SOIL MAP AND LAND RESOURCES OF U.A.R.

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SUMMARY

The soil map of United Arab Republic in the scale of 1 : 4,000,000 is discussed from pedological and land resources points of view. The legend to the map is inspired by the World Soil Map, prepared jointly by FAO and UNESCO on the base of international cooperation. The soil geography of the U.A.R., is outlined shortly with the description of main soil regions of the country. An approximate estimation of potential land resources of the country for the future development of agriculture is presented based on the area measurements from this recent soil map.

GENERAL PRINCIPLES

The soil map of U.A.R. was prepared by the authors in the course of study of calcareous soils of the country. As the soils occupy the largest portion of the countries territory, it appeared that the whole territory should be surveyed to obtain the necessary data on correlation of the soil genesis with the natural surroundings. It was also imperative to classify the calcareous soils of the country into some comprehensive system on the base of modern pedological conceptions. Thus, we came to the necessity of the study of the soil map of U.A.R. as a whole. But, to our great disappointment, the existing soil maps of the country appeared to be not very promising in this respect, being too exploratory.

There are three general soil maps of Egypt published in the recent years, not speaking about earlier publications based more on guesses than on the actual data.

The first of the above mentioned is the part of the Soil Map of Africa in the scale of 1 : 5,000,000 published by J.L. D'Hoore and his coworkers in Lagos (1964). Being rather satisfactory and detailed for other parts of the continent, this map is unfortunately too general for the territory concerned, as there were no data of actual surveys in the possession of the authors.

The second map appeared to be a part of the Soil Map of Africa in the scale of 1 : 25,000,000 published in the Physico-Geographical Atlas of the World in Moscow (1964). This is a very small scale map which could not provide the necessary datails.

The latest map of Egypt was original and compiled in the scale of 1 : 2,000,000 by J.S. Veenenbos, A.M. Ghaith, R. Roberts and F. Eggers in 1964 and was subsequently published by A.M. Gaith and M. Tanious in the scale of 1 : 6,000,000 (1965). This map, unfortunately, has all disadvantages of the formers, being too general for the given scale and lacking the proper soil definitions for the mapping units.

The present soil map of U.A.R. is compiled on the base of the existing materials, on the actual soil surveys for some portions of the country (North West Coast, Nile Valley, Desert Oases) and on field emploratory soil studies for the others. All main soil regions of the country were visited by the authors with the aim of collecting more reliable information on these soils. Numerous soil profiles were studied in the field. All published and officially available data on previous soil studies of the country were fully utilised. The following cartographic materials were utilised for the present soil map.

1. The Topography Map of Egypt, 1 : 2,000, 000. General Survey Department, Cairo, 1966.

2. The Geological Map of Egypt, 1 : 4,000.000. General Survey Department, Cairo, 1963.

3. The Soil Map of Egypt, 1: 2,000,000. Compiled by J.S. Veenembos et all, 1964.

4. The Soil Map of Africa, 1 : 5,000,000. Compiled by J.L. D'Hoore et all, 1964.

5. Ray Roberts (Aero Service Cooperation). New Valley-Western Desert, Egypt, U.A.R. Reconnaissance Soil Survey, Cairo, 1962.

6. Soil Map of the Nile Valley and Fringes, 1 : 200,000. UNDP/FAO. High Dam Soil Survey. U.A.R. 1966.

Then the question arised as to the soil systematics and nomenclature to be used for the present map as well as for future work on more detailed soil surveys of U.A.R. Till now there was no system of soil classification generally accepted for the country. Different pedological schools including,Russian,American, French, etc., have different approahes to the classification of soils. This attempt seems to be most successfull in the course of international cooperation on the work of joint FAO/UNESCO Project on the Soil Map of the World.

It seems, that the system of definitions of the soil units, which has been worked out by the World Soil Resources offiice of FAO 1968, and agreed upon at several international meetings, can be accepted and recommended for international use, but, with more elaborate details for more detailed surveys whenever they are intended to.

In the course of the present study we came to the conclusion that this system being most advanced for the present state of knowledge should be utilized for the new soil map of U.A.R. But for more detailed soil studies some new soil units and sub-units were introduced utilising the same main principle.

