Soil Science Division

ACSAD / SS / P 15 /1980

SOIL MAP OF THE ARAB COUNTRIES

At 1/1 000 000

Vol. 1. SYRIA and LEBANON

Appendix 1. Typical Profiles
Appendix 2. Synoptic Tables

Damascus 1980

THE ARAB CENTER
[FOR THE S]TUDIES OF ARID ZONES AND DRY LANDS
(ACSAD)

THE ARAB CENTER

For The Studies of Arid Zones & Dry Lands

(A C S A D)

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ACSAD Is an intergovernmental autonomous Organization , established by the Arab League in 1971 with its headquarters in Damascus , Syria . It may open branch offices in other Arab Sates .

Its main objectives include regional research programmes and studies related to arid zones such as water resources, soils, plants and animal production as well as :

- training of Arab scientists
- exchange of knowledge and experience among Arab States
- cooperation with other Arab and International Organizations

The head of the excutive authority is the Director General

The Administration Board is composed of country representatives, one from each participant Arab Country.

ACSAD Publishes Research Papers (P) and Scientific reports (R) which are distributed Free or by exchange on request.

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The Hashemite Kingdom of Jordan
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Soil Map of the Arab Countries

At 1/1 000 000

Vol. 1- Syria and Lebanon

I. Introduction

The concept of soil map project in Arabian countries arose in 1972, at the Seminar for Arab soil scientists held in Damascus upon the invitation of both the Arab League for Education, Culture and Sciences Organization (ALECSO) and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD). 15 Arab Countries were represented. Many important recommendations were agreed on, among them a recommendation concerning the preparation of a general map for soils to be established on unified system and legend as a first step to a comprehensive program aiming to survey the natural resources in the Arab countries.

From that time the Arab Center took the responsibility of this program. His experts commenced collection and compilition of available information, comparing and assessing them. As a result it was found that the available information were limited and are restricted to the main agricultural areas specially the irrigated zone.

The first executive step was the Second Seminar for responsibles of soil administrations in Arab countries, which was held in Damascus 1977 to discuss details of this great project and undertake decisions and recommendations related to the scale, the soil classification system, the plan of work and responsibilities of cooperating sides. The USDA Soil Taxonomy was adopted for the soil map and the scale of 1/1 000 000 was recognized as the most suitable for this regional study. A Consultative Committee was invited, formed by eminent Soil Scientists in the world. They represent most known international soil classification systems. Those are:

Prof. Dr. R. Tavernier	Director, Geology Institute Ghent University - Belgium .
Dr. R. Dudal	Director, Land and Water Div. FAO
Dr. A. Pecrot	Land and Water Div. FAO
Dr. W. Johnson	Deputy Administrator- Soil Conservation Service. Department of Agriculture - USA
Dr. F. Luken	Director of Soil Science BGR Hannover W. Germany
Dr. M. Lamouroux	Director, Central Laboratories (ORSTOM) France.
Prof. Dr. E. Servat	Professor of Soil Science - Faculty of Agriculture
Prof. Dr. V.A. Kovda	Academy of Science of the USSR-Moscow

National and Regional Correlators were nominated. They have the responsibility to execute the work. Five regions representing the whole Arab countries were distinguished as follows:

1. Syria, Lebanon, Jordan, Palastine.

   The Director of Soil Science Div. of the Arab Center was nominated as regional correlator.

2. Iraq, Golf countries and Saudi Arabia.

   Dr. Fleyeh Al-Tai, was nominated as regional correlator.

3. Sudan, Somalia, Yemen Arab Republic, People Republic of Yemen, Oman.

   Dr. Mouhamad Abd-Allah Ali was nominated as regional correlator.

4. Egypt, Lybia.

   Prof. Dr. Hasan Hamdi was nominated as regional correlator.

5. Tunisia, Algeria, Morocco, Mauritania.

   Dr. Muhsen Hamza then Dr. A. Al-Suwissi was nominated as regional correlator.

A working Committee formed by Dr. A. Osman, Director of Soil Science Division, (ACSAD), Dr. O. Mukhtar, Head of Soil

Classification Section (ACSAD) Mr. P. Billaux, the Expert of the French Scientific Research Office (ORSTOM), Prof. Dr. Jean Amerykx from Ghent University (Belgium), was asked to prepare the legend for the soil map. The Third Seminar was held in 1978 to discuss the Legend and progress of work in the project.

Soil map of Syria and Lebanon

The first realization of the project is the preparation of the soil map of Syria and Lebanon. This work commenced in 1978 and took more than 2 years.

Several specialists contributed to the execution of this map. The Directorate of Soil in Syria executed general analysis for a great number of soil samples. Special analysis on representative samples were executed in the Central Lab. of Lincoln in Nebraska(USA), also in ORSTOM Laboratories Investigation on clay mineralogy, soil micromorphology and climatic studies were executed in the University of Ghent-Belgium. Additional investigations on soil moisture and temperature regimes were carried out by Professor Dr. A. Wambeke at Cornell University U.S.A.

The interpretation of satellite imageries was executed by ACSAD specialists,as well as the field observations, profiles description, and soil sampling.

II. Basic Documents

1. Topographical map

There are many topographical maps at different scales available in the Arab countries. These maps do not cover all Arabic Area. Some are covering several countries or one country or only part of the country. Comparing these maps with each other they have different legends and geographical projections. Therefore, a common topographical map is to be considered. It was found that the most suitable map is that used for aviation published by the American Defence Mapping Agency, which has the required scale of 1/1 million. Despite that it contains some special specifications among them the contour lines which are given in feet and are to be transfered to meters. ACSAD obtained the complete set of negative separations covering all the Arab countries.

2. Climatic data

There are many climatological stations in Syria and Lebanon amounting to more than 300. But stations giving comprehensive informations on climate are not exceeding 140.

These stations are distributed in all areas. Their density exceed in coastal and interior plains whereas they become less in the desert (Al-Badia) region.

In soil sciences, information available about rainfall and air temperature are not enough to determine climatic properties of the soil itself.

Reference in this document is made to the Climatic Atlas of the Arab countries (1979) published by the Arab Organization for Agricultural Development (AOAD) Khartoum - Sudan, as source of information.

3. Geology and Geomorphology

Many geological studies prepared at several scales and by several sides are available in Syria and Lebanon. Among them the Geological map prepared by Prof. Dr. Louis Dubertret and the geological map on 1/1 million and 1/200 000 by Soviet experts in 1963. Also the geomorphological map at the scale of 1/1 million prepared by the Soviet experts and the scientist K. Mirzaev. There are many other national studies.

4. Previous soils studies

There are many soils studies available in Syria and Lebanon. Most important was the Lebanese soil map, at the scale of 1/200 000 prepared by Prof. Bernard Geze (French) and the soil map of Syria at the scale of 1/1 million by the FAO expert Van Lyre (Netherlands). In addition to these general maps, which are old for more than 20 years, there are several studies prepared by experts of FAO, cooperating countries, private compagnies and national experts.

It is known that these studies with different scales depended on various soil classifications with no connection between them, as remarked in all soil studies in the Arab Countries.

5. Satellite imageries, field work and lab. analysis.

Satellite imageries were used as part of technical operations to determine map units in addition to aforementioned documents. A complete set of lands at imageries with their 4 bands (4,5,6,7) were obtained as well as the false color when available. Various equipments were used to study and analyse these imageries among them a Zoom Transferoscope, additive Viewer, Overhead Projector.

In any soil study, field work forms the most part of it, which has the greatest importance. Field work for this map took more than 2 years, more than 600 sites were observed, among them about 60 profiles were choosen. All kinds of physical and chemical analysis were made for them in the Lab. of Directorate of Soil (Syria). In addition to these analysis more than 25 Profiles were selected and of which samples were sent to the USDA-SCS- Central Laboratories in Lincoln - Nebraska for comprehensive analysis. Detailed mineralogical and micromorphological analysis were executed for these soils in Ghent University - Belgium. Also some analysis for limited samples related to iron oxides, silica and alumina were analysed in ORSTOM Laboratories - France.

III. Environmental Conditions

1. Geology, lithology and geomorphology

Syria and Lebanon lie in the N-W part of the Arabian peninsula, between the Mediterranean sea, the Taurus mountain ranges and the mesopotamian plains.

The main physiographic features of Lebanon are two high and steep mountain ranges stretching S.W. - N.E. and separated by the large valley (or high plain) of Beqaa. Dissected plateaus and narrow littoral plains border the westernmost mountain range towards the sea.

In Syria, a western part is formed by mountain ranges, which, in the north, are bordered by narrow littoral plains and separated by a broad depression. In the eastern (and most larger) part, great plateaux and plains with local topographic accidents progressively slope to the east, while a system of parallel medium high mountains diagonally run from S.W. to N.E. (fig. 1)

The western mountain ranges and associated depressions.

The Mount Liban (maximum elevation : 3083m) and the Jabal Lataquia (max.: 1550m), separated by the Tripoli-Homs depression, stretch nearest to the coast. They are block-type mountains (horsts). Jurassic hard dolomites and limestones in the higher

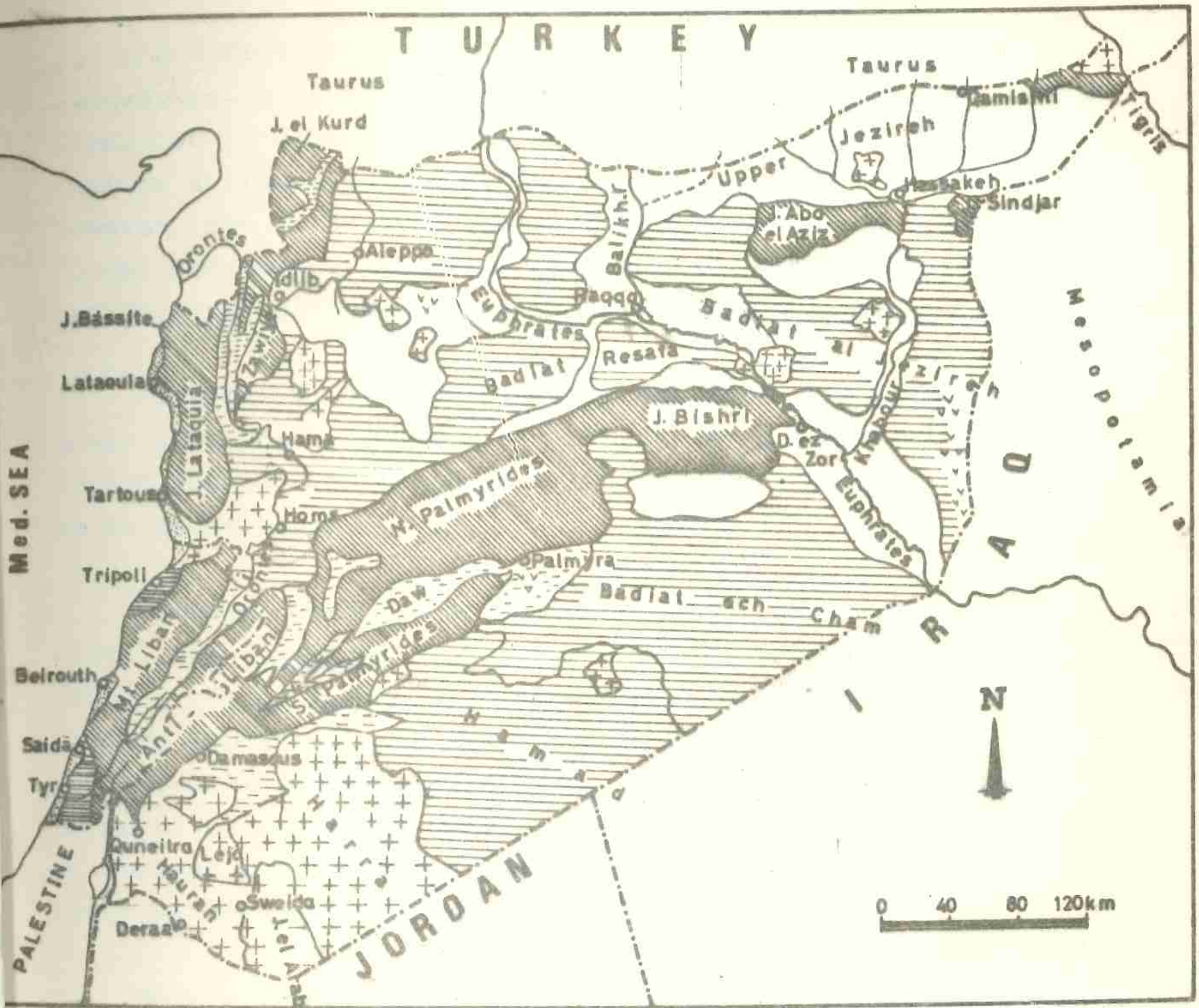
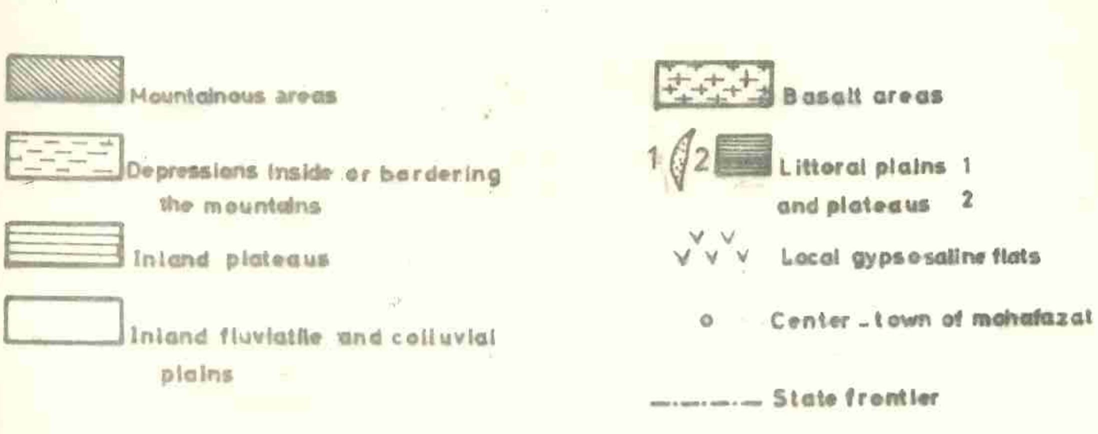


