J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 3 (8): 763 - 778, 2012

SOIL LIMITATIONS AND LAND CAPABILITY CLASSIFICATION OF EL-FAYOUM GOVERNORATE

Zaid, M. S. * ; S. M. Abd El-Rassoul and I. M. Abdalla****
*** Fac. Of Agric. Al-Azhar Univ. Cairo, Egypt.**
**** Soil, Water and Environment Research Inst. ARC.**

ABSTRACT

The objective of this work aims to study the land capability classification. Soil limitations factors and soil taxonomy of the soils of El-Fayoum Governorate. The studied area is abounded by longitudes 30° 20` and 31° 10` East and latitudes 29° 02` and 29° 34` north. 16 soil profiles were selected to represent the main geomorphic unites. Soil profiles were morphologically described and soil samples were physio-chemical analyzed. The taxa output were processed and sorted for soil taxonomy and land evaluation . The main results could be briefly summarized as follows:
ECe values of the studied area varied from 0.55 to 10.80 dS/m^{-1} indicating that the studied soils are non saline to moderately saline. Soil reaction is slightly alkaline to strongly alkaline as shown by pH values which ranged between 7.5 to 8.8. Calcium carbonate content ranged from 2 to 71.8%. Soil gypsum content varied from 1.43 to 5.29%. Soil texture classes ranged from clay to loamy sand with a dominance for clayey grade, which cover most of El-Fayoum area. Soil sodacity ranged from non-sodic to sodic, as exchangeable sodium percent (ESP) ranged from 4.86 to 25.9%. Cation exchange capacity (CEC) values ranged from 8.24 to 58.31 m.e. / 100 gm soil. Soil were classified according to the soil taxonomy system using the taxonomy key manual (USDA 2010) into three orders, i.e, Aridisols, Entisols and Vertisols.

According to the model of Sys and Verheye (1978) the estimated data of soil criteria, the suitability indices for the studied sixteen soil profiles for current and potential classes. The estimated current ratings of the studied soil profiles ranged between 35.11 and 91.2 indicating that the soils of the studied area could be categorized into three classes (1) suitable soils (S1) the rating of this calss is 91.2 - 77.16 (2) Moderately suitable (S2) the rating of this class is 72.68 – 50.87 (3) Marginally suitable soils (S3) the rating of this classis 49.64 – 35.11. Soil improvement practices should be carried out such as land leveling and removing the excess of soluble salts through applying the gypsum and leaching requirements under an efficient drainage diteches for soils suffering from salinity and alkalinity conditions. Such agro-management practices will correct the ratings of soil potential suitability class for the majority of the studied soils, to be ranged 46.75-95 and potential soil suitability becomes as follows:

1. Suitable soils (S1) the rating of this class is 95 - 76.5.
2. Moderately suitable soils (S2), the rating of this class is 66.5 – 50.75
3. Marginally suitable soils (S3) the rating of this class is 46.75

Keywords: Soil Taxonomy, Land capability classification

INTRODUCTION

Agricultural development is the process of liberating the economic structure in general and the agricultural sector in particular from its major drawbacks of agricultural production. These drawbacks stem basically from the inadequacy of the productive capacity, due to the limited cultivated acreage and the fact that the population has far exceeded the optimum size that can be supported by such limited acreage.

The prominent aim of agricultural policy in El-Fayoum is to increase the land production through a better land use; improvement of the agricultural techniques and brining new areas under cultivation looking for ward to the future of stressing population demands.

It is quite obvious, that a very careful use of available soil and water sources as well as development of new water resources is a must. Therefore, any negative effects in these two factors leads to a great decrease in the soil productivity as well as the crop yields.

El-Fayoum depression lies in the western desert of Egypt close to the Nile valley with a distance of 40 km it lies to the south-west of Cairo at a distance of about 90 Km.

The depression is situated between the altitudes 20°34 and 29° 2`, while the city of Fayoum- the capital – lies between 29° 18` altitude to the North and 30° 50` longitude to the east.

The depression is bordered by Qattrani mountatin, to the south the Libyan desert. On the eastern border it is connected with the Nile by Bahr hassan wassif and the main desert high way (about 92 kilometers) joining the north-east of the depression with Cairo. The depression is surrounded by the Libyan desert except for a very narrow cultivated strip connecting it with the Nile valley and with lake ouarun to the north.

El-Fayoum depression has, in general, an extraemly arid climate characterized by long dry and hot summers and short nearly rainless and cold winters. (Ghabbour, 1988).

According to USDA (1975), in El-Fayoum region, the soil moisture regime is torric and the soil temperature regime is Hyperthermic.

Regarding the geomorphology of El-Fayoum depression Egyptian desert and its origin, Ball (1939) stated that the western Desert of Egypt is one of the most arid regions in the world. Its surface is principally abare rocky plateau with stony and sandy plains. It is within this arid western desert that Fl-Fayoum depression developed. Tamer , (1968). stated that the landscape of El-Fayoum depression and the adjacent areas are divided by main phsylographic features namely the table land, the elevated gravelly plains, the moph-tectonical depression and the great mono-clinal edge. Rocks availability to weathering plays an important role in shaping and producing the different geomorphological features. High edges (escarpments) are composed of resistant rocks, while the low lands (vallegs, plains and depressions) are cut through soft or less resistant rocks and weathering of the underlying rocks affects on the soil properties formed above it.