DEFINITIONS OF THE SOIL UNITS

The definitions of the soil units shown on the map are mostly taken from the latest FAO/UNESCO publications (1968). Several alterations and additions were made by the present authors in view of more detailed soil study for the preparation of the soil map of U.A.R. in a larger scale than the World Soil Map. These include the new units of Ermolithosols, Petrosols and Ergosols and also some sub-units of previously defined soil units. The following changes were introduced.

The unit of Ermolithosols is introduced to differentiate the peculiar desert formations known in the literature as "desert pavement" or "desert detritus" from the Lithosols proper and rock out crops, which are characteristic for the mountainous or steep slope soil formations, where as the desert pavement is characteristic for the flat surfaces. These formations are subdivided into three sub-units that is Lithic, Gravelly and Argillic Ermolithosols, which are very different from the point of view of their morphology, genesis and utilisation. The further subdivision is done on the base of parent rocks. These new units are defined as follows :—

Lithic Ermolithosols :

Are the smooth crushed stone bare desert surfaces having no soil profile and underlined by the hard rock.

Gravelly Ermolithosols :

Are the smooth gravelly bare desert surfaces having no soil profile and underlined by gravel or coarse sandy deposit.

Agrillic Ermolithosols :

Are the smooth clays bare desert surfaces having no soil profile and underlined by ancient clays or weathered clay shales.

The above soils are shown on the Soil Map of the World as rock debries or desert detritus.

The sub-unit of Marshy Solonchak was introduced for the salt marshes, which are quite peculiar formations and different from any other solonchak in their morphology and utilisation. This is defined as follows :

Marshy Solonchaks :

Are the soils covered with water for most part of the year (unless artificially drained) and having a salic horizon from the surface, which may turn into petrosalic horizon (thick salt crust) during some dry periods.

The unit of Petrosols with several sub-units, of which only Salipetrosols are shown on the map, was introduced to deliniate the surface thick crust formations of different composition and to differentiate these formations from the Lithosols and other soil units.

The *Salipetrosols* are the soils having a petrosalic horizon (a consolidated horizon of secondary easy soluble salts enrichment that is more than 10 cm thick, have a salt content more than 50 %, and hardness of 3 or more) on the surface or at a depth not more than 25 cm from the surface. These soils are shown on the Soil Map of the World as Salt Flats.

The last soil unit to be defined here is Ergosols, which was introduced for the sand dune complexes. In this way, the shifting sand dunes are named as Dynamic Ergosols, and the semistabilised, sand dunes, as Semistatic Ergosols. On the base of the substantial differences in the composition of the sand the further subdivision into silic and calcic variants is also accomplished.

For all other soil units the exact definitions may be found in the above mentioned FAO/UNESCO publication and thus should not be repeated here.

The present authors wish to state that this system of soil definitions is rather comprehensive for a given scale of the soil map and is quite sufficient for the purposes of the general estimation of the country land potentialities. But, for more accurate and detailed studies more elaborate system with further subdivisions of the main soil units should be worked out in the future.

SOIL MAPPING UNITS

The mapping units of the present soil map consist of a soil group or of an association of soil groups.

Lithosols occupy a large part of the country, especially in the Eastern Desert (East of the Nile), South of Sinai, and Gilf Kabir Plateau. They are characteristic for a greatly dissected terrain with predominating steep slopes as the main feature of the topography. The elevation in these regions ranges up to 2500m, above sea level. Thus, these are through mountainous and the only mountainous regions of U.A.R. Geologically, these three regions are also similar being composed of so called Basement complex mostly of Pre-Cambrian igneous and metamorphic rocks (mica, hornblende talc and graphite schists; basic and ultrabasic intrusions in these and metamorphosed and metasomatized older granites; fundamental genesis) with some newer volcanic rocks (Said Rushdi, 1962). The moutainous plateaux are greatly dissected by a dense network of dry wadis and numerous gullies, and thus are excessively drained. The wadi bottoms are filled up with roughly sorted ancient fluviatile deposits (Pluvial period of Pleistocene) of local origin and ocoupy not more than 15% of the area.

The main soils of this mapping unit are Lithosols, with very shallow stony profiles, having only very weakly developed A horizon underlaned by the hard rocks. Rock outcrops are scattered here and there. The vegetation is scarce due to very limited supply of available water and mostly concentrate in wadis, which soil cover is represented by an association of Takyric Solonchaks and Eutric Rhegosols.