Fig .1. MAJOR PHYSIOGRAPHIC UNITS OF SYRIA AND LEBANON



parts and Cretaceous hard limestones (with lower Cretaceous sandstones, clay and basalt in Mount Liban and Neogene chalky limestone in N.W. of Jabal Lataquia) are the main bed-rocks. Karstic surfaces are frequent. In the northern most part, however, the J. Bassite (max. elevation: 860m) is a block-folded medium-high mountain composed of "green rocks": peridotites, diabases, amphibolites, pillow-lavas ...

Parallel with Mount Liban to the east, the Anti-Liban (max. altitude 2814m at J. el Cheikh) is a large box-type folded mountain bordered by flexures, the rocks are the same as in Mount Liban.

Parallel with J. Lataquia there are, from south to north, the J.Zawiyeh (a horst of Cretaceous and Eocene Limestone), the J. Samaan (a block-folded low mountain of hard Miocene limestone) and the southern part of J.el Kurd (block-folded, mainly Cretaceous chalky limestones). Their elevation is much lower than in Anti-Liban, with a maximum of 877m at J. Zawiyeh and 876m at J. Samaan. Karstic surface is of frequent occurence in these mountains.

Between Mount Liban and Anti-Liban the wide plain of Beqaa occupies a synclinorium bordered by faults and filled by continental Neogene marls and conglomerates. Thick Quaternary alluvium and colluvium cover its southern part and wide pediments spread along the foothills in its northern part. It is traversed by the upper courses of Litani river (southwards) and Orontes river (northwards).

Between J. Lataquia and J. Zawiyeh the flat and poorly drained Ghab plain is due to a graben filled with thick fluviatile deposits of Orontes and lacustrine marls.

Both Beqaa and Ghab are the northernmost parts of the Great East African Faults (Rift).

The Palmyrides ranges and associated depressions.

Running diagonally S.W. - N.E. across inland Syria, the Southern and Northern Palmyrides are medium-high folded mountains (average elevation 1400m) conjugated with a system of faults between them and the more stable plateaus in the south and north.

The Southern Palmyrides have narrow steep ridges and narrow synclinal valleys, while the Northern Palmyrides and their eastern continuation, the lower J. Bishri (861m), have a large, low-dipping brachyanticline structure. Lower Cretaceous hard limestone and dolomite (with small areas of Jurassic dolomitic and gypsiferous sediments in the Southern Palmyrides) outcrop in the higher parts. The slopes are formed from Upper Cretaceous and Paleogene rocks (mainly chalky or hard limestones with flint beds, marls, locally phosphorites), together with smaller outcrops of Neogene (limestones, sandstone, gypsiferous marls, basalt).

Wide depression caused by tectonic downwarping occur between the Palmyrides ranges (the Daw basin and smaller ones) or along their southern border (Palmyra and Damascus basins): They are filled with calcareous and gypsiferous lacustrine deposits of Neogene and Quaternary ages. Flat plains occupy the floors of these basins and in their lower part marshy or gypso-saline flats have developed .

Broad piedmont trains formed by fans and pediments ("glacis") fringe the slopes of the Palmyrides and spread along the valleys and the borders of the depressions (similar trains exist along the eastern parts of the Anti-Liban).

Inland plateaus formed by sub-horizontal rock beds.

South of the Palmyrides

The Hamad plateau is a table-like, broad area, 700 to 800m high, formed chiefly by Paleogene limestones. Its slightly undulating surface with shallow valleys is mostly topped by a calcareous crust up to 1m thick. Shallow scattered depressions are filled with loams and occasionally flooded. The plateau is bordered in its north and east parts by a scarp 20 to 60m deep.

East and north of this scrap lies the Badiat el Cham ("Badiat" means: Nomads land, semi-desert steppe). It is a large flattened surface sloping from south (650m) to north and east (250m) and deeply incised by numerous wide dry valleys. It is formed by paleogene hard limestone and in its eastern part by various Pliocene continental deposits. Its surface is covered by angular fragmental materials (stone desert). In its east part there are some loamy depressions, temporarily flooded. It gradually merges in the higher terrace of Euphrates river to the east and in an alluvial-colluvial plain to the north.

North of the Palmyrides

In the region of Aleppo and between Euphrates and Balikh rivers, erosion has produced a rolling-hilly relief in hard or chalky limestones of Paleogene and Neogene ages (with local Neogene basalt on the foothill of the Taurus).

In the region of Hama, a large flattened surface, deeply incised by Orontes gorge, extends on Paleogene and Upper Cretaceous chalky limestones ("glacis" of Hama). West of this surface, a rolling karstic plateau on Cretaceous hard limestone extends up to J. Lataquia.

The flat plateau of Homs is formed on Pliocene lacustrine marls which fill, together with conglomerates and limestones of the same age, a tectonic depression.

In the plateaus of Aleppo, Hama and Homs, the altitude varies between 400 and 500m. A common feature of these regions is the reddish color of the soils developed on the rocks or on colluvium.

South of Euphrates river, the Badiat er Resafa formed on Paleogene and Neogene limestones and (in the east) gypsum, gently slopes from the south (400m) to the north (300m) where it merges with the higher terrace of Euphrates. Its surface is gently undulating.

In Badiat el Jezireh, the northern parts, west and east of the low mountain J. el Aziz, have a rolling relief. The southern plateaus are flats, they gently slope from north to south or S.E. (350 to 200m) and merge in the higher terrace of Euphrates. Miocene lagoonal gypsum and various Neogene calcareous sediments are the dominant bed-rocks. In the S.E part, near the frontier of Iraq, gypso-saline flats (sebkha) occupy the floor of large dry lacustrine basins.

Inland fluviatile and colluvial plains

The terraces of Euphrates and of its main tributaries the Balikh and Khabour rivers from alluvial plains which stretch along the rivers. Four successive terraces, bordered by cliffs up to 60m high, rise above the flood-plain of Euphrates, the upper one being level with the plateaus. In some parts of Euphrates course they are up to 20Km wide on each side of the river. The lower terraces (Holocene and Upper Pleistocene) are sandy or fine textured but the upper ones are often gravelly-stony. Occurence of gypsum and salt is frequent.

The Upper Jezireh lies north of J. el Aziz and J. Sindjar (low mountains with anticlinal structure, maximum altitude in J. el Aziz: 920m) and south of the Taurus. The plain is formed of thick alluvial and colluvial Quaternary deposits originating mainly from the Taurus mountains and, to a lesser extend, from J. rel Aziz and J. Sindjar. It gently slopes from north to south in its northern part (500 to 350m) and from south to north in its southern part. Its surface is rolling, traversed by numerous wadis mostly tributaries of the Khabour.

Similar thick colluvial deposits lie south of J. el Aziz and form a northern part of Badiat el Jezireh, they slope to the south and merge in the gypsiferous plateau.

South and south-east of Aleppo, a low plain (altitude 250 - 350m) is formed by alluvial or, in the most part, lacustrine sediments. The saline lake of Jabbul lies in its eastern part. The Nahr Queiq (Aleppo river) flows towards the western part, into a poorly drained depression.

The Nahr el Aassy (or Orontes) in its upper and middle courses mostly flows in a deep gorge where the Quaternary terraces are narrow, in the Ghab depression only its alluvium forms a wide plain.

Mountains, plateaus and plains formed of basalt

Large basaltic lava sheets extend in Syria.

The largest ones lie in the south-west. They include: Hauran and Golan plateaus, where lower Quaternary basalts are weathered into vertic soils, the rocky Leja and Harra formed by Holocene basalt flows, the mountain of J. el Arab (1800m high), and the dissected reliefs of thick Miocene basalt flows (J. Maani up to 1000m high) which border the plain of Damascus in the south-west.

West of Homs, a Pliocene basalt flow slopes from a low mountain towards east (down to the Orontes valley) and towards west into the Syrian and Lebanese coastal plain of Akkar.

Relic plateaus of Neogene or Quaternary basalts, limited by cliffs or steep slopes are scattered in the Syrian territory, The larger ones lie E. and N. of Hama and S. of Aleppo.

Littoral plains and plateaus

Narrow colluvial-alluvial gently sloping plains stretch along the coast. The broadest is the plain of Akkar, which lie on both sides of the Syrian-Lebanese frontier and is traversed by the Southern Nahr el Kebir river.

In the rocky coastal areas, marine Quaternary terraces rise at elevations of 2-4m, 6-20m, 30-40m, 50-80m and 100-120m above the sea level.

The south-western part of Lebanon is a polygenetic, deeply dissected plateau, sloping westwards (950 to 120m), which cut the hard or chalky limestones of Upper Cretaceous.

East of Tripoli, the plateau of Zgharta (synclinal structure) is partly covered by Quaternary alluvium and colluvium which overlie the chalky limestones and the marls of Upper Cretaceous and Miocene.

East of Lattaquia, between the littoral plain and the mountain, low plateaus (ancient glacis cutting the chalky limestones) slope gently to the West. They are dissected by small rivers, the most important of which is the Northern Nahr el Kebir.