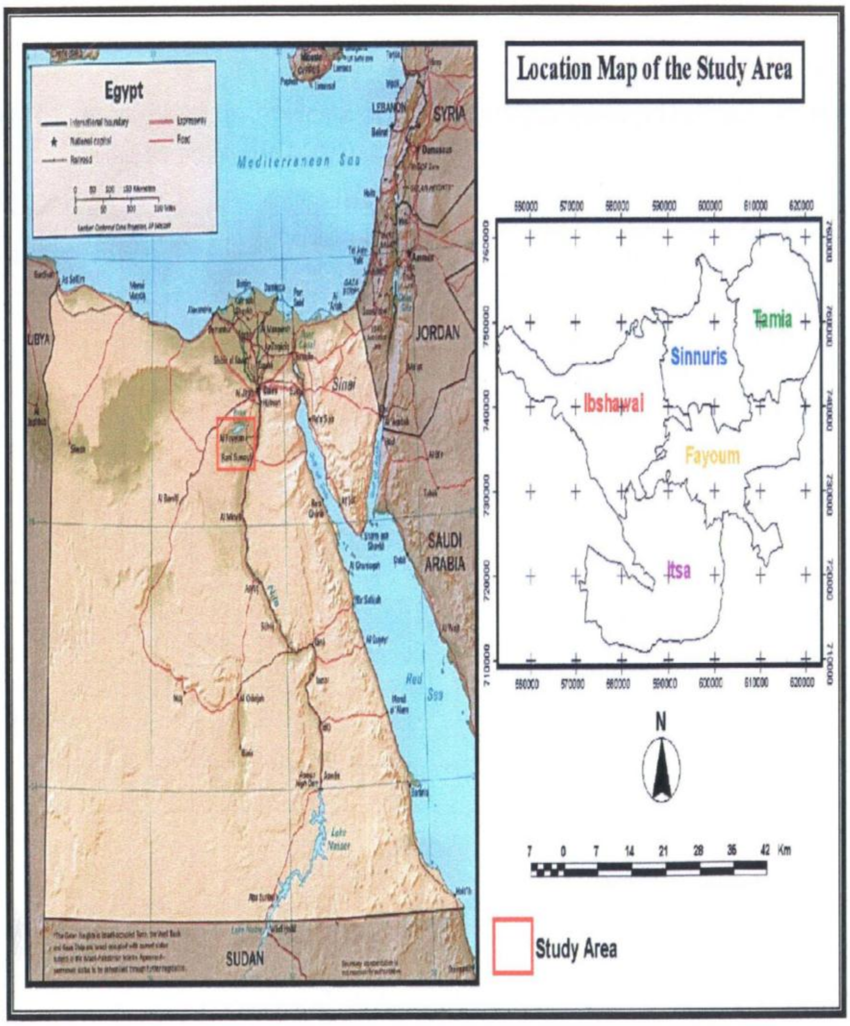
With regard to the main soil characteristics of El-Fayoum Governorate, many authers studied these properties among them "Khater (1973), Abdel-Hady et al., (1982), Abd El-Aal (1984), Birkland (1984), Shendi (1984), Abu El-Einane (1985), Ghabbour (1988), Farrage (2000), Khater et al., (2002), El-Naggar, (2004), Harun (2004).

The main objective of this work is to define soil limitations for productivity and to evaluate the suitability of different soil resources in El-Fayoum Governorate for agricultural purposes.

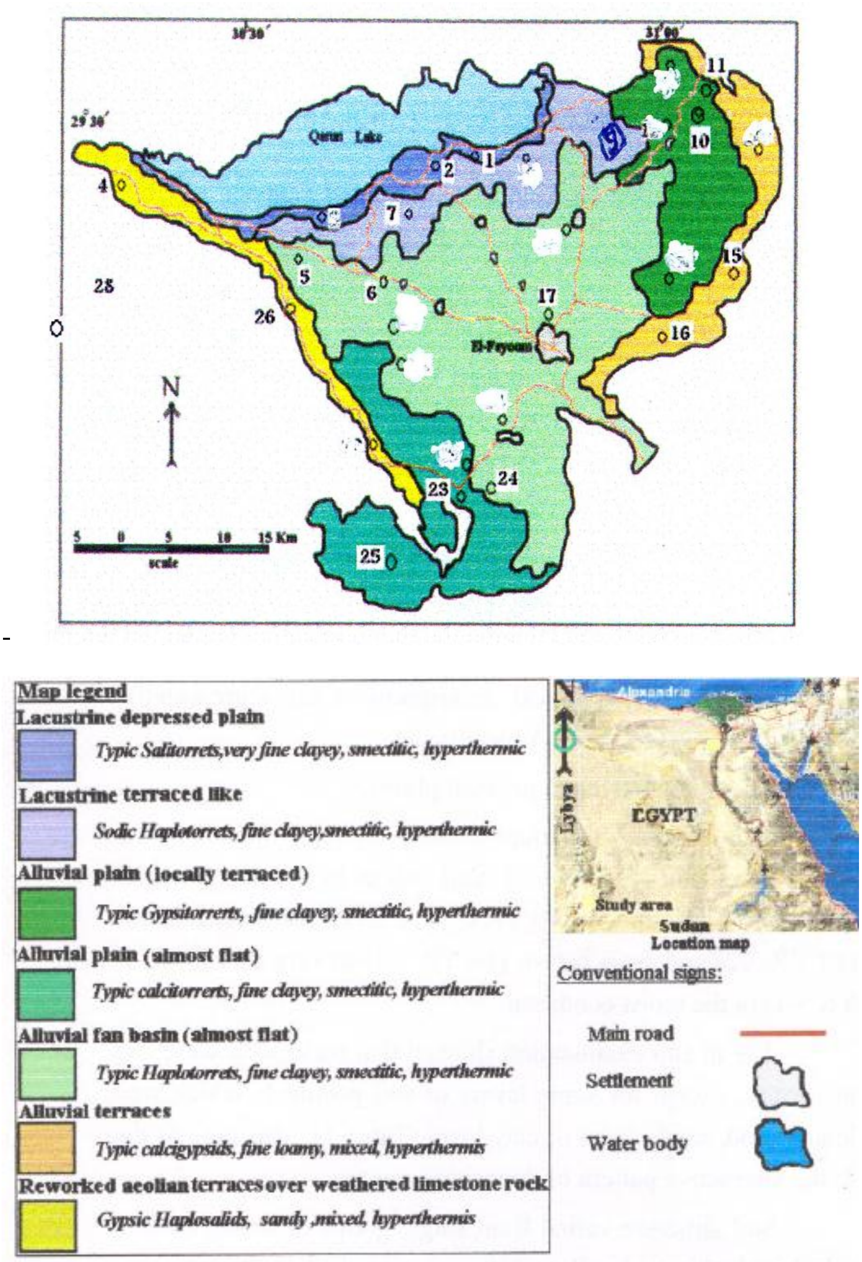
Also throw some lights on the sequence of soil limiting factors for productivity according to their intensity degree in the different physiographic units of El-Fayoum Governorate.