Limestone Lithic Ermolithosols are the main soils of the next mapping unit characteristic for the northern and central parts of the Western Desert (West of the Nile). The terrain is a Tertiary limestone Plateaux gradually rising up from 100mm above sea level in the North to 500 m in the South. The limestones vary in their age from Miocene in the North to Date cretaceous in the South. The surface of the main plateaux is level and only interupted in places by deep depressions of the desert oases (Siwa, Qattara, Buharia, Farafra). The air view of the plateaux gives an impression of the water born surface, as the numerous surface flows transect the area but for only short distances not making a complete hydrological network. These flow bottoms are filled with the colluviums and often contain Takyric Solonchaks and Gravelly Ermolithosols. In the Northern portion some scarse desert and halophitic plants may be found, but at a distance of about 100 km. from the sea coast the surface is absolutely bare.

The soil itself is just a crust of physical weathering smoothed and polished by wind action. A bit of fine earth exists between the crushed stones making the surface very level, but the surface stone pavement protect the material from further blowing out. The surface stones are well polished and rounded allowing a car to go by with a speed of 50 m.p.h. without difficulty. Rock outcrops are seen here and there. Actually, these soils are rather similar to the Lithosols, but they have no A weak horizon and have a continuous rock just below the stony desert pavement.

Limestone Lithic Ermolithosols and Takyric Solonchaks :

Occupy a large area of the main tertiary Limestone Plateaux around Siwa and Cattara Depressions. This soil mapping unit is very similar to the previous one in all respects with exception that the Takyric Solonchaks occupy here much larger area. The cross-section at Fig. 1. shows in more detailed scale the relative destribution of these two mapping units with regard the geomorphology of the plateaux. It is clear that the latter soil association occupy some large closed shallow depressions of the plateaux whereas the former is characteristic for the more open uplands.

Limestone Lithic Ermolithosols, Takyric Solonchaks and Lithosols :

Represent the geomorphological conditions transitional between the Eastern and Western Deserts of U.A.R. The association occur in the north-western portion of the Eastern Desert between Cairo and Qena. Geologically, it is the eastern part of the Tertiary Limestone Plateaux, but much more greatly dissected than its western portion. Numerous dry wadis and gorgeous gullies make the topography very rough with resulting occurance of the steep slopes. Thus, there is here a combination of level plateaux uplands, steep slopes and wide dry wadi bottoms. The limestones here are of Eocene age, not much different from the Miocene northern limestones from the pedological point of view, especially taking into account the specific processes of desert weathering and soil formation.

Sandstone Lithic Ermolithosols :

Are connected in their geography with the Gretaceous (Turonian-Santonian) formation of so called Nubian Sandstone, which occupies the southern portion of the Western Desert. The formation is rather uniform lithologically throughout the region with some associated volcanic rocks in places. The main petrographic unit is the quartzose sandstone, but some clay shales and limestones may be also interrelated.

This region, occupying the heart of the Libyan Desert, is not yet well studied and had been visited only at the outskirts. Thus, some associated soils may be discovered here in the future under the detail surveys. At present it appears as rather uniform surface of stony desert, the desert pavement of which being represented by products of the physical weathering of the sandstones. The surface is absolutely bare and smooth, being well polished by the wind action.

Gravelly Ermolithosols :

Are the soils of upper terraces of the Nile and of the large dry wadis. The parent material is a gravelly fluviatile deposit of Pliocane to Early Pleistocene age, and probably of more recent age in some of dry wadis. The soils are characterised by the monotonous gravelly profile without any pedological stratification (while the fluviatile stratification is apparent). The surface is smoothed by the wind action and is protected from the further wind blowing by the gravelly desert pavement that is by the dense monlayer of the quartzone pebbles. It is interesting to mention that all lower surfaces of the pebbles are covered with a dense growth of green algoes. No other signs of the soil formation process are visible in these primitive soils. The material is full of fine calcareous dust covering the course particles and pebbles.