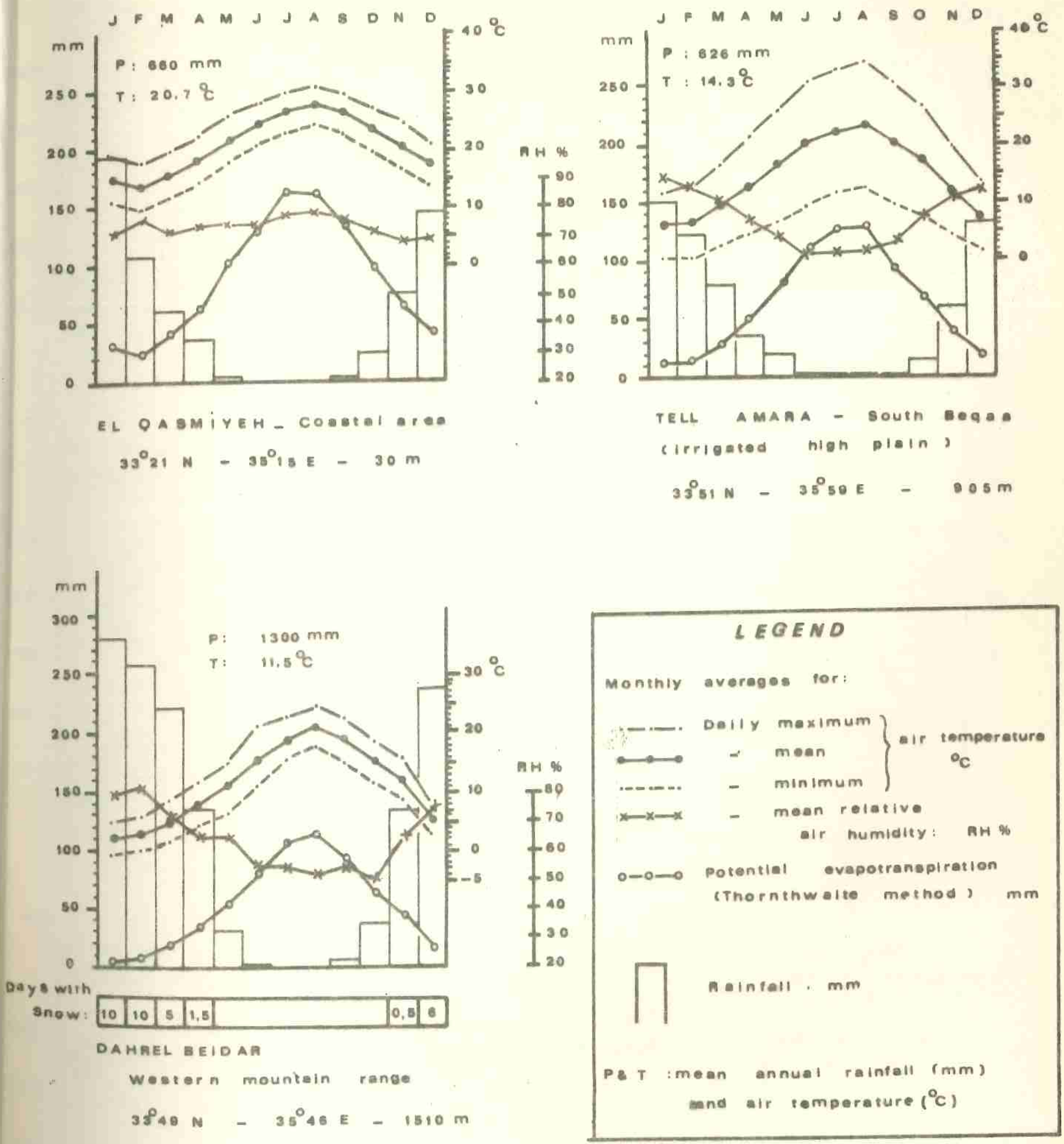


Fig 2 bis – Climatic data for some characteristic station of Lebanon

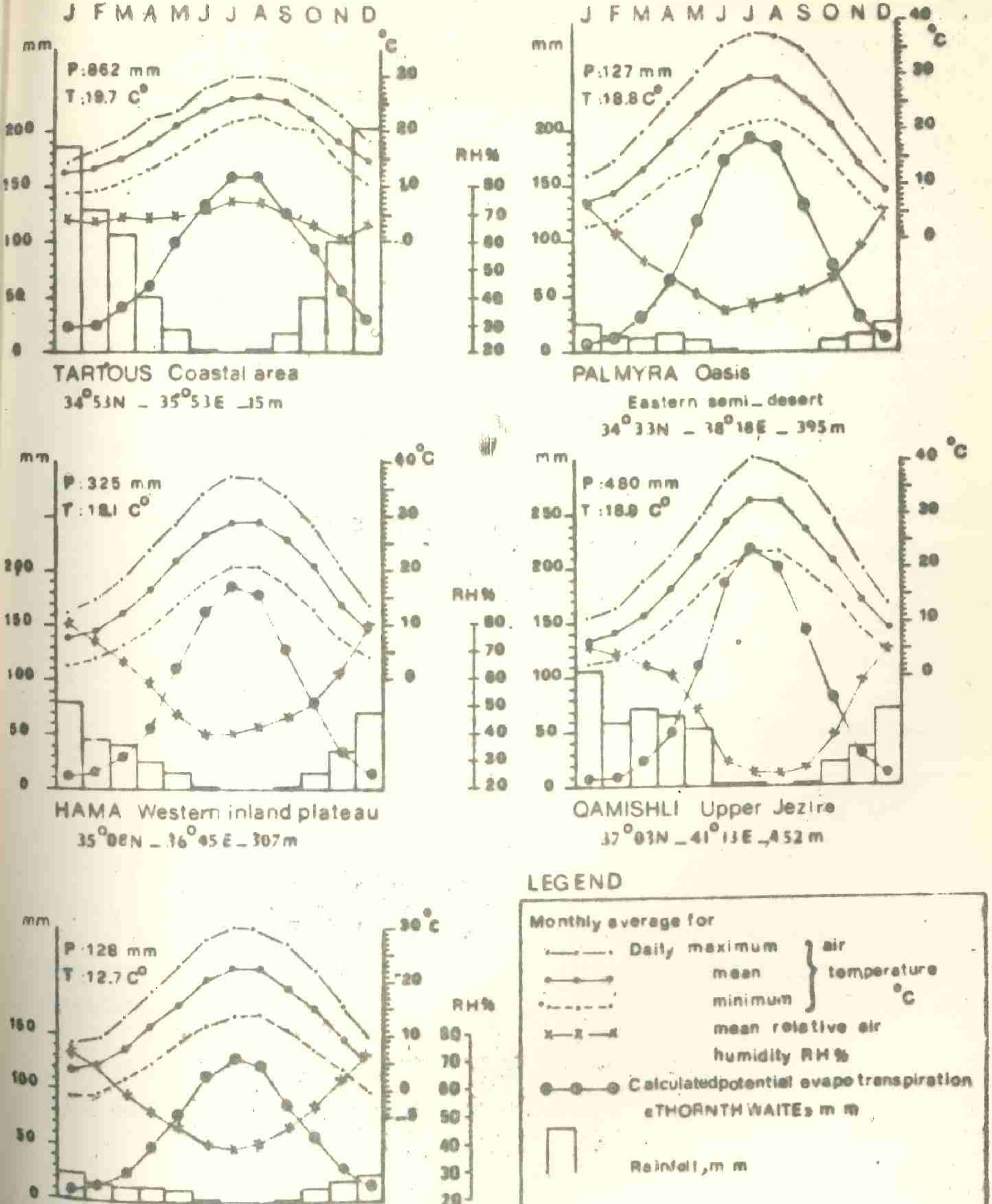


Fig – 2 – Climatic data for some characteristic stations of Syria

2. Climate

A Mediterranean type of climate generally prevails in Syria and Lebanon. It is characterized by a rainy winter and a hot and rainless summer, separated by two short transitional seasons. December and January are the coldest months and July and August are the hotest (Fig. 2 and 2 bis). The amount of precipitation is very irregular from one year to another, the variation may reach $\pm$ 50% of the average annual rainfall.

The spatial distribution of precipitation in the two countries is mainly related:

a) to the fact that most of the rains are due to depressions accompanied by fronts coming from the Mediterranean sea eastwards,

b) to the position and altitude of the mountain ranges on the western border of the countries: These mountains receive most of the precipitation and impede the penetration of the humid air towards the inland regions.

Four major climatic regions may be distinguished.

2.1. The coastal region

It includes the littoral plains and the lower part of the western slopes of the mountains. The climate is sub-humid, with maritime influence.

The precipitation is high, 700 to 1100mm (see the rainfall map), with heavy showers in winter.

The temperature is warm in summer and temperate in winter, there is no or rare frost.

The air relative humidity is high in all seasons.The climatograms of Tartous in Syria and El-Qasmiyeh near Tyr in Lebanon are representative of the coastal region. (fig. 2 and 2 bis).

2-2. The western mountain ranges and associated plateaus and high plains.

The precipitation is high in Mount Liban, Jabal Lataquia, the south part of Anti-Liban (J. el Sheikh) and the high plateau of Golan in the southwestern part of Syria, more than 800 mm everywhere and more than 1000mm above 1000m elevation, reaching 1500mm in the highest parts. In the north of Anti-Liban it is much lower, not more than 600 or 700mm in the highest parts. Above an altitude of about 800m the precipitation falls partly as snow.

The temperature is cold in winter and moderate in summer, in the high mountains, above 2000m, it remains cold or cool throughout the year.

The relative humidity is high in winter and medium or moderately low in summer.

In the eastern slopes of these mountains the amount of precipitation decreases rapidly as the altitude sinks, falling down to 500mm in the foothill (but 600-700mm in the south Beqaa plain). (Fig. 2 bis: Tell Amara).

2-3. The inland semi-arid regions

They border on the eastern side of the western mountains and on the southern side of the Taurus fore-mounts. They include: the Upper Jezireh and Jabal el Aziz, the plateaus of Aleppo, Hama and Homs and the low mountains bordering on these plateaus in the west (J. Zawiyeh, J. Samaan, J. el Kurd), a narrow strip east of the northern part of Anti-Liban, the west part of Hauran plateau, Jabal el Arab, and in Lebanon the central and most of the northern Beqaa.

The climate of these regions has continental characteristics.

The precipitation ranges between 500 and 250mm, decreasing from the foothills to the inland. West of Homs, however, it rises up to 600-700mm owing to the gap between Mount Liban and J. Lataquia. The "dry" season (potential evapotranspiration higher than the precipitation) lasts 5 to 7 months.

The temperature is cool in winter, but with occurence of 10 to 30 days with temporary frost (the highest number in Upper Jezireh and in the low mountains), it is hot in summer (particularly in Upper Jezireh and middle Euphrates basin) with occurence of maxima above 40°C and a high daily difference between the maximum and minimum temperature.

The relative humidity is high in winter and low to very low in summer.

The climatograms of Hama and Qamishli are representative of these regions.

2-4. The arid regions of central Syria

They include all the plateaus, the low or medium-low mountains and the plains which are located east or south of the regions quoted in the paragraphs above, up to the frontiers with Iraq and Jordan. In Lebanon the northernmost part of the Beqaa has a similar climate.

The rainfall is less than 250mm and decreases to less than 150mm in a large area inside Syria, and the "dry" season lasts 8 to 10 months.

The winter temperature is cool in the plateaus and plains, but there are 10 to 30 days with temporary frost. In the mountains it is cold with more than 40 days with frost.

In summer the temperature is moderate in the mountains and high in the plateaus and plains, with large daily difference between the maximum and minimum temperatures.

The relative humidity is high in winter and low or very low in summer.

The climatograms of Palmyra (plain) and Nebek (mountain) are representative of the most arid parts.

In addition, it must be noted that all the regions of Syria and Lebanon are occasionally affected (mainly in spring) by very dry and hot winds ("Khamsin") blowing from the Arabian desert or from the desert areas of eastern North Africa.

In cooperation with Ghent University (Belgium) and the University of Cornell (U.S.A) a climatic study was prepared using computer facilities, according to Prof. Franklin New Hall system of climate classification. Results gave the following:

- In each climatic area there are special spots in which climate differs so that it form microclimates which is affected when exposed to wind, sun rays and availability of natural restrictions and air streams.

- The mentioned study showed that there is a statistical relation between the moisture regiome and hot regime in soil. According to that the aridic and xeric climate may be separated in groups. 3 groups can be distinguished in the Aridic, week, middle and very arid. And 2 groups in the xeric, middle and dry.

Tables 1, 2, 3 and 4 give the average rainfall, mean daily, air temperature, soil temperature at 50 cm. depth and coordinates of some climatic stations near the profiles presented in this document.