MATERIALS AND METHODS

Sixteen soil profiles were taken at El-Fayoum map (1)to represent the different physiographic units of El-Fayoum Governorate Map (2) that were identified by Al-Nagger (2004).



MAP (1) : Location of El - Fayoum Governorate



Map 2: Physiographic-soil map of El-Fayoum depression and Location of the studied soil profiles.

The distribution pattern of the studied soil profiles as related to the identified physiographic units is presented as follow:

- Lacustrine depressed plain unit is represented by soil profile Nos 1 and 2.
- Lacustrine terraced like unit is represented by soil profile Nos 7 and 9.
- Alluvial terraces unit is represented by soil profile Nos 15 and 16.
- Alluvial plain (locally terraced) unit is represented by soil profile Nos 10 and 11.
- Alluvial fan basin (almost flat) unit is represented by soil prfile Nos 5, 6 and 17.
- Reworked Aeolian terraces over weathering lime stone unit is represented by soil profile Nos 4 and 26.

Alluvial plain (almost flat) unit is represented by soil profile Nos, 23,24 and 25.

Representative soil profiles were dug to a depth of 150 cm as well as to either lithic contact or water table level, which ever comes first.

Soil profiles were morphologically described according to the guidelines of USDA (1993). (Table 1).

Forty three soil samples representing the different morphological variations throughout the entire soil profiles were collected, air dried, crushed, sieved through a 2mm sieve and the fine earth (less than 2mm diameter) was used for different analysis.

The laboratory analyses

- Mechanical analysis was carried out by , the pipette method using Na-hexametaphosphate as a dispersing agent without removing calcium carbonate (piper, 1950).
- Soil colour in moist and dry conditions was determined by Munsell soil color charts, soil survey staff (1967).
- Total calcium carbonate content was determined volumetrically using the calcimeter (USDA, 1954).
- Gypsum content was determined by precipitation with acetone (USDA, 1954).
- Soil pH was measured in the soil paste according to Richards (1954).
- Electrical conductivity (ECe) of soil paste extract was determined according to Jackson (1967).
- Cation exchange capacity (CEC) was determined using sodium acetate (Richards, 1954).
- Exchangeable calcium and magnesium were extracted using IN sodium chloride according to Hissink (1923).
- Exchangeable sodium and potassium were determined sodium chloride by using ammonium acetate pH 7 (Richards, 1954).

Soil taxonomy

Based on the different characteristics of the studied soil profiles as well as the metrological data, the studied area was classified up to family level according to the soil taxonomy system of USDA (1975) and USDA (2010).

Soil evaluation

The soils of the studied area were evaluated for the purpose of the agricultural land use applying by developed system of Sys and Verheye (1978) considering the framework of FAO (1976) for land evaluation.
Based on the number and intensity of the limitations Sys and vrheye (1978) suggested definitions of suitability orders and classes.
The suitability index (Ci) is calculated as follows:

$$Ci= TX\frac{w}{100}X\frac{S1}{100}X\frac{S2}{100}X\frac{S3}{100}X\frac{S4}{100}X\frac{n}{100}$$

t: topographic limitation
w: wetness limitations, mainly based on drainage conditions.
S: Limitations concerning the physical soil conditions, which induced:
S1: texture including stoniness.
S2: Soil depth
S3: calcium carbonate status.
S4: gypsum status
n: Salinity and alkalinity limitations.

RESULTS AND DISCUSSION

Morphological description and physiico-chemical properties of the representative soil profiles.

It was important to study seven geomorphic units through describing the most important morphological features characterizing the soils, also the study involves a detailed quantitative evaluation of the different physical and chemical properties required to attain the purpose of this work.

A brief morphological description and phsyico-chemical properties of the representative soil profiles were given in Table 1,2.

With regard to the particle size distribution the data obtained in Table (2): show that the studied soil profiles have different soil textural classes i.e., a relatively fine (clayey, profiles Nos. 1,2, 15, 6 and 17) a relatively medium (clay loam sandy clay loam and sandy clay profiles Nos 7,9,16,10,11 5 and 24 and a relatively coarse textured grades (Loamy sand; profile No. 25 these widely variations are more related to the soil origin, intensity of geo-chemical weathering vertical or horizontal depositional pattern, nature of both depositional media and mechanism of transportation.

Regarding the total carbonate contents of the studied soil profiles have been measured as calcium carbonate content. However, magnesium carbonate might be present, there was a very widely variation in this respect. Data in Table (2) showed that the total carbonate content of the studied soil profiles ranged vastly from as little as 2% in the depth of 60-150 cm of profile 9 to as high as 71.8% (in the 50-80 cm layer of profile 11).

Regarding to the distribution of carbonate within the soil profiles, data showed that it tends to increase with depth in soil profile 4,15,10 and 11 but decrease with depth in soil profiles 2,7,9,16,5,17,23,24 and 25 while in the other soil profiles, it exhibited an irregular distribution throughout the profile layers.

1

2

Cont2

Data revealed that gypsum accumulation were found in all studied soil Table (2) the highest gypsum content was attained in the subsurface layer of soil profile 11, where it reached 5.29% however, the lowest gypsum content (1.43%) was detected in the surface layer and layer (60-90cm) of soil profile 23.

With regard to the distribution of gypsum within the soil profiles, data showed that it tends to increase with depth in soil profiles 2,9,15,16,11,17, and 4 on the other hand, gypsum content showed an irregular distribution pattern throughout the entire depths of the other soil profiles.

Data in Table (2) showed that pH values of the studied soil profiles ranged from 7.50 to 8,8 the lowest value was recorded for the 0-60 cm layer of soil profile 4, while the highest value was recorded for the 30-60 cm layer of soil profile 2, considering the change in pH values, data revealed a slightly increase with depth in soil profiles (2,7,15,16,10,11,5,6,17,4,23,24 and 25) but a decrease with depth was noticed in soil profile 9 and no certain trend can be observed in the other soil profiles, soil pH values may indicate that these studied soils are base-saturated since all their pH values are over 7.0 this is the case in arid and semi-arid soils.