Argillic Ermolithosols :

Are the most peculiar soils of the Egyptian deserts occuring only in Kharga and Dakhla Oases. Genetically and morphologically they are absolutely similar to the lithic and gravelly formations with exception that they are formed from the ancient clays or clay shales. The peculiarity of these formations is in the fact, that they look just like any other deep clayey soils, but in relality they have no soil profile. The whole thickness of the matarial, which is of several meters thick, is absolutely homogenous and is represented by uniform clay or physically weathered clay shales with no trace of any soil horizon. The chemical analysis shows uniform distribution of even most mobile substances along the whole thickness of the material. All usual features of ancient clay rock are present. The original rock structure and lamination is quite apparent. Being cultivated under irrigation these formations acquire the features of the soil profile in a few years : the redistribution of eluviated substances, the presence of a surface accumulative horizon, the deep surface cracking (similar to Chromic Vertisols). In a cultivated state these soils are very similar to the Chromic Vertisols, but in the virgin state they have no features in common except the clayey texture of the material.

Few spots of secondary Ochric Solonchaks and some shifting sand dunes occur in combination with these soils, but as a whole the soil cover sis more or less homogeneous.

Eutric Rhegosols :

Occupy the middle terraces fo the Nile Valley and some geologically related terrains in Sinai. The parent material here is represented by sandy fluviatile deposits reworked by wind action during the following deposition geomorphological cycles. Usually, the reworked and redeposited by wind material has a thickness of several meters, under which the original horizontally laminated alluvial material with lime concretions may be found.

The soils are uniform throughout and are characterised by the presence of only weakly developed A horizon of limited thickness.

Antrhopic Gleysols and Antrhopic Eutric Fluvisols :

Are the main soils of the Nile Valley and delta. This is the heart of Egypt and the homeland of the ancient Egyptain civilisaton. Naturally, during thousands of years of intensive agricultural utilisation these soils were greatly changed from their original state by men activity. During several millennias their great fertility was built up by the huge amount of the Nile silt deposited annually in the fields under the basin irrigation. But at present, when the Nile is completely regulated, and the perrenial irrigation is being practiced throughout, the Nile silt does not reach the fields any more and the soil fertility is supported by the ground and irrigation waters, carrying only dissolved substances.

The soils are mostly heavy in the texture and rather compact from the surface. The degree of gleying varies with the position in the valley. The humus status of the soils is fairly well. Residually saline soils are characteristic in the northern part of the delta, whereas secondary saline soils are scattered throughout.

Takyric Solonchaks and Dynamic Ergosols :

Occupy a tongue like in the association in Farafra oases. Some Ochric Solonchaks scattered in places. Cultivated soils are very limited, being formed by continuous irrigation practice from saline soils.

Marshy Solonchaks and Ochric Solonchaks :

Occupy a large area from North of Sinai to Lake Mariut near lagoons or brackish lakes of the northern delta. Actually, these are the former lagoon or lake bottoms with seasonally changing boundaries. During the rains and high water season the terrain is mostly covered with water, being dry for several summer months. Soils are very badly drained and full of soluble salts. For the reclamation of such areas heavy capital investments are necessary, including the construction of vertical drainage and protective systems.

Marshy Solonchaks, Humic Solonchaks and Humic *Solonetzs*, partly reclaimed represent a typical soil association of the Northern Delta. The soils are usually heavy in texture, poorly drained and are underlined by shally lagoonal or lake deposits. The ground waters are rather high, bing responsible for the strong gleying and soil salinity. Generally speaking, the soils here are under the process of gradual dissalinisation, which proceeds slowly with the growth of the delta. All stages of this process can be easily observed from Marshy Solonchaks, through Humic Solonchaks to Humic Solonetzs or to Humic Gleysols Numerous government projects on the land reclamation are under the implementation in this region at present. A large part of the soils is already reclaimed but still large areas are yet in a virgin state.

Salipetrosols and Ochric Solonchaks constitute the main terrain of the bottoms of deep northern desert depression of Siwa, Qattara and Wadi El Natrun. These are the largest salt accum ulations in the country. Sodium sulfate and chloride are characteristic for Siwa and Qattara, whereas sodium carbonate is worked out in Wadi El Natrun. The salts in these depressions are in the form of thick and hard surface crusts, oftern intermixed with gypsum and lime. The origin of these accumulations as well as the depressions is still not clear, but according to V.A. Kovda (1960) the aeolian-saline weathering in the deserts close to the ground water table is always accompanied by heavy salt accumulations.

Salipetrosols, Ochric Solonchaks and Dynamic Ergosols occupy the outskirts of Siwa and Qattara depressions, especially to the South. Shifting sand dunes comprise about one third of the area, other being covered with salt inpregnated soils. Thick salt crusts are similar to those of the previous mapping unit.