CLIMATIC DATA FOR STATIONS NEAR THE SOIL PROFILES

Table 1. Average rainfall, mm

	J	F	M	A	M	J	J	A	S	O	N	D	Year	Period	Days with rainfall > 1mm
Deir es Zor (agric.)	30	16	21	25	7	0	0	0	1	6	8	21	135	58-73	27
Raqqa	39	24	35	26	14	1	0	0	2	17	15	28	201	58-73	38
Hama	76	60	44	32	12	1	0	0	3	13	34	60	335	46-73	50
Homs	105	88	64	45	17	1	0	0	4	15	45	95	479	46-73	58
Forglos	39	28	24	20	12	0	0	0	0	12	22	33	190	59-74	-
Palmyra	22	19	21	21	9	0.5	0	0	0.5	8	14	22	137	46-75	24
Kharabo	35	30	16	13	4	0	0	0	0	4	20	39	161	46-75	27
Izraa	74	53	48	23	4	0	0	0	1	8	30	54	295	58-78	-
Deraa (Tell Shehab)	74	59	57	22	5	0	0	0	1	12	27	64	321	56-71	41
Sweida	78	82	68	28	8	0	0	0	2	9	29	59	363	46-75	45
Chahba	79	58	53	31	12	0	0	0	0	14	27	70	344	58-73	-
Rayak (Tell Amara)	151	124	81	37	20	1	0.5	0.5	1	16	61	133	626	54-64	64
Baalbek	96	89	58	28	12	1	0.5	0.5	1	9	43	72	410	39-64	52
El Qaa	-	-	-	-	-	-	-	-	-	-	-	-	228	66-70	-
Fakehe	47	35	30	26	10	0.5	0	0	0.5	6	22	37	214	33-64	41

Table 2. Air temperature °C

	Mean daily temperature													Mean daily		Days with	
	J	F	M	A	M	J	J	A	S	O	N	D	Year	Max. Aug*	Min* Jan*	max. tem ≥ 35°C	Period
Deir ez Zor (Agric.)	7.5	9.5	11.9	18.7	23.5	29.5	30.2	30.5	26.5	20.8	13.9	8.7	19.3	38.1	2.3	110	58-72
Raqqa	6.8	8.7	12.7	17.8	23.1	27.7	30.1	30.1	25.7	20.1	13.3	8.3	18.7	38.6 x	1.8	99	58-73
Hama	7.1	8.8	11.9	16.0	21.1	25.5	27.9	28.1	25.1	20.2	13.5	8.5	17.8	36.2	2.2	75	46-75
Homs	6.8	8.7	11.3	15.5	19.8	23.9	25.5	26.2	24.1	19.3	13.3	8.1	16.9	32.8	2.3	19	46-75
Forglos	6.5	7.5	10.5	14.5	19.5	23.5	24.5	25.5	21.5	18.5	12.5	7.5	16.5	-	-	-	55-69
Palmyra	7.3	9.2	13.3	18.1	22.9	27.5	29.5	29.6	26.5	21.1	14.1	8.6	18.9	37.9	2.4	89	46-75
Kharabo	6.5	7.8	10.9	14.9	19.1	22.7	24.3	24.7	22.0	17.7	12.3	7.7	15.9	36.3	0.7	67	46-75
Izraa	8.0	9.1	11.7	15.7	20.1	18.4	25.1	25.5	23.9	20.3	15.1	9.8	17.3	33.5	2.9	32	58-75
Deraa (Tell Shehab)	9.7	9.8	12.4	15.8	20.0	23.7	25.1	25.7	23.5	20.1	15.6	10.9	17.6	33.6	3.6	26	58-71
Sweida	7.1	7.3	10.3	14.3	18.5	21.8	23.0	23.5	21.9	19.2	14.6	9.2	15.9	31.2	3.1	10	46-75
Chahba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rayak (Tell Amara)	5.9	6.6	9.2	12.7	16.9	20.1	22.1	23.1	20.0	17.1	11.9	7.3	14.3	34.0	0.3	11	54-64
Baalbek	5.5	6.1	9.1	13.8	18.0	22.8	24.9	25.9	22.2	18.3	12.5	8.0	15.6	35.7	-0.5	32	39-64
El Qaa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Faqehe	6.5	7.3	9.8	14.4	19.4	23.1	25.1	25.9	22.5	19.7	14.5	8.9	16.5	32.4	2.9	7	33-64

* The hottest month. * The coldest month x July
*

Table 3. Soil temperature (°C) measured at 50 cm

	J	F	M	A	M	J	J	A	S	O	N	D	Year	Sum.	Wint.	Period
Deir ez Zor (agric.)	13.7	14.0	16.5	20.8	25.2	29.4	31.3	31.9	29.9	25.8	20.8	16.0	22.9	31.0	14.7	60-69
Raqqa	10.7	11.1	14.3	19.6	25.6	31.1	33.5	33.8	30.9	25.5	19.5	13.7	22.4	32.7	12.0	60-69
Hama	10.4	9.8	12.0	16.1	21.0	26.0	28.9	29.6	28.0	23.9	18.3	13.1	19.7	28.8	10.7	60-69
Palmyra	10.7	10.9	14.2	18.7	23.3	27.5	29.8	29.9	28.3	23.9	18.4	13.2	20.7	29.3	11.9	60-69
Tell Amara	6.8	7.0	9.6	13.0	16.8	21.3	23.3	23.8	22.4	19.6	14.7	10.1	15.7	23.1	7.8	64-73
Hauch Snaid	8.6	8.5	10.6	13.6	16.8	20.3	22.0	22.0	21.2	18.7	14.9	11.1	15.7	21.7	9.2	64-73

Table 4 Coordinates of the stations

	Lat. N	Long. E	Alt.		Lat.N.	Long. E	Alt.
Deir ez Zor(agric.)	35°.22	40°.11	203m	Deraa(Tell Shehab	32°.42	35°.59	399m
Raqqa	35.57	39.00	251	Sweida	32.42	36.35	997
Hama	35.08	36.45	307	Chahba	32.51	36.37	1250
Homs	34.45	36.43	487	Tell Amara	33.51	35.59	905
Forglos	34.37	37.06	675	Baalbek	34.00	36.12	1150
Palmyra	34.33	38.18	395	Fakehe	34.15	36.24	1060
Kharabo	33.30	36.28	620	El Qaa	34.21	36.28	650
Izraa	32.51	36.15	575	Hauch Snaid	33.56	36.04	995

3. Vegetation

At country scale the most important factor of differenciation of the vegetation is the climate. Besides, Man's activity for tens of centuries has greatly influenced the vegetal landscape, particularly by degrading the forest and reducing its surface and by causing the subdesert to expand out of its climatic zone.

Four major zones may be distinguished (the following data are mainly extracted from the UNESCO-FAO Vegetation Map of the Mediterranean zone, 1970).

Forests in subhumid or humid climates

They are located in the western mountain ranges (fig.3).

- Lower stage. The dominant type is a more or less degraded evergreen oak forest: Quercus calliprinus and infectoria,with Pistacia lentiscus, Pyrus, Fraxinus, Amygdalus, Ceratonia and Graminaceae. Locally: Pinus pinea on acid soils, Pinus brutia (particularly in J. Bassite)...

- Upper stages

. Oak - Juniper forest: Quercus infectoria, Quercus pseudocerris (J. Bassite), Juniperus oxycedrus and excelsa, with Pinus syriaca, ...

. Cedar and Fir stage between 1400 and 2000m:
Cedrus libani and Abies cilicica (small relic forests), with Quercus and Juniperus excelsa.

. Subalpine stage between 2000 and 2500m in Mount Liban and Anti-Liban: mostly Juniperus excelsa.

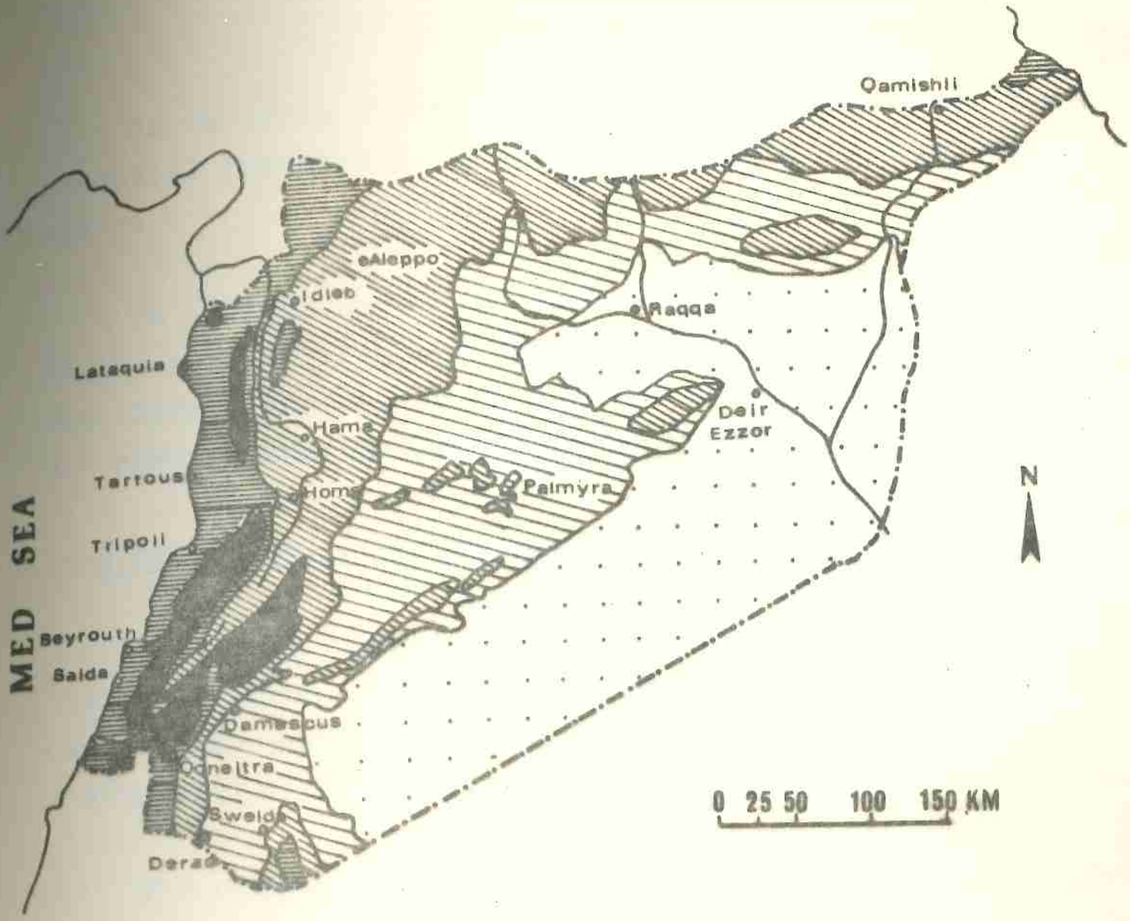


Fig: 3 Schema of the major zones of natural vegetation in Syria and Lebanon

Forest zone in sub-humid or humid climate

- Lower stage
- Upper stages

Tree or shrubby pseudosteppe in semi-arid to arid climate

Shrubby or dwarf-shrub pseudosteppe in arid climate

Pseudosteppe and subdesert formations in arid to very arid climate

(Simplified contours from

UNESCO-FAO Vegetation map of the mediterranean zone 1970

Above 2500m there is no more forest but grassland of perennial graminaceae with Carex and dwarf-shrubs of thorny species.

In general way, the forest vegetation is best preserved on the western versants facing the sea, it is much more degraded on the eastern and drier slopes of the mountains and also in the northern part of Anti-Liban.

Tree of shrubby pseudosteppe in semi-arid to arid climate

This zone corresponds to the most rainy parts of the inland plateaus (part of the "fertile crescent") located east of the western mountains and south of the Taurus. The precipitation gradually decreases to the inside of Syria.

The vegetation is composed of Graminaceae (Andropogon, Dactylis,...) Ziziphus lotus, and more or less trees: Pistacia, bushes of Quercus, Juniperus,...

The low or medium-low mountains of inland Syria have a similar vegetation.

Due to man activity, the tree vegetation is much reduced.

Shrubby or dwarf-shrub pseudosteppe in arid climate

This zone forms the inland part of, or borders on the "fertile crescent". In the less arid areas (for instance the eastern part of Hauran plateau) the natural vegetation has been destroyed centuries ago by cultivation and grazing. In the most arid parts the present vegetation is similar to that described in the following paragraph.

Pseudosteppe and sub-desert formations in arid to very arid climate.

In the south-east and east parts of inland Syria, the vegetation mostly consists of perennial formations formed by sparse dwarf-shrub or succulent species (Artemisia herba-alba, Anabasis aphylla, Zygophyllum, Salsola, Chenolea,...), short grasses (Poa sinaica, Stipa tortilis,...), lichens, with or without ephemerophytes.

In the most arid parts, the vegetation is mainly confined to channels of surface drainage which collect and contain run-off water.

The gypso-saline flats bear edaphic formations of halophytes.

IV. Classification of soils

1. Properties of soil horizons.

Soils are characterized by diagnostic surface horizons (epipedons) and diagnostic subsurface horizons.

1-1. Epipedons:

The epipedon is a diagnostic surface horizon. It includes:
- the upper part of the soil darkened by organic matter (mostly As, Ap),
- the upper eluvial horizons (mostly A2, A3).

Very limited number of epipedons were observed in Syria and Lebanon. Those are:-

a. Ochric epipedon.

Concept - Surface horizon mostly thin, light colored and humus-poor.

Properties (simplified).

The ochric epipedon has a color of 5.5 value or more when dry and 3.5 or more when moist, has too little organic matter, has an n value too high, or too thin to be mollic, or is both hard and massive when dry.

b. Mollic epipedon

Concept - Surface hor., thick, dark, humus-rich, highly base saturated (dominant Ca++, Mg++), with "soft" structure.

Genesis - Underground decomposition of organic residues (roots, surface residues taken underground by animals), mainly of grasses. Clays 2/1.

Properties (simplified)

+(1) Position : Surface

+(2) Structure : Not massive and hard when dry.