Data of soil salinity, as expressed in terms of electrical conductivity (EC) of the saturation extract of the soil past Table (2), EC values ranged from 0.55 to 10.8 dS/m^{-1} so the grade of soil salinity varies from "non-saline" to " Strongly saline" the soils can be grouped into the four categories according to the USDA salinity laboratory (USDA, 1954) as follows:

1. Non-saline soils (less than 4 dS/m^{-1}) represented by soil profiles 16, 6, 17,4,23,24 and 25.
2. Moderately saline soils (4-8 dS/m^{-1}) represented by soils of profiles 2,7,9,15,10,11 and 5.
3. strongly saline soils (8-16 dS/m^{-1}) represented by soil profile 1.

Concerning the distribution of soluble salts within the soil profile, data showed that EC values trend to decrease with depth in soil profile 25 while they tend to increase with depth in soil profiles 2,4,15,16,11,6,17, and 23,. however, EC values of the other soil profiles show an irregular trend throughout the profile layers, which my be attributed to intensive surface irrigation and / or active upward movement of saline soil solution with drawn as a result of the relatively high saline water table.

Ion- exchange properties of a soil is due to the colloidal clay, silt and organic matter in soil (Hagag 1994). Which provide an adsorption surface for ions. The cation exchange capacity (CEC) values for the studied soil profiles Table (2) showed a wide range of 8.24 to 58.31 m.e./100g soil due to the differences in clay and organic matter contents. The lowest value was attained for the 0-40 cm layer of soil profile 25 (sandy loam) while the highest one was recorded for the 60-90 cm layer of soil profile 23 (clay) . within soil profiles CEC values tend to increase with depth in profile 16,5,17 and 25 but decrease with depth in profiles 2,15,10 and 11. in other profiles there an irregular distributions.

Data in Table (2) showed that exchangeable sodium percent (ESP), in most studied soils, constituted less than 15% of CEC, therefore based on the ESP criteria most soils were classified as non-sodic in some other soils. ESP values were more than 15%, thus being soidc soils. ESP values tend to increase with depth in soil profiles, 2,7,15,16,10,11,14,5 and 6, while the decrease with depth in profiles 9 and 4 but they showed an irregular distribution in the other soil profiles.

Soil Taxonomy:

Soil taxonomy of the studied area was done according to USDA (1975) and its subsequent edition of USDA (1999), using the taxonomy key-manual (USDA 2010) accordingly, the studied soils belong to the soil orders of Vertisols, Aridisols and Entrisols Table (3) shows the taxonomy of soils.

Land evaluation

Many qualitative and quantitative systems of land capability classification are established and widely used.

Results obtained from some studies about land suitability carried out in some areas in Egypt (Moussa, 1991), suggested that the parametric system developed by Sys and Verheye (1978) and adopted by the FAO may be suitable under the conditions prevailing in Egypt. Such classification was originally processed as a FAO framework (FAO, 1976) using the guidelines for the definition of orders, classes, sub-classes and units.

In the current study, parameter evaluation system in applied to determine the soil limitations and their intensities as well as soil suitability classes and sub-classes according to the current and potential suitability ratings by Sys and Verheye (1978) and it is based on some independent limiting factors for irrigated soils in arid and semi-arid regions, i.e., individual factors of soil topography (t), wetness (w), texture (S1), depth (S_2), $CaCo_3$ content (S_3), gypsum content (S_4) and salinity / alkalinity.

The obtained data in Table (4) reveal, that all the studied soils have no limitations concerning their topography (t) (since the surface landscape in situ is nearly level to gently slopping), effective soil depth (S2) except for the soil site No. 26 that showed a moderate intensity degree) and wetness (w) Except for the soil sites Nos 2, 7, 15, 16, 17 and 25 that showed a moderate intensity) it is, quite to notice that the wetness of the studied soils is moderate, that means the excess water drives that air from the soil pores and leads to lack of oxygen. Also, the availability of foot hold for roots is affected by excess water even in the soil depth is deep.

Table (3): Soil classification of the investigated soils profiles (according to USDA 2010).

Order	Suborder	Great group	Sub great group	Representative profiles
Vertisols	Torrerts	Hapletorrerts	Sodic Haplotorrerts	1,2,7,9
			Typic haplotorrerts	23.6.5
Aridisols	Gypsids	Calcigypsids	Typic calcigypsids	11
	Calcids	Haplocalcids	Aquic haplocalcids	15
Entrisols	Orthents	Torriorthents	Aquic torriorthents	16,17,25
			Lithic torriorthents	26
			Typic Torriorthents	10,24,4

On the other hand, most soils of the studied area are suffering from soil texture (S1), $CaCo_3$ content (S3), gypsum content (S4) and salinity /alkalinity (n) as limiting factors for soil productivity, which are put into variable intensity degrees of slight (< 85), moderate (85-60), severe (60-45) and very severe (< 45).

According to the model of Sys and Verheye (1978) and the estimated data of soil criteria, the suitability indices for the studied sixteen soil profiles for current and potential classes are assessed and recorded in table (4). The obtained results show that the estimated current ratings of the studied soil profiles ranged between 35.11 and 91.2, indicating that the soils of the studied area could be categorized into three classes, as follows.

a. suitable soils (S1)

The rating of this calss is 100-75 and is represented by soil profiles Nos. 10, 5, 4 and 24. these soils showe no limitations.

b. Moderately suitable (S2):

The rating of this class is 75-50, and is represented by soil profiles Nos. 1, 7, 9,11, 6, 17 and 23. soil limitations factors are wetness, soil texture, soil depth and salinity/ alkalinity.

c. Marginally suitable soils (S3)

The rating of this class is 50-25 and represented by soil profiles Nos, 2, 15, 16, 26 and 25. soil limiting factors are wetness and soil depth.

Potential soil suitability

Soil improvement practices should be carried out such as land leveling and removing the excess of soluble salts through applying the gypsum requirements, and leaching requirements under an efficient drainage ditches for soils suffering from salinity and alkalinity conditions. Such agro-management practices will correct the ratings of soil potential suitability class for the majority of the studied soils to be ranged 45-95, and potential soil suitability becomes as follows:

a) suitable soils (S1)

The rating of this class is 100-75, and is represented by soil profiles Nos, 1, 2, 7, 9, 15, 16, 10, 5, 6, 17, 4, 23 and 24.

b) Moderotely suitable soils (S2)

The rating of this class is 75-50 and is represented by soil profiles No5, 11 and 25.

c) Marginally suitable soils (S3)

The rating of this class is 50-25 and represented by soil profile No. 26.

