	264	74,923	3.4
dates	18,544	47,122	13,260	833	1,238	8,198	22,878	36,455	203,497	9.2
No. of date palms.	927,217	2,356,074	663,049	41,640	61,908	409,888	1,143,881	1,822,760	10,174,660	
fruits	16,000	25,000	9,500	4,000	2,500	2,500	13,500	25,000	171,500	7.7
Total area of crops.									2213,910	100
Fallow land									1,693,474	
Total.									3,907,384	

Source:- Directorate General of Agriculture, Statistics Division, 1957.

NOTE:- In abstract, the above distribution may be seen as

- Saifi cropped land 21%
- Shitwi cropped land ... 70%
- dates 9%

TABLE 19

The total number of fruit trees in the districts of the Middle Euphrates Valley, 1957.

Districts.	Pomegr-anites. (No. of. trees)	Oranges (No. of trees)	Apples (No. of trees)	Apricots (No. of trees)	Lemons (No. of trees)	Peaches & pears. (No. of trees)	Total.
Remadi & Falluja	24,000	7,000	22,000	14,000	4,000	2,100	73,100
Karbala gadha	212,000	50,000	10,000	41,500	17,000	7,600	338,100
Najaf gadha	92,000	25,000	11,000	15,000	8,500	3,800	155,300
Mahmudiyah gadha	180,000	62,500	122,000	35,000	26,000	11,400	436,900
Hillah province	52,000	20,000	4,000	21,000	11,000	-	108,000
Diwaniya province	16,000	25,000	11,000	14,000	7,000	2,700	75,700
Total	576,000	189,500	180,000	140,500	73,500	27,600	1,185,100

Source: Ministry of Agriculture, Statistics Division, 1957.

TABLE 20

The total number of livestock in the Quada Units of the Middle Euphrates, 1957.

District	total sheep	total goats	total cattle	total buffaloes	total horses	total mules	total donkeys	total camels
Ramadi	116,600	4,156	16025	-	4085	113	31724	600
Falluja	113550	29110	7930	700	3795	1215	15270	2380
Mahmudiya	45800	36200	64300	380	5840	300	42780	450
Karbala	8578	1500	2978	84	128	8	2016	-
Najaf	23695	7129	15803	1580	1206	440	11269	1687
Hilla	25795	11000	7567	657	780	115	4256	210
Hashimiyah	60549	5726	16681	300	6520	-	10120	3820
Hindiya	78670	6451	11687	1348	1141	4	5626	-
Musayib	55210	11000	12490	600	1500	-	6000	200
Diwaniya	40150	8545	10200	2812	3017	-	4767	1430
Ifaq	61221	24505	5300	817	3501	50	6830	5061
Samawa	299850	3080	32700	328	9285	-	21550	363
Abu-Skhair	101160	6000	7259	1500	633	50	6280	1770
Shamiyah	65630	8585	5465	2000	2527	-	6325	355
Total-	1096428	162887	216385	13106	43958	2295	174813	18326=
								= Total 1,707,320.%100
Percentage	%61	%10	%12.4	%1.5	%3	%0.2	%10	%1.4

Source: Directorate General of Veterinary Services, 1957.

TABLE 21

Land classification of Gadha units according to the types of land tenure, 1957.

gadha units	holdings under Mulk (private ownership)	holdings under Matrouk (for public purposes)	holdings under Waqf (religious property)	holdings under Miri (Government).			
	land classification of gadhas according to the types of land tenure (in mesharas).			Miri tapu	Miri Lazmah	Miri Sirf	gross area.
Ramadi	1417	-	13232	15201	199357	303133	532340
Falluja	5	-	-	102373	215537	16360	334276
(Mahmudiyah Abu-Ghraib)	5861	-					
Karbala	8	1	2777	133803	19090	23071	178750
Najaf	3	-	8	7312	2388	2168	11879
Hillah	2732	-	600	157014	164517	51704	376568
Musayib	-	18	16519	113403	115401	75649	320991
Hindiyah	1667	-	5886	197809	181436	9322	396121
Hashimiyah	580	18	5366	130559	365869	30698	533091
Diwaniya	-	-	-	114460	540935	140399	794785
Shamiyah	2	118	3	825877	554289	119529	758604
Abu-Skhair	-	26	-	19495	98764	9955	128241
Afaq	-	-	-	51225	573644	426923	1051793
Samawa	44	1450	191	90345	400609	681442	1174082
Total -	12136	1630	44582	2204319	3650366	1903655	7847184
Percentage	0.3%	0.03%	0.55%	28.2%	46.61%	24.31%	100%

Source: Directorate General of Land Settlement, 1957.