Ermosols constitute the most complex soil contour of the country being typical for the North-West Coastal region. Firstly, there are all subunits of the Ermosols in this area, namely: Haplic, Luvic, Calcic, Gyrsic, Salic. The terrain is composed of a series of oolithic limestone ridges, running parallely, to the sea beach, and broad depressions between them. The elevation of the ridges varies from 15 to 50 m, above sea level, or several meters higher. The whole terrain is gradually rising up inland. The ridges with their steep slopes are covered with the Lithosols, and the bottoms of the depressions are occupied by the Marshy or Ochric Solonchaks, the slopes from the ridges to the bottoms being covered with the Ermosols. The geomorphological conditions of destribution of the Ermosols in relation ot toher soils is clearly seen on Fig. 2.

Dynamic Ergosols are scattered throughout the main plateaux especially near the plateaux depressions. The great sand sea of the Libyan desert occupies western portion of the country. Very little can be said on the origin of these shifting sand dune belts of the desert due to the very limited studies. The present seolian character of these formations is doubtless, but the origin of sandy deposit is far from clear. There is a theory connecting these huge sand masses with the wind excavation of the great desert depressions (Siwa, Qattara, etc.), but it is not clear to the present authors how these huge silicious sand masses were formed from predominatingly limestone formations. Thus, the origin of these sandy sheets is still to be studied in future.

Semistatic Silic Ergosols occur along the northern sea coast east of Abou Kir Bay, separating the clayey Nile Delta alluvium from the open sea. The silicious sand dunes are semistabilised at present whether naturally with some sparse cover of the grasses and occasional bushes of psammophitic vegetation or artificially. The sand dunes belt is rather narrow and discontinous, but may be traced along the whole coast and even in the Sinai.

Semistatic Calcic Ergosols having been formed along the northern sea coast west of Abou Kir Bay by the joint action of sea waves and wind from the first oolithic limestone coastal range. Sand particles are represented here by the rounded fragments of sea shells made up from calcium carbonate. All stages of the destruction of the oolithic limestone into the sand may be observed here, due to which reason there are Lithosols in an association with these formations in the region. The coastal strip of naturally semistabilised calcic sand dunes does not exceed in width several hundred meters, being in the widest places only up to one kilometer.

LAND RESOURCES OF U.A.R.

The area of different soil contours were measured using planimeter and square mesh methods. The corrected results of these measurements are presented in the following below table. Naturally, the area measurements on the 1 : 4, 000,000 map give only very approximate data, and thus they should be regarded only as such.

The analysis of these data, with all due reservations, gives a general picture of the country territory and is very informative as it gives also the ideas on the possibilities of the agricultural development of the country. It is also necessary to mention that these data are the first in the history of Egypt being based not on the general guesses, but on the actual soil map although of a small scale.

About 96 % of the country territory are represented by true deserts, out of which stony deserts occupy 76 %, clay desert — 0.3 %, salt deserts — 2.5 %, and sandy deserts — 16.9 %. The remaining land is mostly made up by the alluvial plains of the Nile Valley and delta. The semi-deserts of the North Coast occupying only a fraction of percent. So, actually speaking, with exception of the Nile Valley, the whole territory of Egypt is a true desert.

We have done also some optimistic calculations of the possibilities of the land utilisation for the purposes of agriculture. These calculations are based on the assumption that water being available for all lands, although it is not so at present, and that heavy works on land reclamation being in view for some particular areas. With these reservations we may state that approximately 48,500 sq. km. are available for the cultivation in the country, out of which about 24,500 sq. km. are already under cultivation at present. By the main regions of the country these potentially available for agriculture lands are destributed as follows :

Nile Valley and Delta	26,800 sq. km.
Fringes of Nile Valley	14,000 sq. km.
North-West Coast	3,800 sq. km.
Desert Oases	3,900 sq. km.

Thus, the present area under cultivation may be about doubled under the favourable conditions, if appropriate sources of water will be available, and with some heavy ameliorations. The potentially suitable for future development of agriculture lands occur mainly in the fringes of the Nile Valley, in the northern part of the delta, in the North Western Coastal region, and in the desert oases, especially in Kharga and Dakhla.