+(3) Color : +(31) value $\leq$ 3.5 (moist)
$\leq$ 5.5 (dry).
+(32) chroma $\leq$ 3.5 (moist).

+(4) Base saturation: V $\geq$ 50% (NH4Ac method)

+(5) Organic carbon : + (51) $\geq$ 0.6% C
+ (52) Max. limit %C=min. limit %C of histic epipedon

+(6) Thickness : - (61) $\geq$ 10cm : if epipedon rests on R
- (62) $\geq$ 1/3 of the solum, but always $\geq$ 18 cm:
if the solum $\leq$ 75cm
- (63) $\geq$ 25cm

+(7) P205 : $\leq$ 250 ppm (soluble in 1% citric acid)

+(8) Moist : $\geq$ 3 months (cumulative) in some part in $\geq$ 7/10 years when the soil temperature at 50cm is $>$ 5°C (unless irrigated)

+(9) n-value : $<$ 0.7

1-2 Diagnostic subsurface horizons

The diagnostic subsurface horizons are lying:

- below an epipedon
- below a leaf litter,
- at the surface (after truncation).

They are mostly B horizons, but may include a part of the A horizons.

a) ARGILLIC horizon

Concept - Horizon that contains illuvial layer-lattice silicate clays, from below an eluvial horizon, but may be at the surface if the soil has been partially truncated. Concurrent neoformation clay is normal.

Genesis - Migration of clay, carried by water, from A to B horizon. "Precipitation" of the clay on the dry peds surfaces and in the pores. Concurrent neoformation of clay.

Time : A few thousands of years

Vegetation : Any.

Climate : Alternatively wet and dry periods.

Morphology

- Distinctly more clayey than the overlying eluvial horizon and than the underlying parent material.
- Cutans of oriented clay on the peds and in the pores, especially at the bottom of the horizon.
- Fine clay (< 0.2m)/ total clay (< 2m) ratio of the argillic horizon is larger than in the eluvial horizon or in the underlyinv horizon.
- Structure of weathered rock (saprolite) is not evident or has disappeared in more than half of the volume.
- Minerals resistant to weathering are less abundant than in the eluvial hor. or in the underlying hor.

- Nearly parallel to the surface.
- Exterior color of the peds is redder or darker than the interior color.

Properties (simplified)

+(1) Position: below the surface (exception truncated soils).

+(2) Clay content must increase from A to Bt in a vert. dist.

$<$ 30 cm:

% clay in A	% clay in Bt	Vertical distance
+1/3 $<$ 15%	$>$ %A + 3%	$<$ 30cm
+1/3 15-40%	$>$ %Ax1.2	$<$ 30cm
- $>$ 40%	$>$ %A + 8%	$<$ 30cm
+8 t.c. $>$ 60%	f.c. $>$ A% + 8%	

+(3) Thickness

-(31) Bt loamy or clayey :

- $>$ 1/10 of the sum of all overlying hor., but always $>$ 7.5cm.
- $>$ 15cm if A+B $>$ 150cm

-(32) Bt sandy or loamy sand:

- $>$ 15cm
- lamellae $>$ 1cm, total thickness $>$ 15cm

+(4) Clay cutans on peds, in pores, or bridging the sand grains.

+(5) Lithologic discontinuity A/IIBt or Ap/Bt sequum: see + (4)

b) CAMBIC horizon

Concept - Altered, non or weakly illuvial horizon, loamy very fine sand or finer. Formerly called "structural B horizon".

Genesis - The physical alternation is produced by:

- movement of the soil particles by frost, roots and animals, to such extent as to destroy most of the

original rock structure,
- aggregation of the soil particles into peds.

The chemical alteration is produced by :

- hydralysis as some of the primary minerals to form clays and liberate sesquioxides (in small amounts),
- solution and redistribution or removal of some carbonates.
- reduction and segregation, or removal of free oxides, accompanied by biologic decomposition of inherited organic matter.

Position

- At the surface or below an epipedon.
- Not above or below an argillic or spodic horizon

Conclusion: Position and alteration (without important illuviation) are essential characteristics of the cambic horizon.

Properties (simplified)

+(1) Texture : loamy very fine sand or finer in the fine earth fraction (< 2mm)

+(2) Structure: soil structure in > 1/2 of the volume (of the fine earth).

+(3) Mineralogy: significant amounts of weatherable minerals

+(4) Illuviation: not meeting the requirements of argillic or spodic horizons.

+(5) No cementation or induration

+(6) Thickness : lower limit > 25cm below the surface .

c) CALCIC horizon

Concept - Hor. of accumulation of $CaCo_3$ and /or $Mg\ Co_3$.

Genesis - Carbonates accumulate in the C hor, but may also affect the mollic epipedon, the argillic or natric hor. and the duripan. They precipitate as : powder, concretions, pendants on pebbles.

Arid regions : on calcareous materials : often the only hor. that can develop is the calcic, at shallow depth.

Semi-arid regions : the calcic hor. may form above or in an argillic hor., the carbonates are received from eolian sources.

Soils with groundwater: when the groundwater contains Ca $(HCO_3)_2$, the evaporation may cause precipitation of $CaCo_3$, at the surface or at shallow depth (30-60cm) the surface calcic hor. may at the same time be a mollic epipedon.

Properties (simplified)

Underlying materials have < CO3 than the calcic hor.:

+(1) Thickness : > 15cm

+(2) CaCo3 equivalent (CaCo3+MgCo3, expressed as CaCo3)

  +(21) > 15%

  +(22) > 5% more than the underlying layer.

Underlying materials have < CO3 than the calcic hor.:

+(1) Thickness : > 15cm

+(2) CaCo3 equivalent:

  +(21) > 15%

  +(22) > 5% by volume secondary carbonates.

d) PETROCALCIC horizon

Concept - Calcic hor. continuously cemented or indurated by CaCo3 or MgCo3 (accessory silica).

Genesis - Regular and important additions of carbonates plug the calcic hor. Old surfaces.

Properties (simplified)

+(1) Continuously cemented or indurated calcic hor.

+(2) Hardness : does not slake in water, impervious.

+(3) Cement : $>$ 1/2 is destroyed by treatment with acid

+(4) Thickness : $>$ 10cm

e) GYPSIC horizon

Concept - Horizon of secondary gypsum enrichment.

Properties (simplified)

+(1) Thickness : $>$ 15cm

+(2) CaSo4 :

+(21) $>$ 5% more than the underlying layer

+(22) cm x % gypsum $>$ 150 .

+(3) Cementation : weak, slakes in water

Remark : % gypsum = meq. gypsum/100g soil x 0.086

f) PETROGYPSIC horizon

Concept - Cemented and indurated horizon.

Genesis - Arid climate. Parent material rich in gypsum.

Properties (simplified)

+(1) Indurated gypsic horizon: see gypsic horizon +(1), +(2)

+(2) Cementation: does not slake in water

Remark : The % of gypsum is usually more than 60%.

g) SALIC horizon

Concept - Horizon with secondary enrichment of salts more soluble in cold water than gypsum.

Properties (simplified)

+ (1) Thickness : more than 15cm.
+ (2) Salt.
    + (21) $\geq$ 2% salt
    + (22) cm x % salt $\geq$ 60

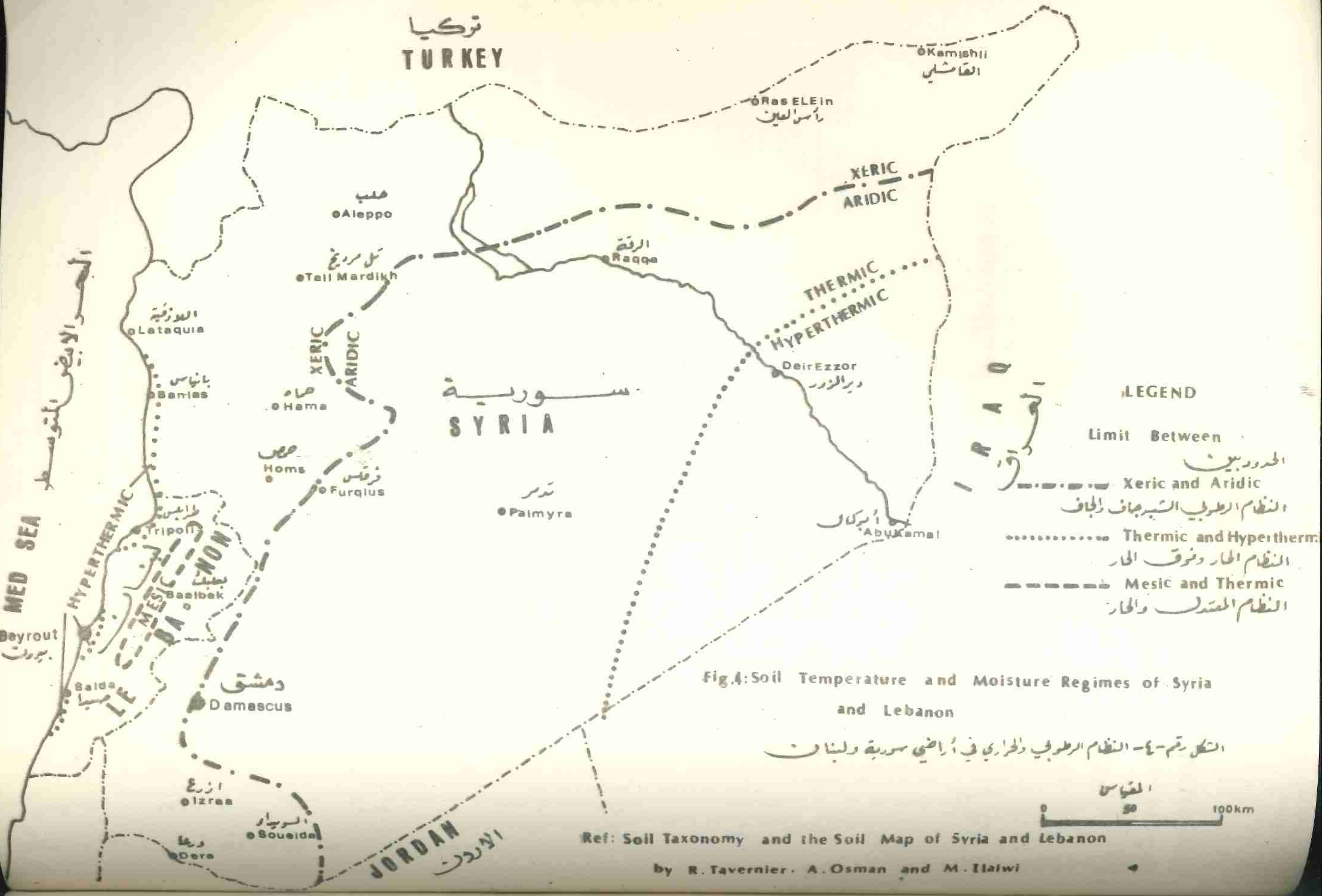


Fig.4: Soil Temperature and Moisture Regimes of Syria and Lebanon

الشكل رقم -٤- النظام الرطوبي والحراري في أراضي سورية ولبنان

Ref: Soil Taxonomy and the Soil Map of Syria and Lebanon

by R. Tavernier. A. Osman and M. Ilaiwi

2. Soil Moisture and Temperature Regimes

2.1 - Soil Moisture Regimes

2.1.1. Aquic (= water) : The soil is saturated by water (no Oxygen) (Stagnated water)

2.1.2. Aridic or Torric (= hot and dry).

a) Dry in all parts more than half the time (cumulative) that the soil temperature at 50 cm is above 5°C.

And

b) Never moist in some or all parts for as long as 90 consecutive days when the soil temperature at 50 cm is above 8°C.

2.1.3. Udic (= Humid) In most years the S.M.C.S. is not dry in any part for as long as 90 days (cumulative) (Perudic = extremely wet).

2.1.4. Ustic (= Intermediate between Aridic and Udic) (Tropical and subtropical regions with one or two dry reasons).

In most years, the SMCS is dry for 90 or more cumulative days, but moist in some part for more than 180 cumulative days. Or moist in some part for at least 90 consecutive days.

2.1.5. Xeric (=dry) (Mediterranean) {moist and cool winter / dry and hot summer}

The SMCS is dry in all parts for 45 or more consecutive days within 4 months following summer solstice in 6 or more years out of 10.

And

The SMCS is moist in all parts for 45 or more consecutive days within 4 months following winter solstics in 6 or more years out of 10 .

Or

The SMCS is moist in some part more than half the time (cumulative) that the soil temperature at 50 cm is $> 5^oC$

Or

The SMCS is moist in some part for at least 90 consecutive days, that the soil temperature at 50 cm is $> 8^oC$.

