

# THE DETERIORATION OF SOME SOIL PHYSICAL PROPERTIES IN NEWLY RECLAIMED SOILS FOLLOWING POOR SOIL MANAGEMENT: A CASE STUDY FROM AL-QASASIN, EGYPT

## ABSTRACT

In newly reclaimed areas, some improper farming practices like using heavy machines in tillage, adding excessive quantity of fertilizers, irrigation by flooding method and intensity cultivation could affect the soil physical properties. The study area is located in Al-Qasasin, Ismailia Governorate, Egypt northern tip of it extended between latitudes  $30^{\circ} 33' 1.147''$  N and  $30^{\circ} 28' 16.096''$  N, and longitudes  $32^{\circ} 4' 12.984''$  E and  $32^{\circ} 4' 15.696''$  E, with total area of 144.25 km<sup>2</sup> (34345.1 Feddan) which falls in the semi-arid zone. Eighty soil samples were collected from the twenty-seven profiles to evaluate the deterioration of soils' physical properties at four locations (A, B, C and D) after different improper soil managements. Profile depth, soil texture, total porosity (TP), bulk density (BD), hydraulic conductivity (HC) and infiltration rate (IR) were determined according to the standard procedures. According to the values of general mean of the studied properties in the four locations, BD takes the order: C>B>A>D. While the TP take the opposite trend of BD (D>A>B>C). on the other hand, both of HC and IR follow the same order: C>A>B>D. These results attributed to that the locations B and D using surface flooding irrigation system, while A and C locations using sprinkler and drip irrigation systems, respectively. In addition to the intensive cultivation and the conventional tillage planting system are used in the B and D locations. Where the tillage tools like heavy plows, disks or chisels are used seasonally. While in A and C sites light tillage and orchards planting only are used commonly. These findings should be considered in future research to improve the soil management programs in these examined areas particularly the fourth location that should stop flooding technique and terns to the drip or springer method.

**Key Words:** Soil physical properties- Improper management – Plowing- irrigation – Intensive cultivation - Al-Qasasin

## INTRODUCTION

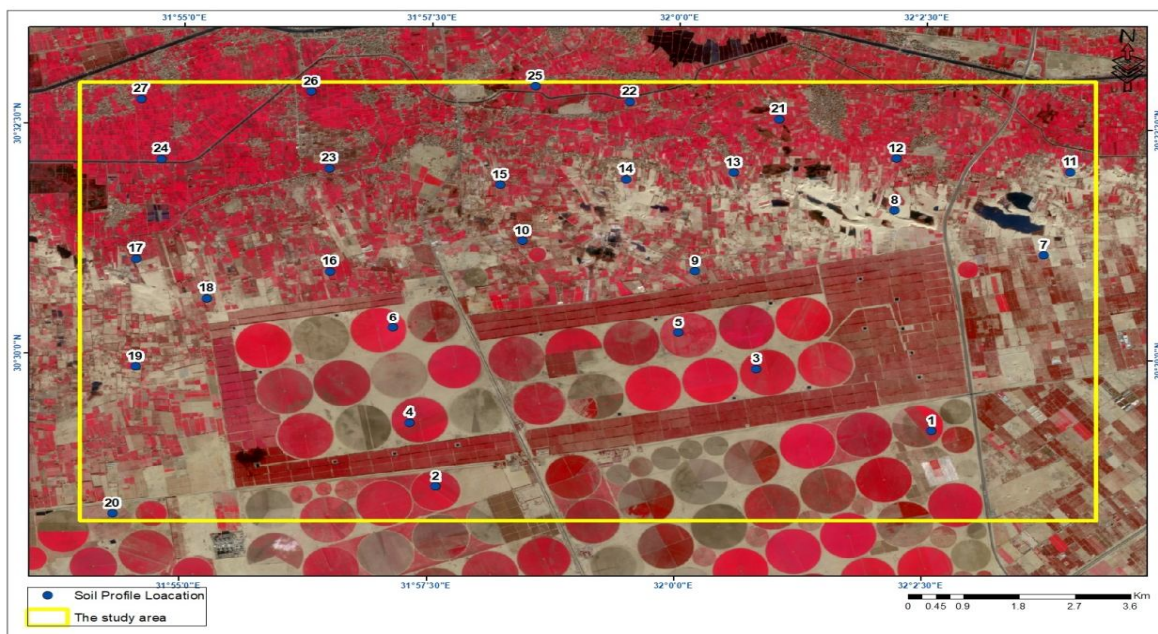
The complex process of soil degradation is the outcome of extensive alterations in soil characteristics produced by anthropogenic and/or natural sources (**Shoba and Ramakrishnan, 2016**). Occasionally, agricultural practices have a negative impact on the environment. The deterioration and instability of soil quality is one of the adverse effects brought on by agricultural practices (**Abdelrahman et al., 2016**). Flood irrigation and other conventional irrigation practices resulted in a significant rise in groundwater levels and salt deposition in soil surface layers (**Li et al., 2008**). Water diversion and irrigation used in agricultural production raise the underground water level and push it past the critical depth in areas with high evaporation, which leads to continuous water evaporation and significant surface salt accumulations. Soil salinization is also common in these regions (**Rietz and Haynes, 2003 and Xu et al., 2013**). Hydraulic conductivity, porosity, and water infiltration rate decrease when salt concentration in soil rises due to structural degradation features such as formation of surface crust, swelling, dispersion, and slaking (**Amini et al., 2016**). Generally, the water flow and retention, crusting,