The land evaluation criteria (suitability classes and soil limiting factors) are briefly described for the studied soils according to the parametric system developed by Sys and Verheye (1978) and adapted by the framework of FAO (1976) to define the order, classes and sub-classes as presented in Table (4).

It is clear, from the obtained data that soil texture (S1) represents the major limiting factor for all the studied soils developed on the different identified physiographic units, with widely limitation intensity degree varies from No (95) to moderate (60).

4

It is worthy to mention that soil texture has a direct influence on soil permeability and retained moisture content, and can therefore be considered as a good indicator for the water holding capacity of the entire soil profile.

On the other hand, it seems that majority of the studied soil profiles have wetness, $CaCo_3$ content, salinity / alkalinity and rarely soil depth as soil limitations in different degrees of intensity categorized into slight (95) to very severe (< 45).

REFERENCES

Abd El-Aal, T.S. (1984). Pedological and physical studies on some soil of the expansion areas in Fayoum Governorate, Egypt. M.Sc., Thesis, Fac. Of Agric., Cairo univ., Egypt.

Abdel-Hady, M.A.; El-Kassas, I.A. and Ayob, A.S. (1982). Automatic classification of lake Qarun water by digital processing of land sat Mss data in : proceeding of the international symposium of remote sensing of environment. First thematic conference: remote sensing of arid and semi-arid lands : 1143-1165, Cairo, Egypt.

Abu El-Einane, S.M. (1985). Pedogenesis of the Fayoum area ph.D. Thesis, Fac. Of Agric., Al-Azhar univ., Cairo, Egypt.

Ball, ,J. (1939). Contribution to the Geograpy of Egypt. Survey Dept., Egypt; Government press., Cairo univ., Egypt.

Birkland, P.W., (1984). Soils and Geomorphology. Dept. of Geological science. Colorado state univ., USA.

El-Naggar, M.A. (2004). Land Evaluation of some soils in Arab Republic of Egypt. Ph.D. Thesis, Fac. Of Agric., Moshtohor, Zagazig university, Banha Branch.

FAO (1976). A framework for land evaluation . FAO soils Bulletin No. 32, Rome.

Farrage, R.M.F. (2000). Potential effects of low quality water for soil irrigation in El-Fayoum Governorate, Egypt. M.Sc., Thesis, Fac., of Agric. At El-Fayoum, Cairo Univ., Egypt.

Ghabbour, T.K. (1988). Soil salinity mapping and monitoring using remote sensing and a geographical information system (some applications in Egypt). Ph. D Thesis, Fac. Of Sciences, State univ. of Ghent.

Hagag, A.A. (1994). Soil classification of north coast of Delta. Ph.D. Thesis, Fac., of Agric., Mansoura Univ., Egypt.

Harun, M.R.O. (2004). Soil Evaluation systems as a guide to identify an economical feasibility study for agricultural purposes in El-Fayoum Governorate, Ph. D. Thesis, Fac. Of Agric. Cairo university, Egypt.

Hissnk, D.J. (1923). Method for estimating adsorbed bases in soils and importance of these bases in soil economy. Soil Sci., 15: 269.

Jackson, M.L. (1967) . " Soil chemical Analysis ". prentice Hall, ladia private. LTD, New Delhi.

Khater, E.A. (1973). Pedological studies on Fayoum Governorate, A.R.E. M.Sc., Thesis Fac of Agric., Cairo univ., Egypt.

Khater, E.A.; Ibrahim, S.B. and Awadalla, A.A. (2002). Utilization of some organic farm residues for improving the productivity of the newly reclaimed soils at El-Fayoum Governorate, Egypt 6th National Congress, Egyptian Soil Science Society.

Moussa, M.A. (1991). Land suitability evaluation of El-Saff area, Eastern desert of Egypt for agriculture utilization. Ph. D. Thesis, Fac. Of Agric., Zagazig univ., Egypt.

Munsell colour charts (1967). Macbeth a division of kollmorgen corporation 2441 Norht calvert St. Baltimore, Mary 12/2/8, USA.

Piper, C.S. (1950). " Soil and plant analysis". Interscience and publisher Inc., New york.

Richards, L.A. (1954). " Diagnosis and improvement of saline and Alkali soils". U.S. Dept. of Agric., Handbook No. 60.

Shendi, M.M. (1984). Pedological studies on soils adjacent to Qarun lake, Fayoum Governorate, Egypt. M.Sc., Thesis, Cairo university, Egypt.

Sys, C. and Verheye, W. (1978). An attempt to the evaluation of physical land characteristics for irrigation according to the FAO framework for land evaluation Int. 1. Trai. Cent. Post. Grad. Soil Sci, Ghent. Belgium.

Tamer, M.A. (1968). Subsurface geology of the Fayoum regions. M.Sc., Thesis, Alexandria univ., Egypt.

USDA (1954). Diagnosis and improvement of saline and Alkaline soils (revised (1969). United states department of Agriculture (USDA). Handbook No. 60, U.S. Govt. printing office, washington, D.C., USA.

USDA (1975). Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil conservation service. U.S. department of Agriculture (USDA), Hand book 436.

USDA (1993). Soil survey Manual. United states Dept. of Agric. (USDA), Hand book No . 18.

USDA (1999). Soil Taxonomy. A basis system of soil classification for making and interpreting soil surveys. Second Edition. U.S. Department of Agriculture, Natural Resources conservation service USDA., Agriculture Handbook No. 436.

USDA (2010). Keys to soil taxonomy 8th Ed, united states department of Agriculture, USA.