NB.

Soil Moisture Control Section (SMCS)

- Upper boundary : 2,5 cm water in 24 H.
- Lower boundary : 7,5 cm water in 48 H.

2.2 - Soil temperature Regimes

M.A.S.T. = Means Annual Soil Temperature at 50 cm.

2.2.1. Pergelic M.A.S.T $< 0^oC$.

2.2.2. Cryic M.A.S.T. $> 0^oC$.
$< 8^oC$.

2.2.3. Frigid M.A.S.T. $< 8^oC$. and MAST Summer-MAST winter $> 5^oC$.

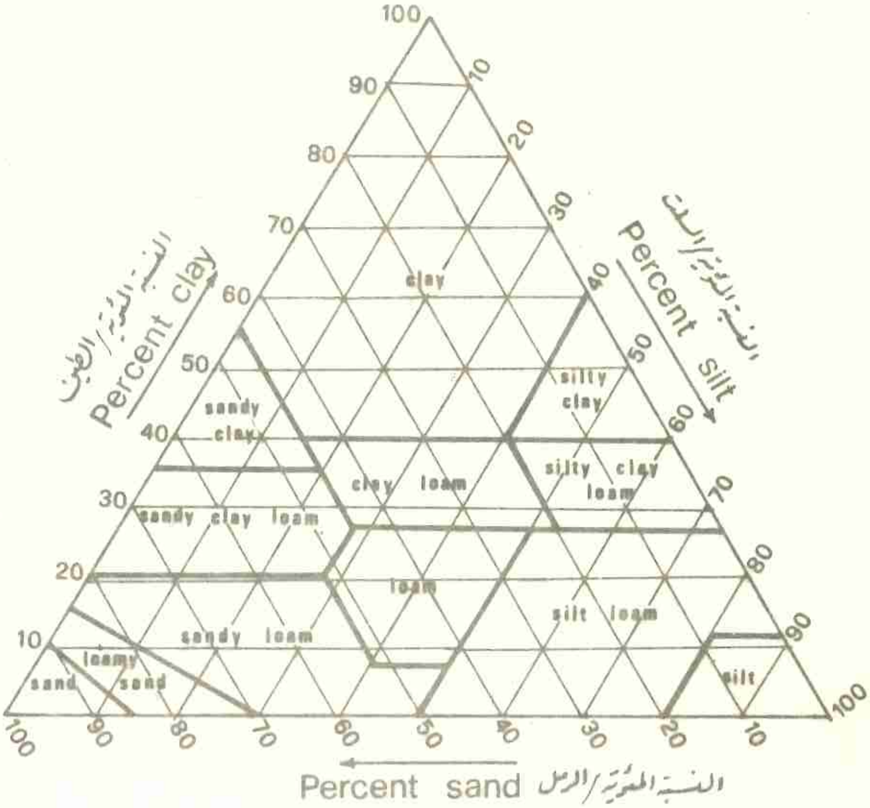
2.2.4. Mesic M.A.S.T. $\geq 8^oC$. and $< 15^oC$. MAST Summer-MAST winter $> 5^oC$.

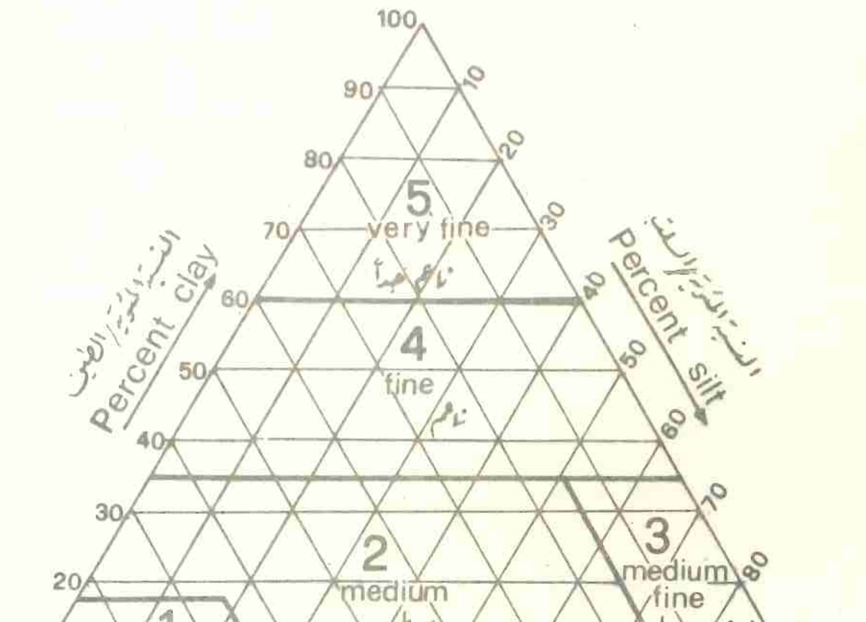
2.2.5. Thermic M.A.S.T. $\geq 15^oC$. and $< 22^oC$. MAST Summer-MAST winter $> 5^oC$.

2.2.6. Hyperthermic M.A.S.T. $\geq 22^oC$. and MAST Summer-MAST winter $> 5^oC$.

الشكل رقم ٥ مثلث قوام التربة

fig:5_TEXTURAL CLASSES





NB. (For 2,3,4,5, and 6 the prefix "ISO" is used when the diference between MAST Summer and MAST Winter is less than $5^{o}C$).

3. Mapping units

The soil map of Syria and Lebanon is formed by units that are association of soils. Each unit represents dominant soils associated to soils with common characters. The associated soils could represent up till 30% of the total area. They are called major or minor associations according to their importance comparing to dominant soils. The mapping unit represents only dominant soils. Appendix II gives the associations of all mapping units that have been represented.

Representation on the map is at subgroup level with indications to textural classes, slope and stoniness.

Profiles description is based on "FAO Guidelines for Profile Descriptions".

4. The legend

Details of the legend were presented in ACSAD bulletin SS/P8/79. In this bulletin informations related to the elements of the legends with explanatory notes and guidelines show that every mapping unit is indicated by a formula as follows:-

- Three capital letters are used to indicate soils at great group level.
- One small letter indicates the subgroup.
- One figure represents the textural class.
  5 textural classes are adopted from the FAO soil map of the world at 1/5 million. (figure 5)

- One small letter indicates the slope.

Four slope classes are adopted as follows:

a = the level or flat 0-3%

b = Sloping 3-10%

c = moderate steep 10-25%

d = steep greater than 25%

Example : RHY K 1 a

Gypsiorthids (great group)	RHY
Calcic subgroup	K
Coarse texture	1
Flat topography	a

Letters g and s are representing respectively gravelly and stony phases.

5. The soils

The Soil Map of Syria and Lebanon shows several soils. These soils are classified into 6 Orders and 13 Great Groups. Some soils are classified at Subgroup level. The map represents 24 different soils as follows:-

ORDERS	GREAT GROUPS	SUBGROUPS
ALFISOLS	- Rhodoxeralfs	- Typic
ARIDISOLS	- Calciorthids	- Typic - Lithic - Xerollic
	- Camborthids	- Typic - Lithic - Xerollic
	- Gypsiorthids	- Typic - Calcic - Petrogypsic
	- Paleorthids	- Typic
	- Salorthids	- Aquollic
ENTISOLS	- Torrifluvents	- Typic
	- Torriorthents	- Typic
	- Xerorthents	- Lithic
INCEPTISOLS	- Vitrandepts	- Typic
	- Xerochrepts	- Typic - Calcixerollic - Lithic - Ruptic-Lithic - Vertic - Petrocalcic.
MOLLISOLS	- Haploxerolls	- Typic
VERTISOLS	- Chromoxererts	- Typic

5-1. ALFISOLS

Alfisols are characterized in this area by the presence of an ochric epipedon and an argillic horizon under xeric soil moisture regime. They are mostly spreaded in Lebanon where rainfall is relatively high. The parent rock is hard karstic limestone. Normally the topography is flat. These soils are generally eroded. Although the part of the soil is sometimes colluviated. The argillic horizon is mostly e expressed by the presence of a thick coating and highly oriented clays. The clay mineralogy is formed mainly by 2/1 clays. The soils show evidence of swelling and vertic characters.

RHODOXERALF (LXR):

These soils are the dark red Alfisols formed on hard limestone or alluvial material originated from similar soils, under xeric soil moisture regime. They are more common in Lebanon than in Syria. In the south of Lebanon they are severely eroded on steep slope. In the Bekaa valley (Lebanon) they are very deep (Profile No. L1) . They may have a calcic horizon under dryer conditions (Profile No. L2).

5-2. ARIDISOLS:

Aridisols are soils that do not have water available to mesophytic plants for long periods. During most of the time when the soil is warm enough for plants to grow, water is held at a tension of more than 15 bars or it is salty, or both . There is no period of three months or more when moisture is continuously available and the soil is warm. Few Aridisols are associated with soils in semiarid region because most of the rainfall runs off.

The pedogenic horizons may be the result of translocation and accumulation of salts, carbonates, sulfates, or silicate clays or of cementation by carbonates or silica. They also may be only an alteration of the parent materials without any significant accumulation.

Most of Aridisols have an ochric epipedon. This epipedon is characterized by its light color, low organic matter and a high value. It is normally a thin horizon massive and hard when dry.

The subsurface horizons are mostly calcic or gypsic. The petrocalcic and petrogypsic horizons could be also present. The cambic and the salic horizons occur in the depressions. Under these conditions, the soils are classified as Calciorthids or Gypsiorthids and, in other places Camborthids or Salorthids.

Calciorthids. (RHK)

These are Aridisols with an ochric epipedon and a calcic horizon. They have had much lime in the parent materials or added in dust. The scant rainfall is unable to remove the lime completely from the surface soil to a depth of 18 cm. The only horizons normally present are the ochric epipedon and a calcic horizon. (Profiles H3 and L5). Variatations could affect mainly the depth of the soil. Deep soils are classified as typic Calciorthids while shallow soils are recognised as lithic Calciorthids.

Calciorthids represent about 33% of the total area in Syria. They have high calcium carbonate content besides the presence of the calcic horizon at a shallow depth.

CAMBORTHIDS (RHH).

Camborthids are Aridisols that have an ochric epipedon and a cambic horizon. They are normally very deep soils located in the depressions and valleys. In the Ghota, oasis of Damascus, they are associated with ENTISOLS and Calciorthids. The color of the cambic horizon is darker than the top soil. They have much less calcium carbonates than the Calciorthids. They are represented in Syria by 3.5% of the total area.

GYPSIORTHIDS (RHY)

Gypsiorthids are Aridisols that have an ochric epipedon and a gypsic or petrogypsic horizon whose upper boundary is within one meter of the soil surface. Some have overlying cambic and calcic horizons. They are mostly very pale and have very little organic matter.

Typic Gypsiorthids are defined by the presence of a gypsic horizon in which the product of the percentage of gypsum and the thickness in centimeters above a depth of 1.5 meter is 3000 or more. (Profile D3) .

Normally Gypsiorthids have a calcic horizon above gypsic horizon. (Profile D2).

Gypsiorthids occurs in the eastern part of Syria, mostly in association with Calciorthids. They are dominant to the north and the south of the Euphrates river. These soils represent 22% of the total area in Syria.

PALEORTHIDS (RHZ)

These are Orthids that have petrocalcic horizon. The upper boundary is close to the soil surface and is thick. They form a remnent part of an old terrace, that is a narrow strip bordering the upper part of a plateau or a plain along the piedmont of the mountain. These soils are difficult to be represented in the map at the scale of 1/1 million.

SALORTHIDS (RHN)

These are the very salty soils of wet places in the desert where capillary rise and evaporation of water concentrate the salts into a salic horizon. These soils are mainly soils of depressions. The concentration of salts is within 75 cm., of the surface, and usually it is within a few centimeters of the surface or at the surface. (Profiles D1b and P1).

Salorthids are usually deep soils. They may have water held at a tension of less than 15 bars but the dissolved salts, because of its osmotic pressure make the soils physiologically dry.

Salorthids are good soils for crop production if the salt could be leached and irrigation water is available. Salorthids occur in low lands, valleys and depressions. (Sabkhas and Fayda). They are associated with Torrifluvents.

5-3. ENTISOLS:

Entisols are soils that have little or no evidence of development of pedogenic horizons. Many Entisols have an ochric epipedon. Some others do not have horizons.

Entisols are good soils for agriculture unless a lithic or paralithic contact is present.

Entisols are mostly stony or sandy. They are generally associated to Aridisols.