recycling of nutrients, root penetration, and crop production of a soil are all influenced by its structure (Bronick and Lal, 2005). Soil compaction has a negative impact on nearly all of the soil's physical, chemical, and biological qualities. As a result, using fertilizers in excess of the recommended amounts promotes the development, accumulation, and concentration of fertilizer mineral salts, which leads to soil compaction and degradation in the long term (Massah and Azadegan, 2016). Over the last several decades, agricultural intensification has resulted in catastrophic biodiversity losses (Culman et al., 2010). In agricultural soils, compaction is induced by agricultural machinery and trampling of animals applying stresses larger than soil bearing capacity (Nawaz et al., 2013). The soil becomes more compacted as agricultural equipment passes over the same spots repeatedly (Chehaibi et al., 2005 and Botta et al., 2009). Tillage practices alter the soil's chemical, physical, and biological properties, which can alter the roots' traits, growth, and development (Hajabbasi, 2001; Augustin et al., 2019). Soil compaction is an important component of land degradation syndrome and is a significant challenge facing advanced agriculture that adversely affects nearly all soil properties: physical, chemical and biological (Weisskopf et al., 2010). Compaction induced soil structure disturbance can lead to crusting, fast nutrient recycling, decreased water and air access to roots (Bronick and Lal, 2005) and mostly damages big pores (Abdollahi et al., 2014). Consequently, crop performance is decreased due to stunted aboveground growth and decreased the expansion of roots. (Shah et al., 2017).

Therefore, this study aimed to evaluate some soils' physical characteristics after different improper management of four locations in AL-Qasasin region.

## **MATERIALS AND METHODS**

The study area is located in Al-Qasasin, Ismailia Governorate, Egypt northern tip of it extended between latitudes 30° 33' 1.147" N and 30° 28' 16.096" N, and longitudes 32° 4' 12.984" E and 32° 4' 15.696" E, with total area of 144.25 km<sup>2</sup> (34345.1 Feddan) which falls in the semi-arid zone. Eighty soil samples were collected from the twenty-seven profiles to evaluate the soils' physical properties at four locations (A, B, C and D) after different improper soil managements. The soil profiles were selected by using GPS and their random distribution (Fig, 1). The main water source in the studies area is Ismailia Canal. Both of mineral and organic fertilization are applied in the studied area.



**Fig (1) Locations of the studied soil profiles**

Based on the applied irrigation system, the field observations of soil degradation features, Agricultural services data was collected in each area covered by the studied land sectors and soil productivity, the studied area was classified to four locations as follows:

- 1- The first location (A) represents the soil irrigated by using sprinkler irrigation system. This location was represented by six soil profiles of 1 to 6.
- 2- The second location (B) represents the soil irrigated by using surface flooding irrigation system, where this location represented by nine soil profiles of 7 to 15.
- 3- The third location (C) represents the soil irrigated by using drip irrigation system this third location represented by five soil profiles of 16 to 20.
- 4- The fourth location (D) represents the fourth location represent the soil irrigated by using surface flooding irrigation system, where this location was represented by four soil profiles of 21 to 27.
- 5- The conventional tillage planting system is used in the B and D locations. Where the tillage tools like plows, disks or chisels are used seasonally. While in first and third sites light tillage is used commonly.
- 6- Type of crop and agricultural cycle: the first location A is planted with wheat, onions, garlic and alfalfa. While the second site B is planted with various field crops, vegetables and fruits. The second location is the largest part of the studied area that is planted intensively. As well as the third site C is planted with citrus, mango, peaches and apricots. Finally, the fourth location D is planted with wheat, alfalfa, corn and tomatoes.