محددات التربة والقدرة الإنتاجية لأراضي محافظة الفيوم

محمد سليمان زيد*، شعبان محمد عبدالرسول وإبراهيم محمد عبدالله****

*** قسم الأراضي والمياه - كلية الزراعة - جامعة الأزهر - القاهرة.**

**** معهد بحوث الأراضي والمياه والبيئة - مركز البحوث الزراعية - الجيزة - مصر.**

تقع منطقة الدراسة في محافظة الفيوم بين خطي طول ٢٠- ٣٠° ، ١٠-َ، ٣١° شرقاً، ودائرتي عرض ٢ ً ٢٩° ، ٣٤ ً ٢٩° شمالا ويتميز منخفض الفيوم بوجود سبع وحدات فيزوجرافية والغرض من هذا البحث هو دراسة القدرة الإنتاجية للتربة والعوامل المحددة لها وتقسيم أراضي منخفض الفيوم ولتحقيق هذا الهدف تم اختيار ١٦ قطاعاً أرضيا لتمثل الوحدات الفيزوجرافية الموجودة في منطقة الدراسة وقد تم وصف القطاعات الأرضية وصفاً مورفولوجيا دقيقاً وأجريت التحليلات على عينات التربة طبيعياً وكيميائيا حيث تم استخدام نتائج هذه التحليلات في تقييم القدرة

الإنتاجية للأراضي وتقسيمها وقد تراوح قوام التربة بين الطينية والرملية الطميية وأن الأراضي الطينية تغطي معظم المساحة تحت الدراسة وأظهرت الدراسة أيضا أن محتوى التربة من كربونات الكالسيوم يتراوح بين ٢% إلى ٧١.٨% ، محتوى التربة من الجبس يتراوح ما بين ١.٤٣% إلى ٥.٢٩%، قيم Soil pH تراوحت ما بين ٧.٥ إلى ٨.٨، أما ملوحة التربة معبراً عنها بقيمة التوصيل الكهربائي (ECe) تراوحت ما بين ٠.٥٥ إلى ١٠.٨ ديسيمنز/متر. قيم السعة التبادلية الكاتيونية (CEC) تتراوح مابين ٨.٢٤ إلى ٥٨.٣١ مليمكافيء / ١٠٠ جرام تربة) تراوحت صودية التربة ما بين غير صودية إلى صودية حيث تتراوح نسبة الصوديوم المتبادل (ESP) من ٤.٨٦% إلى ٣٨.٦% .

تقسيم التربة:

تم تقسيم التربة بأستخدام النظام الصادر عن وزارة الزراعة الأمريكية (USDA) ١٩٧٥ والمعدل في ١٩٩٩ ومفتاح تصنيف التربة ٢٠١٠ وقد بين أن الأراضي المدروسة تتبع ثلاثة رتب أرضية هي (Aridisols), (Entisols), (Vertisols) and . وقد أجريت عملية التقسيم حتى مستوى تحت العائلات الكبرى.

القدرة الإنتاجية للتربة:

استخدمت هذه الدراسة لتحديد المعوقات وشدة تأثيراتها وكذا تقييم مستويات الصلاحية الحالية والكامنة للأراضي تحت الدراسة وقد استخدم نظام Sys and Verheye (1978) والذي يعتمد على خواص التربة، وقد اتضح من تطبيق هذا النظام أن عوامل الطبوغرافيا وعمق التربة والترطيب لا تمثل عائقاً لإنتاجية الأراضي تحت الدراسة، فيما عدا القليل منها بالنسبة للعاملين الأخيرين وبدرجة شدة متوسطة وعلى الجانب الآخر فإن قوام التربة والمحتوى من $CaCO_3$ والجبس ومستويات الملوحة/ القلوية وأحياناً العمق الفعال للتربة فإنها تمثل أهم المعوقات لإنتاجية التربة وبدرجات شدة متباينة تبدأ من الخفيفة (أكثر من ٨٥%) فالمتوسطة (٨٥-٦٠%) حتى الشديدة (٦٠-٤٥%) كما تراوحت قيم دليل الصلاحية الحالية للأراضي تحت الدراسة ما بين ٣٥.١١ -٩١.٢% مشيرا إلى أن الأراضي تحت الدراسة تنتمي إلى ثلاث مستويات تبعاً للقيم المتحصل عليها من درجات الصلاحية وهي عالية الصلاحية (S1) معامل الصلاحية يتراوح مابين ٧٧.١٦ – ٩١.٢ متوسطة الصلاحية (S2|) معامل الصلاحية يتراوح ما بين ٥٠.٨٧ – ٧٢.٦٨ هامشية الصلاحية (S3) معامل الصلاحية يتراوح ما بين ٣٥.١١ – ٤٩.٦٤. وبإجراء بعض العمليات الزراعية المناسبة للتغلب على مشاكل الملوحة والقلوية الزائدة وذلك من خلال إضافة الاحتياجات الجبسية والغسيلية مع وجود نظام صرف فعال، فإن مثل هذه العمليات تمكنا من رفع القدرة الإنتاجية لهذه الأراضي تحت الدراسة ورفع دليل الصلاحية لمعظمها لتصبح قيم دليل الصلاحية ٤٦.٧٥-٩٥% ومن ثم تصل درجات الصلاحية الكامنة للأراضي إلى عالية الصلاحية (S1) معامل الصلاحية يتراوح ما بين ٧٦.٥ – ٩٥ متوسطة الصلاحية (S2) معامل الصلاحية يتراوح ما بين ٥٠.٧٥-٦٦.٥ هامشية الصلاحية (S3) معامل الصلاحية (٤٦.٧٥).

قام بتحكيم البحث

أ.د / أحمد عبد القادر طه	**كلية الزراعة – جامعة المنصورة**
أ.د / محمد أحمد عبد المطلب	**كلية الزراعة – جامعة الأزهر**

Table (1): Morphological description of the representative soil profiles in El-Fayoum depression.