TORRIFLUVENTS (NFR)

These are the Fluvents of arid climate that are not flooded frequently or for long periods. They have a torric (aridic) moisture regimes and most of them are alkaline or calcareous and are somewhat salty in some places. The amount of organic matter is more nearly a function of the frequency of flooding and the source of sediments.

Torrifluvents occur in valleys and depressions with no or few salinity characters. They are associated to Torriorthents and Salorthids if a salic horizon is present. (Profile Dla and Gl).

Torrifluvents are excellent soils for crop production if irrigation water is available.

TORRIOTHENTS (NHR)

These are the Orthents of arid climates that are dry or salty. They have a torric moisture regime or are salty or both.

Torriorthents are generally gravelly. Sometimes they have a sandy texture associated to Torripsamments, or highly calcareous evoluating to Calciorthids.

XERORTHENTS (NHX)

These are the Orthents of mediterranean climates that have a xeric moisture regime. They are mostly sloping and loose water by runoff. These soils occur in western part of Syria and in most part of the Lebanese mountain. They are formed on hard limestone and basalt. At the subgroup level they are mainly shallow soils (lithic Xerothents).

The vegetation cover is different from that of the arid zones. The growing season is much longer than in the aridic moisture regime. The potential evapo-transpiration is much lower.

5-4. INCEPTISOLS

INCEPTISOLS are soils of relatively high rainfall areas of Syria and Lebanon. These soils are normally rich in weatherable minerals. They are characterized by the presence of an ochric epipedon and a cambic horizon.

To the north of Syria the presence of a gypsic horizon implies the consideration of a gypsic subgroup for Ochrepts. The soil moisture regime is xeric.

Some Xerochrepts have calcic or petrocalcic horizon. They have generally light color. The dark color of some Xerochrepts is related to the presence of a high amount of iron oxides in these soils.

VITRANDEPTS (CDG)

These soils are not yet defined in Soil Taxonomy. The They were recognised as a subgroup temporarily. They are formed by an ochric epipedon and a cambic horizon developped on volcanic material under aridic (torric) soil moisture regimes. The clay fraction in these soils are not well cristallized. The pH by the NaF method is relatively high.

These soils occur in the Euphrates area and to the south of Syria. (Profile R1 and S3).

XEROCHREPTS (CCX)

These soils are formed by an ochric epipedon and a cambic horizon under xeric soil moisture regimes. They are moist in winter and dry in summer. They are mostly developped on steep slope or at the piedmont. In Syria and Lebanon they have fine texture, they are gravelly, stony and shallow. The color is dark. In most cases they are associated with Entisols when deeply eroded, and with ALFISOLS in some other places. They could have a calcic or a petrocalcic horizon in the transitional region to ARIDISOLS. Under dense vegetation they are associated to MOLLISOLS. (Profile H2, S1 a and L3).

5-5. MOLLISOLS

These are the dark to very dark colored soils. They have a mollic epipedon overlying on cambic or calcic epipedon or both. Some of these soils are very shallow associated with ENTISOLS. Some other are not enough dark to meet the requirements of the mollic epipedon and are associated with INCEPTISOLS.

HAPLOXEROLLS (MXH)

These are MOLLISOLS with xeric soil moisture regimes. They are very wet during the winter and very dry during the summer.

Most of these soils in Lebanon are developped under dense vegetation. They are gravelly and stony on steep slope.

In Syria, at the Ghab depression (Graben), they were developped under wet conditions before the reclamation of the area.

Haploxerolls are developped on different rocks (limestone, sandstones, basalts) and alluvial material. They are easily degraded by afforestation and intensive agriculture.

Haploxerolls are associated with Xerorthents or Xerochrepts according to the soil depth and the presence or absence of mollic epipedon.

5-6. VERTISOLS

These are clayey and heavy clay soils that have, unless irrigated deep wide cracks during the dry season. The mineralogy of these soils is dominated by montmorillonite clays.They are self mulching between the dry and the wet season ao that no diagnostic epipedon is characterised. Most VERTISOLS have dark color and blocky subangular well developped to pismatic structure with slickensides.

Some VERTISOLS are calcareous within the whole profile. Some others under dryer conditions show the evidence of calcium carbonate deposition but not enough to meet the requirements of a calcic horizon.

Due to the movement of these soils, masonries, roads, telephone and power poles and pipe lines could be tilted or even broken.

VERTISOLS are developped in Syria and Lebanon mainly under Xeric soil moisture regimes and much less under aridic (torric) soil moisture regimes in the depressions and low lands.

CHROMOXERERTS (VCX)

These are the VERTISOLS developped under xeric soil moisture regimes. They are very common in the depressions and low lands of the Bekaa valley in Lebanon, the northern part of Syria, and along the coastal area. Chromoxererts are developped on hard limestone, basalt or alluviated material. Usually they are associated with Xerochrepts and Rhodoxeralfs. (Profile S2 and S1C)

These soils have local names in different places, such as Tirs in north Africa, Smolniza in Bulgaria Takir in India. They are very wet during the winter and difficult to be cultivated.

Soil Classification at lower categories.-

Soil classification in Syria and Lebanon at the scale of 1/1000 000 was based mainly on characteristics at the Great Group level. However for most common soils and particularly ARIDISOLS and Xerochrepts, a tentative representation at the subgroup level was adopted where possible.

For Calciorthids and Camborthids three main subgroups were characterised, the typic (t), the calcic (k) and the Xerollic (xm).

The Gypsiorthids subgroups were mainly typic (t), calcic (k) and the petrogypsic (py).

The Xerochrepts subgroups were typic (t), calcixerollic (km), lithic (l), ruptic lithic (rpl), vertic (v) and petrocalcic (pk).

6. Distribution and extension

Most of the soils in Syria are formed under arid conditions. Aridisols represent more than 60% (111000 Km2) of the total area. Two main Subgroups are dominating. The Calciorthids are covering about 62 000 km2 (33% of the total area) distributed in the South East of Syria, and the Gypsiorthids that are covering 42 000 Km2 (22%) distributed in the central part extending to the Iraqi border on both sides of the Euphrates river.

This part of Syria is considered as desertic (Badiat El Sham) and devoted for grazing.

The other part is formed by soils developped under xeric soil moisture regimes. During the winter, the soils could be very wet but they are completely dry during the summer. Another limitation for crop produciton is related to steep slope in the Lattaqia mountain as well as in the Lebanese mountain chains.

The flat plains in the xeric zone are extending from Homs area to Aleppo in the North then to the East in the Djezira area. Another good croping area is located to the South in the Hauran plateaus. Some of those plains and plateaus are irrigated either from river water or underground water. In the arid zone most the Euphrates basin is irrigated from the Euphrates dam. Other irrigation projects are under consideration.

Coordinates	Average Km2		Planimeter Km2 1	2	3	Soil Units
						CCX
A-5	650		660	650	640	t
B-3-4	1520		1510	1530	1520	t
B-4-5-	410		410	410	410	t
B-2	1576		1600	1540	1590	t
B-4	100		100	100	100	t
A-3	100		100	100	100	t
B-5	313		300	330	310	t
B-C-3	400		400	400	400	t
B-5	233		230	230	240	t
	5302					Sub total
B-3	400		400	400	400	1
C-D-3-4	2230	-170-	2400	2400	2400	1
A-B-4-5-	9350		9340	9360	9350	1
A-B-2-3-4	6080		6070	6070	6100	1
B-3	500		500	500	500	1
	18560					Sub total
B-C-3-4	5700		5600	5800	5700	kxm
D-E-F-G-H-1-2	14407	-270-	14690	14680	14690	kxm
D-2	290		290	290	290	kxm
B-3	500		500	500	500	kxm
B-3	500		500	500	500	kxm
B-4	200		200	200	200	kxm
	21597					Sub total
B-4	580		550	600	600	v
B-3	320		320	320	320	v
B-2-3	293		290	280	310	v
C-2	600		600	600	600	v
A-B-4	680		690	670	680	v
F-G-1-2	930		930	930	930	v
	3403					Sub total
B-C-3-4-	1700		1700	1700	1700	pk
C-D-2	6010		6010	6010	6010	pk
	7710					Sub total

B-5	95	95	95	95	rpl
	95				Sub total
	56667				Total
A-B-5	327	340	320	320	VXC
A-B-5-6-	3910	3910	3910	3910	VXC
C-2	990	990	990	990	VXC
G-H-1	847	850	840	850	VXC
	6074				Total
B-3	500	500	500	500	MXH
A-3	260	260	260	260	MXH
B-4	110	110	110	110	MXH
B-4	870				Total
	270	270	270	270	RHZ
	270				Total
E-2-3	410	410	410	410	CDG
	410				Total
A-4	180	180	180	180	LXR
	180				Total
D-5	110	110	110	110	NFR
F-2	270	280	270	260	NFR
D-E-F-2-3-4	2800	2800	2800	2800	NFR
D-2	285	285	285	285	NFR
	3465				Total
F-G-2	373	380	380	360	NHR
E-3	70	70	70	70	NHR
D-3-4	400	400	410	390	NHR
C-5-6	350	350	350	350	NHR
D-4-5	233	250	220	230	NHR
B-5	320	320	320	320	NHR
C-5	133	140	120	140	NHR
B-C-4-5	410	410	410	410	NHR
B-5	60	60	60	60	NHR
B-4-5-	45	45	45	45	NHR
B-C-4-5	180	190	170	180	NHR

B-C-4-5	480	480	480	480	NHR
C-D-4	290	290	290	290	NHR
C-D-4	560	560	560	560	NHR
	3904				Total
B-3-4-	757	770	750	750	NHX
B-5-6-	3190	3200	3190	3180	NHX
B-5	607	600	610	610	NHX
D-4	1140	1140	1140	1140	NHX
D-4	70	70	70	70	NHX
D-3-4	100	100	100	100	NHX
C-D-4	140	140	140	140	NHX
B-C-3	177	170	180	180	NHX
B-3	350	370	340	340	NHX
C-3	177	180	180	180	NHX
C-2-3	1120	1120	1120	1120	NHX
C-D-2	820	820	820	820	NHX
D-2	613	600	620	610	NHX
F-2	393	390	400	390	NHX
					NHX
	9654				Total
G-2	197	200	190	190	RHN
D-4	237	230	250	230	RHN
	434				Total
					RHH
D-E-3-4	410	410	410	410	t
B-C-4-5	4200				t
	4610				Sub total
B-C-5	920	910	930	920	l
	920				Sub total
B-5	650	650	650	650	xm
	650				Sub total
	6180				Total

					RHK
B-C-D-E-F-4-5-6	45260				t
C-D-2-3	970				t
D-3	230	230	240	220	t
D-E-2-3	500	500	500	500	t
E-F-3	393	390	400	390	t
F-3	840	840	840	840	t
F-G-2-3	1923	1930	1920	1920	t
G-3	400	390	410	400	t
	50516				Sub total
B-4	387	390	370	390	xm
D-2-3	2620				xm
B-C-4	780	790	780	770	xm
C-4	85	90	80	80	xm
	3872				Sub total
C-B-4	473	470	480	470	l
	473				Sub total
	54861				Total
					RHY
F-2	197	200	200	190	t
F-4	2370	70-2440	2440	2440	t
F-G-3-4	5150	5150	5160	5140	t
D-E-F-2-3	13436				t
C-D-E-F-2-3-4	18440				t
	39593				Sub total
D-E-3-4	3700	3700	3700	3700	py
F-3	320	330	310	320	py
F-3	240	240	240	240	py
F-G-3	1490	1490	1490	1490	py
D-E-3-4	690	690	690	690	py
	6440				Sub total
	46033				Total
	6398				Micellaneous
	195 400				Grand Tot

7. Soil Associations

The scale of the soil map determine the degree of details that could be represented in the map. This scale reflects also the objectives for which the soil map was established. The 1/1 million scale was adopted for the soil map of the Arab Countries to show the soil resources of these countries at the same scale using one single system of soil classification.

Soil Units were presented at the subgroup level of the USDA Soil Taxonomy with detailed information at the family level related to the slope, texture and stonyness. These information could be very valuable for further investigations at the country level and bigger scale.

The Soil Map presents soil units that are formed by dominant soils. Other soils that could not be represented in the map are existing and called associations. These associations are either major ones representing 5 to 30% or minor not exceeding 5% of the unit area.

These informations are presented separately from the map in the Synoptic Tables (Appendix 2) .