Eighty soil samples were collected from the twenty-seven profiles according to the differences between their layers, where the soil profiles vary from one site to another. Disturbed and undisturbed soil samples were taken at different soil depths to determine some physical soil properties according to the standard procedures.

## Laboratory Analyses

Particle size distribution, according to the international method using sodium hexameta-phosphate as a dispersing agent, soil bulk density (BD) and particles density (PD) were determined according to **Klute (1986)**. Total soil porosity was calculated by using the data of particle density PD and bulk density BD from the formula:

$$\text{Total porosity (\%)} = \frac{PD - BD}{PD} \times 100$$

The hydraulic conductivity (HC) was recorded using the constant head method (**Klute and Dirksen, 1986**). Infiltration rate (IR) was determined using a double ring infiltrometer according to method described by **Klute (1986)**.

## GIS assisted spatial modeling and remote sensing analysis

Arc GIS (Geographic Information System) version 10.4.1 ERDAS Imagine (Earth Resources Data Analysis System) version 2015 Microsoft office (Excel and Word). The field work and laboratory data of the surface layer were imported in a GIS database and then correlated with land form map to produce the soil map. The investigated soils were classified according to keys of soil taxonomy (**Soil Survey Staff, 2014**).

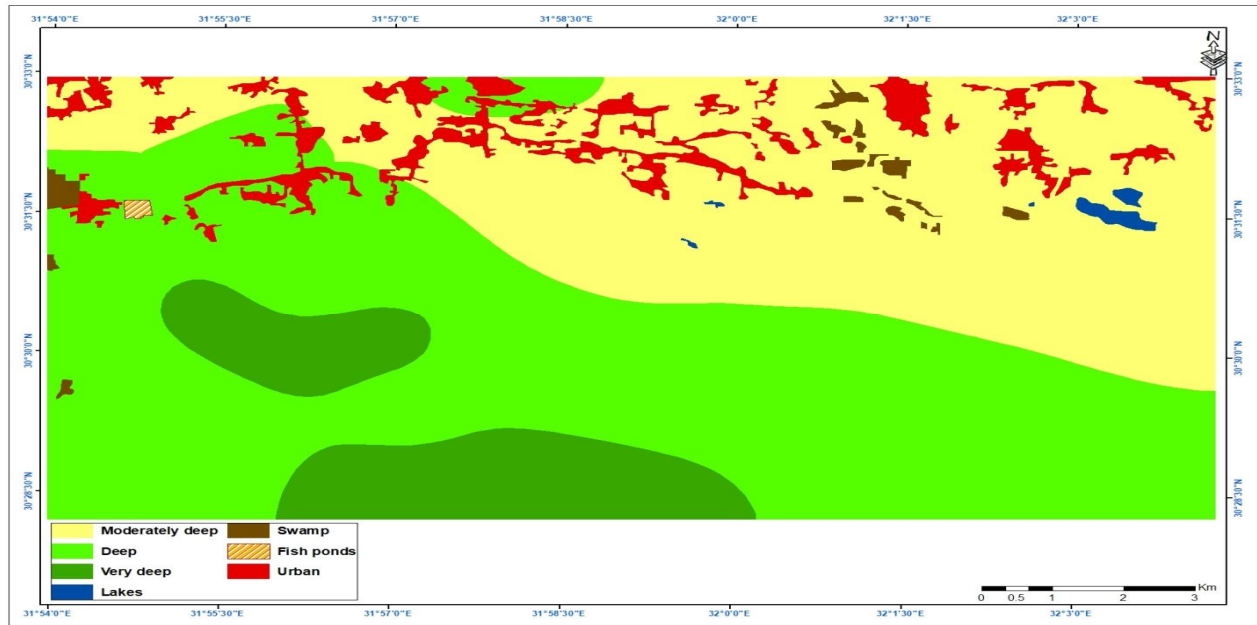
## RESULTS AND DISCUSSION

The land form map illustrated that, lakes, swamp, fish ponds and urban covered about 109.66, 263.98, 30.45, 1860.14 fed., that covered 0.32, 0.77, 0.09 and 5.42% of the total studied area ( 34345.1Feddan), respectively. These uncultivated areas represent 6.6 % of the total studied area.