TABLE 22

Statistics of the occupants and houses in the Middle Euphrates, 1957.

Towns of over 6,000 inhabitants.

towns	persons	houses	persons per house.
Najaf	88,809	10,164	7.3
Karbala	60,804	6,455	6.9
Hillah	54,005	6,121	7.6
Diwaniya	33,204	3,799	7.3
Samawa	26,838	2,582	7.5
Kufa	21,880	2,816	6.3
Falluja	20,009	2,745	7.3
Ramadi	17,747	1,071	7.1
Habbaniya	13,484	2,244	
Hindiya	12,839	1,647	5.9
Musayib	12,179	1,542	5.9
Hamza	8,463	1,411	6.0
Mahmudiya	8,095	1,172	6.9
Shamiyah	9,381	1,073	7.2
Rumaitha	7,598	1,084	7.0
Abu-Ghuraib	6,601	1,140	5.8

Note: Average number of occupants per house in the Middle Euphrates Valley is 6.2.
Source: Ministry of Economics, Principal Bureau of Statistics, 1956.

cont'd.

Towns between 2,000 and 6,000 inhabitants.

towns	persons	houses	persons per house.
Shinafiya	5,668	789	7.2
Ghammas	5,099	701	7.2
Al-Sadda	4,853	825	5.9
Madhatiya	4,372	729	6.0
Iskandariya	4,185	789	5.9
Afaq	4,000	715	5.6
Qasim	3,462	578	6.0
Khdhir	3,284	469	7.0
Hashimiyah	3,050	509	6.0
Dagharrah	2,965	530	5.6
Hira	2,804	419	6.8
Abu-Skhair	2,490	366	6.8
Kifl	2,230	378	5.9

cont'd.

Villages of over 15 houses.

total of villages	total of persons	houses	persons per house
1,329	155,220	19,900	7.8

Some of these villages are as follows:

Mulaiha	840	140	6.0
Budair	1,587	282	5.6
Kadisiya	996	147	6.8
Salakiya	392	55	7.2
Abbasiya	822	114	7.2
Karma	1,269	174	7.3
Mahawil	1,987	348	5.7
Jadwal	1,083	184	5.9
Faisaliya	1,988	362	6.0

Hamlets of less than 15 houses.

total No. of hamlets.	total of persons	total of houses	persons per house.
216	11928	1,988	6.0

TABLE 23

Yield per hectare of various crops in the Middle Euphrates and in different other advanced and less advanced countries (in 100 kilos. 1950-52).

yield per hectare in 100 kg.				
Country	wheat	barley	rice	cotton
Middle Euphrates	7.85	9.1	10.0	1.9
Persia	10.2	10.5	18.7	1.8
Egypt	18.5	-	32.9	5.4
Turkey	11.9	13.8	35.3	2.4
Australia	12.9	14.5	54.9	-
Denmark	40.7	33.6	-	-
U.Kingdom	28.5	24.4	-	-
U.S.of America	12.3	14.8	27.4	3.1

Source: (1) United Nations, F.A.O. Yearbook of Food and Agricultural Statistics, 1951, Rome, Italy.

(2) Ministry of Agriculture, Statistical Division, 1956-57.

TABLE 24.

Yields per hectare of main crops in the Middle Euphrates, the Nile, the Indus and Colorado (in 100 kilos.).

	Yield per hectare in 100 kg.				
Country	barley	wheat	maize	rice(paddy)	Cotton (lint)
Middle Euphrates	9.1	7.8	6.8	10.0	1.9
Indus	7.4	9.3	9.8	13.8	2.2
Nile	19.5	17.7	21.4	42.2	4.6
Colorado	15.6	12.1	24.0	27.8	5.3

Sources:

(1) United Nations, Yearbook of Food and Agriculture Statistics vol., 5, 1951.

(2) Ministry of Agriculture of Iraq, Statistics Division, Baghdad, 1956-57.

(3) United States, Agricultural Statistics, 1958.

(4) Ministry of Agriculture of Pakistan, "Agricultural Economics and Statistics", Section Government of Pakistan, 1955.