Geemorphyic unit	Prof. No	Depth	Soil colour			Texture class	Soil structure	Soil consistence		Lower boundaries
			Hue	Dry	Moist			Moist	Wet	
Lacustrine depressed plain	1	0-30	10yR	5/2	4.2	C	w.m.sub.an.bl	VS	VP	Diffuse smooth
		30-60	10yR	5/2	4/2	C	m.m.sub.an.bl	VS	VP	Cndual smooth
		60-90	10yR	5/2	4/2	C	m.Fino.ang.bl	VS	VP	Clear smiooth
		90-120	10yR	5/2	4/2	C	S.m.an.bl	VS	VP	
	2	0-30	10yR	5/2	4/2	C	w.f.sub.an.bl	VS	VP	Clear smooth
		30-60	10yR	5/2	4/2	C	m.fine.sub.an.bl	VS	VP	Clear smooth
Lacustrine terraced like	7	0.30	10yR	5/2	4/2	C	w.f.sub.an.bl	Vs	VP	Clear smooth
		30.60	10yR	5/2	4/2	C.L	w.f.sub.an.bl	Ms	Mp	Gradual smooth
		60-90	10yR	5/2	4/2	C.L	w.f.sub.an.bl	Ms	Mp	Gradual wavy
	9	0-30	10yR	6/3	6/2	S.C.L	m.suban.bl	Ms	Mp	Clear smooth
		30-60	10yR	6/4	6/3	S.C.	w.F.an.bl	m.s	Mp	Gradual wavy
		60-150	10yR	6/4	6/3	C.L	Angular blocky	Ms	Mp	Gradual wavy
Alluvial terraces	15	0-40	10yR	5/2	4/2	C	w.fine.sub.an.bl	VS	VP	Clear smooth
		40-100	10yR	7/3	6/3	C	m.m.an.bl	VS	VP	Clear smooth
	16	0-30	10yR	5/2	4/2	S.C.L	w.f.sub.an.bl	Ms	Mp	Clear smooth
		30-75	10yR	6/2	4/2	S.C.L	m.m.sub.an.bl	Ms	Mp	Clear smooth
Alluvial plain (locally terraced)	10	0-30	10yR	5/3	5/2	Si.L	w.m.sub.an.bl	Ms	Mp	Clear smooth
		30-70	2.5y	7/4	7/3	S.L	w.f.sub.an.bl	SS	SP	Clear smooth
		70-150	2.5y	7/3	7/2	S.L	Massive	SS	SP	Clear smooth
	11	0-50	2.5y	6/2	5/2	C	w.f.sub.an.bl	VS	VP	Clear smooth
		50-80	2.5y	8/2	8/4	Si.C	Massive	mS	Mp	Clear smooth
Alluvila fan basin (Almost Flat)	5	0-40	10yR	5/2	4/2	C.L	w.fine.sub.an.bl	Ms	Mp	Clear smooth
		40-95	10yR	5/2	4/2	C.L	m.m.an.bl	Ms	Mp	Clear smooth
		95-120	10yR	5/2	4/2	C	S.Co.an.bl	VS	VP	Clear smooth
	6	0-30	10yR	5/2	4/2	C	w.f.sub.an.bl	VS	VP	Clear smooth
		30-60	10yR	5/2	4/2	C	w.f.sub.an.bl	VS	VP	Gradual smooth
		60-90	10yR	5/2	4/2	C	m.m.an.bl	VS	VP	Gradual smooth
		90-150	10yR	5/2	4/2	C	`m.m.an.bl	VS	VP	Gradual smooth
	17	0-25	10yR	4/2	`3/2	C	w.f.sub.an.bl	VS	VP	Clear smooth
		25-85	10yR	6/2	4/2	C	m.sub.an.bl	VS	VP	Clear smooth
Reworked aelion terraces over lime?	4	0-60	2.5y	7/2	6/4	S.C.L	Massive	Ms	Mp	Clear smooth
		60-100	10yR	7/3	6/3	S.C	Single grain	Ms	Mp	abrupt smooth
		100-150	10yR	7/2	7/1	S.C.L	Massive	Ms	Mp	Abrupt smooth
	26	0-30	2.5y	5/3	4/2	C	w.f.sub.an.bl	VS	VP	Abrupt smooth
Alluvial plain (Almost flat)	23	0-30	10yR	5/2	4/2	C	`w.f.sub.an.bl	VS	VP	Clear smooth
		30-60	10yR	6/2	4/2	C	m.m.an.bl	VS	VP	Gradual smooth
		60-90	10yR	5/2	4/2	C`	m.m.an.bl	VS	VP	Clear wavy
		90-150	10yR	5/2	4/2	S.C.L	w.f.sub.an.bl	MS	Mp	Clear wavy
	24	0-30	10yR	5/3	3/3	S.C.L	w.f.sub.an.bl	Ms	Mp	Clear smooth
		30-60	10yR	5/3	4/3	S.L	w.f.massive	SS	SP	diffuseirragulr
		60-120	10yR	6/3	5/3	S.C	w.f.sub.an.bl	Ms	Mp	Diffuseirr?
	25	0-40	10yR	5/2	4/2	L.S	Massive	Ms	Np	Clear smooth
		40-70	10yR	5/4	4/4	S.L	w.f.an.bl	SS	Sp	Clear smooth

VS= very sticky ms= moderately sticky mp= moderately plastic m.m=moderate medium s.m=strong medium bl.=blocky VP = very plastic SS= slightly sticky SP = slightly plastic W.F = weak fine an-= angular w.m = weak medium