The above figures, being rather approximate and very optimistic, gives a general idea on the future of Egyptian agriculture. They show very clearly that any future expantion of agriculture in the country demands heavy capital investments and should be conducted with a great precaution, the main emphasis being on the water availability for such extention projects and the economical possibilities and advisabilities.

Table 1. Areas of different soils of U.A.R. and possibilities of their agricultural utilisation (cokpiled on the base of 1: 4,000,000 soil map).

No.	Soil Associations	Area	Possibilities of agricultural utilisation			
		Thous-ands sq.k.	Per cent of total soil	Per cent total area	Thous ands sq.km.	Per centl of tota area
1	Lithosols	190.2	17.3	—	—	—
2	Limestone Lithic Ermolithosols	269.4	25.2	—	—	—
3	Limestone Lithic Ermolithosols and Takyric Solonchaks	69.2	6.3	—	—	—
4	Limestone Lithic Ermolithosols Takyric Solonchaks and Lithosols	41.6	3.8	—	—	—
5	Sandstone Lithic Ermolithosols	230.5	20.9	—	—	—
6	Gravelly Ermolithosols	27.3	2.5	25.0	6.8	0.6
7	Argillic Ermolithosols	3.1	0.3	75.0	2.3	0.2
8	Eutric Rhegosols	14.4	1.3	50.0	7.2	0.7
9	Antropic Gleysols and Antrhopic Eutric Fluvisols	27.4	2.5	80.0	21.9	2.0
10	Takyric Solonchaks and Dynamic Ergosols	2.5	0.2	10.0	0.3	0.03
11	Marshy Solonchaks and Ochric Solonchaks	1.8	0.2	75.0	1.4	0.1
12	Marshy solonchaks, Humic Solonchaks and Humic Solonetz, partly reclaimed	4.0	0.4	80.0	3.2	0.3
13	Salipetrosols and Ochric Solonchaks	14.0	1.3	5.0	0.7	0.06
14	Salipetrosols, Ochric Solonchaks and Dynamic Ergosols	11.4	1.0	5.0	0.6	0.05
15	Ermosols	7.2	0.7	20.0	3.6	0.3
16	Dynamic Ergosols	169.2	15.4	—	—	—
17	Semistatic Silic Ergosols	1.4	0.1	25.0	0.3	0.03
18	Semistatic Calcic Ergosols	0.9	0.1	25.0	0.2	0.02
19	Inland Water surface	14.5	1.3	—	—	—
20	Grand Total	1,100.0	100.0	—	48.5	4.39