V. Land suitability for agriculture

Lands in Syria and Lebanon are considered mostly as suitable for crop production when they are under xeric moisture regimes. The Bekaa valley in Lebanon, the coastal plains in both countries, the Orontes valley, the Gezira area and the Hauran plateau are the most important agricultural zones. The limiting factors for agricultural production could be in some cases either the shallow depth of the soils or excess of moisture in the winter time. In Lebanon and Lattaquia area in Syria the steep slope and erosion hazard decrease land productivity and increase the cost of production. Terracing is well known practice in this area. In most cases, even in good lands, agricultural production is related firstly to land management. Even in good soils, yields are considered as very low due to unsuitable land management.

Under aridic soil moisture regimes the limiting factors for agricultural production are the stress of water and soil characteristics.

1- Soils under xeric moisture regime

Xerochrepts

They represent the best soils and they are widely represented in the xeric zone. Field crops, fruit trees and vegetables are mostly grown on these soils. The yield is relatively high unless a lithic or paralithic contact is reducing the depth of the soil.

Chromoxererts

These are the deep and flat lands developped on clayey material. The limiting factors for crop production are related to the excess of soil moisture during the winter and the low infiltration rate. The heavy texture of these soils is reducing the depth of the root zone. Chromoxererts are considered good producing land with specific management. They are suitable mainly for wheat production without irrigation. With additional irrigation, these soils could be used for mais, groundnuts and vegetables. Fruit trees plantation need particular management of the soil.

Other soils in the xeric area

Xeralfs, Xerolls and Xerorthents have limited extend and they occur in the mountainous part of Syria and Lebanon, mostly associated with Inceptisols. In most cases they are shallow soils. Typic subgroup are good soils for agricultural production.

2- Soils under torric (aridic) moisture regime.

This part of Syria is considered as a pastural area. It is called Badia, to be distinguished from the real and completely dry desert. The annual rainfall ranges between 50 mm in some part and more than 200 mm in some other parts of the Badiah.

The particularity of the rainfall in this area is that the distribution is very heteragenous. Another characteristic is that the Badiah has in so many places small depressions that receive runoff water. These depressions could be used for crop production in some years unless other limiting factors are present such as salinity problems or high gypsum content.

The use of runoff water for agriculture could be developped by means of special management of the land and water harvesting.

Camborthids

They are considered as the best soils for crop production, comparing to other Aridisols. Most Camborthids are deep soils with flat topography. They can produce good yield if irrigation water is available. They are suitable also for fruit trees especially pistacios, olive trees and walnuts.

Calciorthids

These soils are widely represented in Syria. In most cases they are shallow soils with calcareous crust at shallow depth. The high Calcium carbonate content in most horizons is a limiting factor for agricultural development.

Gypsiorthids

These soils are distinguished by the presence of gypsum in high amount in the root zone. Some Gypsiorthids have gypsum in all horizons. Gypsum (calcium sulfate)could be present under different shape, size and distribution. Gypsiorthids are considered as poor soils for crop production and they are classified as unsuitable for irrigation. It has been noticed that even some soils in the xeric area, in the northern part of Syria, have significative amount of gypsum.

Salorthids

In Syria, Salorthids are affected by sodium chloride. They could be easily leached and cultivated if irrigation water is available.This implies the presence of adequate drainage system. In the lower Euphrates basin Salorthids are expanding year after year due to the absence of the drainage system or its bad maintenance. These soils have normally good infiltration rate and should be reclaimed. After their reclamation, they are considered as good for crop production.

Other soils in the aridic area

Besides the aforementioned Aridisols, Torrifluvents are the most represented soils under torric (aridic) moisture regime. They are highly represented in the Euphrates and Orontes valley as well as other alluvial areas. They are considered as the best soils for agricultural development in the aridic zone.

VI. Land use in Syria

Rainfed cultivation is only possible in the regions where rainfall is sufficient, these are: a) The coastal plains, b) The inland semi-arid plateaus and plains bordering the western mountains and the Taurus (fig. 1) and receiving not less than 250mm precipitation (see the rainfall map), namely, the Upper Jezireh, the plateaus of Aleppo, Idleb, Hama and Homs, the Hauran and the Golan.

Between 600 and 250mm it is estimated that, due to rainfall variability, it is possible to get two yield crops seasons every three years. Between 250 and 200mm barley is planted, but one year out of two the chances are that it will be good only for grazing. With less than 200mm the land is only able to seasonal grazing.

Irrigation is therefore of the utmost importance for the agricultural production.

Table 1 gives a general review of the land use in Syria in 1977, including the forests which are confined to the western mountainous and rainy areas.

Rainfed crops

The most important crops are the following ones (data from "Statistical abstracts", Damascus, 1978, areas and productions in 1977, a year with precipitation around the average).

	Area (x 1000ha)	Production (x1000 tons)
Wheat	1528	1217
Barley	1021	337
Sorghum	25	24
Lentils	178	117
Beans	8	13
Sesame	39	18
Chick-peas	41	25
Water melons	88	716
Melons	26	201
Olive trees	228	175
Grapes	94	353
Pistachio trees	13.2	5.4
Almond trees	7.5	15.5
Figs	21	45

Some of these crops are partly irrigated (approximately, wheat 30%, barley 10%, beans 50%, sesame 40%) and olive trees are partly associated with irrigated crops.

Pistachio trees are only located in Aleppo, Idleb and Hama regions, and most of olive trees are located in Aleppo, Idleb, Tartous and Lataquia regions.

In the rainfed cultivation areas, fallowing is a common practice.

Irrigation

The most important areas irrigated by rivers are: Damascus plain (Barada river), the plains of Aacharne and Ghab (Rastan and Maharde dams over Orontes river), the region between Homs and Hama (Qattine dam over Orontes), the two lower terraces of Euphrates, Balikh and Khabour rivers, the areas of Mzerib and Tell Chihab near Deraa (Yarmuq river), the coastal plains (northern Nahr el Kebir near Lataquia, southern N. el Kebir in Akkar plain, N. es Senn near Jebleh).

The Euphrates dam at Al Thawra will allow large extension of irrigation in the regions of Meskene-Aleppo, Balikh basin, Resafa basin, lower Khabour basin and Mayadin plain. The total Euphrates project covers not less than 640 000 ha.

Beside the rivers, irrigation by pumping ground-water is important in Syria. In 1977, 214 700 ha., i.e. 40% of the total are irrigated by groundwater.

The main irrigated crops are as follows (data for 1977):

	Area (x 1000 ha)	Production (x 1000 tons)
Cotton	186	395
Sugar beet	12	273
Maize	26	59
Tomato	33	453
Potato	13	164
Other vegetables	90	1054
Peanuts	11	20
Tobacco	15	11
Sunflower	7.4	5
Forages (Vetch, Alfalfa, Barley ...)	65	319
Apples	19	61
Apricot	12	32
Agrums	4.9	42.5
Other fruits (Plums, Pears, Peaches, Cherries, Nuts, Loquats, ...)	26	99

Agrums are only planted in the coastal palins. Peanuts are planted mostly in the coastal areas and a few in Homs region.

Tobacco is only partly irrigated (approximately 60%).

Livestock in Syria

In 1977, it amounted to : 1 010 000 goats, 7 070 000 sheeps, 639 000 cows, 185 000 calves,35 400 oxen, 234 900 asses, 47 500 mules, 55 000 horses, 2000 buffalos.

Land Use in Syria by Mohafazat (1977)

x 1000 ha

Mohafazats	Total area	Steppe &pasture	Forest	Uncultivable *	Total x1000ha	% of total area	Uncultivated	Cultivated Total	Fallow	Under Crops Rainfed	Irrigated Total	Irrigated by ground water
Damascus	1814	1366	15	227	206	11	40	166	41	55	70	44
Aleppo	1850	26	26	564	1234	67	–	1234	393	767	74	62
Homs	4222	2750	104	964	404	10	–	404	152	212	40	15
Hama	838	118	129	134	507	57	7	500	130	310	60	29
Lataqie	230	3	84	37	106	46	11	95	6	72	17	4
Deir ez Zor	3306	1957	2	1207	140	4	11	129	–	44	85	1
Idleb	610	75	48	146	341	56	–	341	33	295	13	7
Hassakeh	2333	809	6	58	1460	63	116	1344	437	826	81	21
Raqqa	1962	1141	–	110	711	36	2	709	241	407	61	20
Sweida	555	234	6	116	199	36	23	176	93	83	–	–
Daraa	373	35	1	66	271	73	3	268	116	141	11	0.2
Tartous	189	1	30	28	130	69	–	130	–	112	18	11
Quneitra	186	16	1	14	155	83	142	13	–	12	1	0.5
TOTAL	18518	8531	452	3671	5864	32	355	5509	1642	3336	531	214.7

* Rocky and sandy lands, marshes, lakes, buildings and roads.

From: Statistical abstract 1978 - Central Bureau of Statistics - Damascus

Land Use in Lebanon

Out of the total surface area of Lebanon (10.170 Km2) about one third is cultivated, in spite of the large proportion of mountainous regions.

The major part of the country receives substantail amounts of rainfall, except in the North parts of Beqaa plain and of Anti-Lebanon mountains. However the rains fall mainly from November to April, leaving 5 or 6 dry months during the warmest season. As a consequence rainfed cultivation is possible but with limited agricultural capabilities. Fortunately Lebanon is well provided with springs, rivers and ground-water, which allow to palliate the seasonal lack of rainfall by irrigation in most regions of the country.

The main agricultural regions may be briefly described as follows, from west to east.

The coastal plains. Their warm climate without winter frost allows the cultivation of Agrums and Akidinia orchards, or Banana (in the southern plains) and of early vegetables. Cereals and Peanut are also grown in the large plain of Akkar (North of Tripoli)

The western slopes of Mount Liban and plateaus bordering on them. In this region, cultivation is generally scattered on small areas, except in the plateau of Zgharta (Koura) and inland Akkar. Terraces have been built on steep slopes for centuries and are still built at the present time.

Up to 800 m. elevation the climate is suitable to Olive-tree which is in some regions the principal cultivated plant, while in other parts mixed farming is practiced.

At higher altitude, up to 1800 m., Apple-tree orchards were planted on increasing surfaces during the last few decennies. In the southwest drier plateaus and hills, irrigation development is planned but not yet achieved and cultivation of annual plants and fruit-trees is rainfed for a large part. In this region Tobacco is an important cash-crop.

The eastern steep slopes of Mount Liban are far less cultivated.

The Beqaa high plain. It is the largest agricultural region of Lebanon. Its south and central parts, well provided with deep soils and water resources, are the richest. The principal plants grown in these parts, besides cereals, legumes and forages, are Apple-tree and Cherry-tree orchards, Sugarbeet, Potatoes, vegetables (particularly Onions and Tomatoes) and Vineyards for dessert-grapes or for wine (the latter also extending on the hills bordering the plain).

In the northern part of Beqaa the climate is mostly arid, cultivation is only possible with perennial irrigation and extends on limited oasis-like areas.

In Ante-Lebanon the steep relief and shallow stony soils (and a dry climate in the northern part) are limiting agricultural factors. Cultivation is restricted to a few thousands hectares in the valleys, while the slopes are used for grazing.

Irrigation in Lebanon

In 1971 the total irrigated area amounted to about 80 000 hectares out of approximately 325 000 ha cultivated, i.e. 25%. Including the projects quoted below (partly achieved at the present time) the irrigated area will amount to 147 000 ha.*

- Coastal plains: 18,300 ha. are irrigated by 13 small rivers (including the Qasmiyeh i.e. lower Litani) and by groundwater. irrigation project on 7 000 ha. in Akkar plain.

- Mountainous regions: About 12 000 ha. irrigated by springs and small water dams.

- Koura plateau: Irrigation project on 6,800 ha. (not yet achieved).

- Southwestern plateaus and hills: 9 200 ha. irrigated. Project for 31 800 ha. to be irrigated from the Litani river (dam of Qaraoun in southern Beqaa).

- Central and south Beqaa: About 30 000 ha. irrigated by Litani and its small tributaries and by groundwater. Springs irrigate the plain around Baalbek. Projects: 13 000 ha. more irrigated from the dam of Qaraoun and 5 000 ha. in the west part of the plain of Baalbek.

- Northern Beqaa: 5 600 ha. irrigated by springs and groundwater. Project: 6 000 ha. irrigated by the Orontes river.

<u>Estimated area of some important crops (1971).</u>

Agrums	10 000 ha.
Apple trees	11 000 ha.
Bananas	3 000 ha.
Olive trees	27 000 ha.
Vineyards	21 000 ha.
Wheat	72 000 ha.
Sugar beets	1 500 ha.

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* Data on irrigation from :M.Z. Ayoubi - Les regions irriguees du Liban. Hannon. VI. 1971. pp. 3-17.