Table (2): Some physical and chemical properties of the studied soil profiles

Geomorphyic unite	Prof. No	Depth (cm)	EC dS/m^{-1}	pH 1: 2.5	$CaCO_3$%	Gypsum%	Particle size distribution %				Tex class	CEC m.e./100s oil	ESP%
							CS	FS	Silt	Clay			
Lacustrine depressed plain	1	0-30	9.00	8.45	10	3.36	0.25	14.36	22.61	62.78	C	49.28	20.4
		30-60	10.80	8.05	9	4.93	0.47	10.71	23.51	66.31	C	54.24	24.4
		60-90	9.50	8.15	12	3.45	0.21	6.92	30.96	61.91	C	48.4	21.3
		90-120	9.50	8.05	12	2.58	7.14	24.92	10.16	58.65	C	47.2	21.9
	2	0-30	4.60	8.10	8	2.19	1.60	8.29	20.60	69.51	C	52.88	20.4
		30-60	7.90	8.80	7	2.39	8.40	21.18	16.25	54.17	C	45.8	28.3
Lacustriane terraced like	7	0-30	5.3	8.05	7	2.63	2.57	36.88	12.62	47.93	C	39.9	17.4
		30-60	6.6	8.4	5	2.42	2.77	39.35	25.16	32.72	CL	28.2	24.5
		60-90	7.4	8.5	5	2.43	2.59	37.62	22.42	37.37	CL	31.4	31.1
	9	0-30	4.43	8.35	7	2.46	15.43	33.96	5.06	45.55	S.C	39.98	25.9
		30-60	7.4	8.25	5	2.32	17.76	34.04	5.07	43.13	S.C	37.82	22.2
		60-150	6.09	8.1	2	3.39	11.67	21.26	7.75	59.32	C	49.4	20.2
Alluvial terraces	15	0-40	5.50	7.95	18	2.34	6.24	23.31	22.65	47.80	C	31.58	12.9
		40-100	6.40	8.00	31	2.91	1.53	30.99	17.61	49.87	C	22.05	13.42
	16	0-30	1.11	7.75	7	2.29	22.94	37.92	14.68	24.46	S.C.L	18.72	4.86
		30-75	1.30	7.80	6	4.18	15.83	43.19	12.80	28.18	S.C.L	23.66	5.9
Aluvial plan (locally terraced)	10	0-30	1.70	7.85	11	2.71	20.15	46.52	7.14	26.19	Si.L	16.72	10.9
		30-70	4.30	7.9	11.50	2.67	11.64	63.91	4.89	16.56	S.L	12.7	13.9
		70-150	3.70	8.15	15.90	2.88	1.72	68.91	9.79	19.58	S.L	10.48	14.2
	11	0-50	2.0	7.95	23.90	2.48	9.92	25.18	15.58	49.32	Si.C	23.1	14.33
		50-80	5.10	8.26	71.80	5.29	0.56	3.39	45.50	50.55	C.L	17.44	15.9
Alluvial Fan basinl almot flat)	5	0-40	3.50	7.95	9	2.47	10.93	37.32	14.37	37.38	C.L	22.9	11.9
		40-95	4.10	8.00	6.20	1.84	8.86	34.04	17.13	39.97	C	33.36	12.46
		95-120	3.50	8.20	5.60	3.54	8.86	26.73	13.41	51.00	C	44.4	14.75
	6	0-30	1.50	7.85	6.00	1.68	1.51	33.80	13.48	51.21	C	42.28	9.4
		30-60	1.80	7.90	6.6	2.69	1.92	33.70	8.04	56.34	C	74.02	10.6
		60-90	2.30	7.95	7.7	2.27	1.02	32.79	15.27	50.92	C	46.24	12.5
		90-150	2.30	8.0	6.9	2.06	0.71	36.45	10.05	52.79	C	44.68	13.1
	17	0-25	1.33	7.95	8.50	1.55	4.65	23.85	28.09	43.41	C	36.2	10.2
		25-85	1.80	8.10	5.20	2.51	3.09	19.67	28.32	48.92	C	38.24	12.08
Reworked aelion terraces over wethring lime ston	4	0-60	1.13	7.5	9.1	2.3	5.61	52.56	9.84	31.99	S.C.L	23.64	8.2
		60-100	3.50	7.65	11.50	3.01	6.01	39.62	15.54	38.83	S.C	27.66	4.9
		100-150	3.2	7.7	24.50	3.24	20.72	33.88	11.34	34.06	S.C.L	19.14	5.07

Geomorphyic unite	Prof. No	Depth (cm)	EC dS/m^{-1}	pH 1: 2.5	$CaCO_3$%	Gypsum%	Particle size distribution %				Tex class	CEC m.e./100soil	ESP%
							CS	FS	Silt	Clay			
	26	0-30	2.2	7.86	13.4	1.66	2.12	22.04	25.28	50.56	C	32.06	7.2
Alluvial planin (almost flat)	23	0-30	1.7	7.75	10.40	1.43	8.75	9.78	10.86	70.61	C	57.6	9.2
		30-60	1.75	7.8	6.6	2.15	6.62	6.16	20.52	66.70	C	55.12	10.34
		60-90	2.4	7.9	5.6	1.43	4.22	5.71	18.01	72.06	C	58.31	11.73
		90-150	3.1	7.95	4.00	2.26	51.65	16.92	5.24	26.19	S.C.L	22.08	13.59
	24	0-30	95	7.65	9.1	1.67	61.78	11.10	4.94	22.18	S.C.L	18.22	6.8
		30-60	1.03	7.7	7.1	2.1	60.86	12.89	7.16	19.09	S.L	16.22	6.8
		60-120	0.90	7.75	5.6	1.89	51.53	16.77	9.75	21.95	S.C	17.74	8.4
	25	0-40	2.3	8.00	9.2	1.67	76.28	9.49	4.75	9.48	L.S	8.24	11.9
		40-70	0.55	8.10	8.2	1.68	39.73	40.23	7.52	12.52	S.L	9.44	13.77

Table (2)cont.:

Table (4): land capability classification of the studied soil profiles.

Profile No.	Topography		Wetness		Soil		$CaCo_3$ Content	Gypsum content	Salinity & alkaliaity		Rating index %		Suitability classes	
	C	P	C	P	Texture	Depth			C	P	C	P	C	P
1	100	100	95	100	85	100	95	100	70	100	53.7	50.75	S2	S1
2	100	100	55	100	85	100	95	100	80	100	35.53	80.75	S3	S1
7	100	100	70	100	95	100	95	100	85	100	53.7	91.75	S2	S1
9	100	100	100	100	85	100	95	100	70	100	56.53	30.75	S2	S1
15	100	100	70	100	85	100	90	100	80	100	42.84	76.5	S3	S1
16	100	100	55	100	95	100	95	100	100	100	49.64	90.25	S3	S1
10	100	100	100	100	95	100	100	100	96	100	91.2	95	S1	S1
11	100	100	100	100	85	75	90	100	90	100	51.64	57.38	S2	S2
5	100	100	95	100	95	100	95	100	96	100	82.31	90.25	S1	S1
6	100	100	100	100	85	100	95	100	90	100	72.68	80.75	S2	S1
17	100	100	70	100	85	100	95	100	90	100	50.87	80.75	S2	S1
4	100	100	100	100	95	100	100	100	96	100	91.2	95	S1	S1
26	100	100	100	100	85	100	100	100	90	100	42.08	46.75	S3	S3
23	100	100	100	100	85	100	95	100	90	100	72.68	80.75	S2	S1
24	100	100	95	100	95	100	95	100	90	100	77.16	90.25	S1	S1
25	100	100	55	100	70	100	95	100	96	100	35.11	66.5	S3	S2

C: Curreutly **P: Potinalitty**