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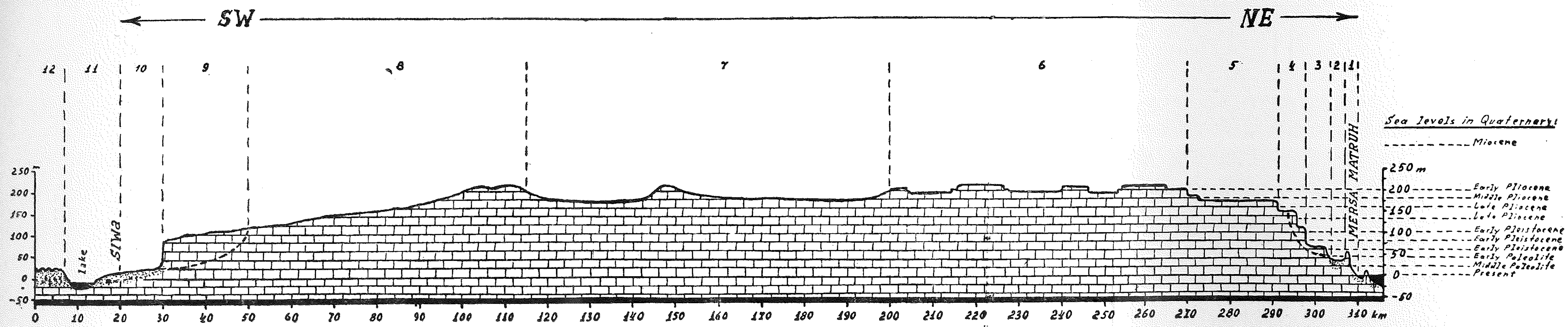
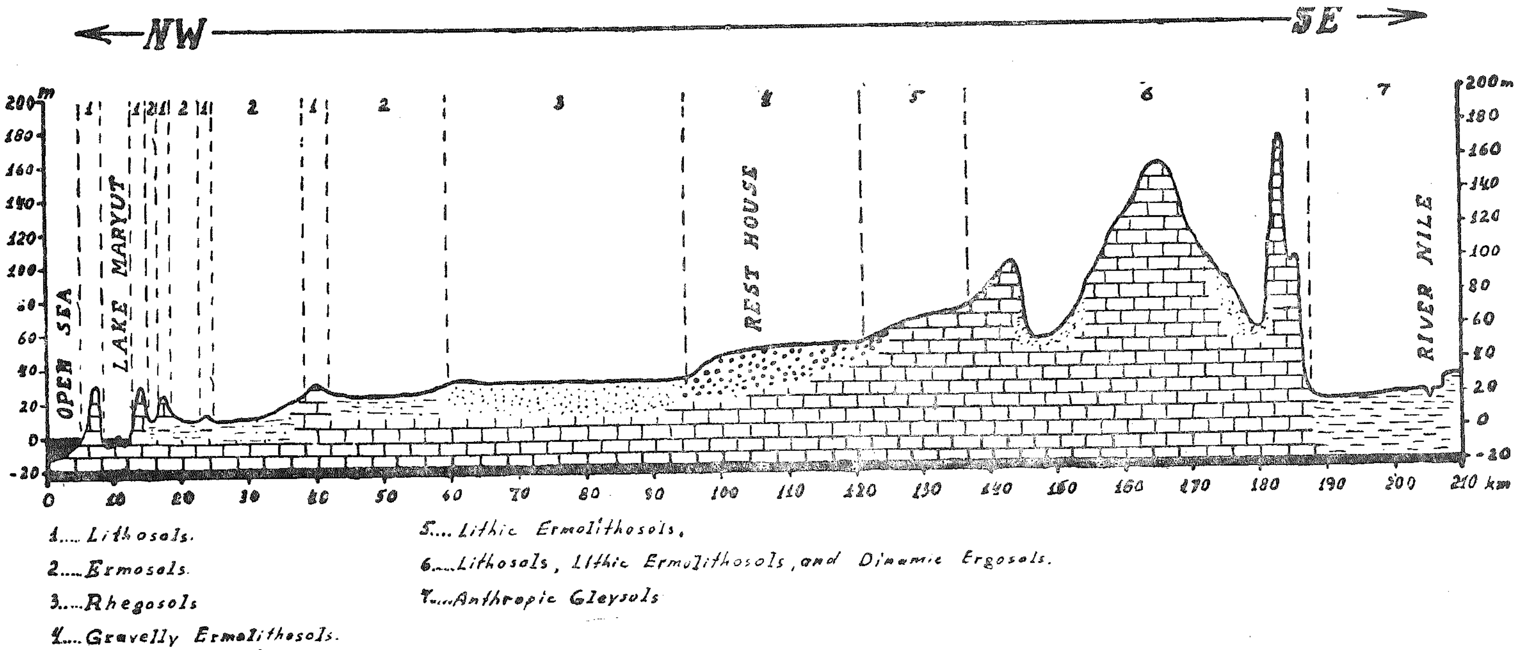
Fig. 1 A crossection through the northern Miocene limestone plateau of Egypt showing the destribution of the main soils



1....Semistatic Calcic Ermosols and Lithosols on limestone (25-50%).
2....Calcic Ermosols.
3....Lithic Ermolithosols and Calcic Ermosols (10-25%)
4....Lithic Ermolithosols and Haplic Ermosols (10-25%).
5....Lithic Ermolithosols and Gravelly Ermolithosols (to 10%).
6....Lithic Ermolithosols and Gravelly Ermolithosols (10-25%).
7....Lithic Ermolithosols and Takyric Solonchaks (10-25%).
8....Lithic Ermolithosols.
9....Lithosols and Lithic Ermolithosols (25-50%).
10....Salipetrosols and Dinamic Ergosols (10-25%)
11....Salipetrosols, Ochric Solonchaks (to 10%) and Salic Gleysols (to 10%)
12....Dinamic Ergosols.

Fig. 2 A crossection along Alexandria - Cairo Desert road showing the destribution of the main soils.



SOIL MAP
OF
UNITED ARAB REPUBLIC
SCALE 1:4 000 000