## Degradation Degree of Soil Physical Properties

### Profile Depth

Data in Fig (2) and Table (1) indicated that, the deep soil class dominated in the study area covered about 16533.33 feddans (Feddan = 4200 m<sup>2</sup>) and forms 48.14 % of the total area. According to **FAO (1990)**, the moderately deep class follows the deep soil depths class and covers an area of about 12024.15 feddans (35.01%). Only 10.26 % of the total study area is considered as very deep soil class with an area of about 3523.42 feddans. The profile depth of the first (A), second (B), third (C), and fourth (D) locations reached 130, 100, 125, and 115 cm, respectively. And thus, the locations A, followed by C, are characterized by deep profiles in contrast to the other locations (B and D). This may be due to the second and fourth locations (B and D) being irrigated by flooding techniques that raise the water table and form shallow profiles.



**Fig (2) Profile depth of the surface layer of the studied area**

**Table (1): Effectiveness deep classes and area of each class as feddan\* and its percent (%) of the studied area**

Effective depth classes	Area-(F) *	Percentage (%)
Moderately deep	12024.15	35.01
Deep	16533.33	48.14
Very deep	3523.42	10.26

\*Feddan = 4200 m<sup>2</sup>

### Soil Texture

One of the most crucial factors influencing soil behavior and management is soil texture, which has an effectiveness on a variety of chemical and physical soil properties. Data in Tables from 2 to 5 showed that in the first location the predominant texture class is loamy sand.

The results in Table (3) showed the particle size distribution and the soil texture of the profiles number 7 to 15 that collected from the second location. Similar texture class was found with all soil samples selected from the second location. The predominant texture class of all soil samples that were taken from different depths was loamy sand.

The texture classes of soil samples of third location representing the profile number 16 to 20 were showed in Table (4). The major texture class of all soil samples was loamy sand, except for the soil samples collected from the deeper layers i.e., 60 -120, 60-110, 75 -125, 60-120 and 75-120cm of soil profiles number 16,17,18,19 and 20, respectively have a sandy texture.

Data in Table (5) also showed that, the texture class of soil samples representing the soil samples of fourth location (profiles 21 to 27) appeared wide variations in their texture class. This texture class was loamy sand in profile number 21, sandy loam in profiles number 22, 23 and 24 and was clay loam in the profiles number 25, 26 and 27. As the data of surface layer, Fig (3) and Table (6) showed that, the loamy sand class is prevalent in the study area. It covered an area of about 28447.0 feddans and forms 82.8 % of the total study area. On the other hand, the sandy

loam class covered an area of about 2276.0 feddans and forms 6.6 % of the total study area. However, clay loam class is the least abundant texture where it covered an area of about 1357.9 feddans and forms 4 % of the total studied area.

**Table (2): Particles size distribution (%) and soil texture in the selected soil profiles from the first location**

Profile No.	Soil depth (cm)	Particles size distribution (%)				Texture class
		Clay	Silt	Fine sand	Coarse sand	
1	0-30	5.9	14.5	41.3	38.3	Loamy sand
	30-60	4.6	13.6	41.1	40.7	Loamy sand
	60-120	3.2	12.2	44.5	40.1	Loamy sand
	Mean	4.6	13.4	42.3	39.7	
2	0-25	5.1	12.8	43.3	38.8	Loamy sand
	25-75	3.7	12.5	42.6	41.2	Loamy sand
	75-130	2.5	11.1	44.0	42.4	Sandy
	Mean	3.8	12.1	43.3	40.8	
3	0-20	6.0	15.6	41.3	37.1	Loamy sand
	20-50	5.7	14.2	39.4	40.7	Loamy sand
	50-120	3.3	13.5	42.8	40.4	Loamy sand
	Mean	5.0	14.4	41.2	39.4	
4	0-25	6.2	14.2	43.8	35.8	Loamy sand
	25-70	5.3	13.3	41.0	40.4	Loamy sand
	70-90	4.0	12.0	44.8	39.2	Loamy sand
	90-120	3.2	11.3	44.0	41.5	Sandy
	Mean	4.7	12.7	43.4	39.2	
5	0-25	6.3	14.8	42.5	36.4	Loamy sand
	25-70	5.8	14.5	40.2	39.5	Loamy sand
	70-90	4.5	13.2	40.5	41.8	Loamy sand
	90-120	4.1	12.3	43.6	40	Loamy sand
	Mean	5.2	13.7	41.7	39.4	
6	0-20	6.6	15.0	42.8	35.6	Loamy sand
	20-50	5.0	13.0	41.1	40.9	Loamy sand
	50-125	5.0	11.3	43.5	40.2	Loamy sand
	Mean	5.5	13.1	42.5	38.9	
<b>General mean</b>		4.8	13.2	42.4	39.6	

**Table (3): Particles size distribution (%) and soil texture in the selected soil profiles from the second location**

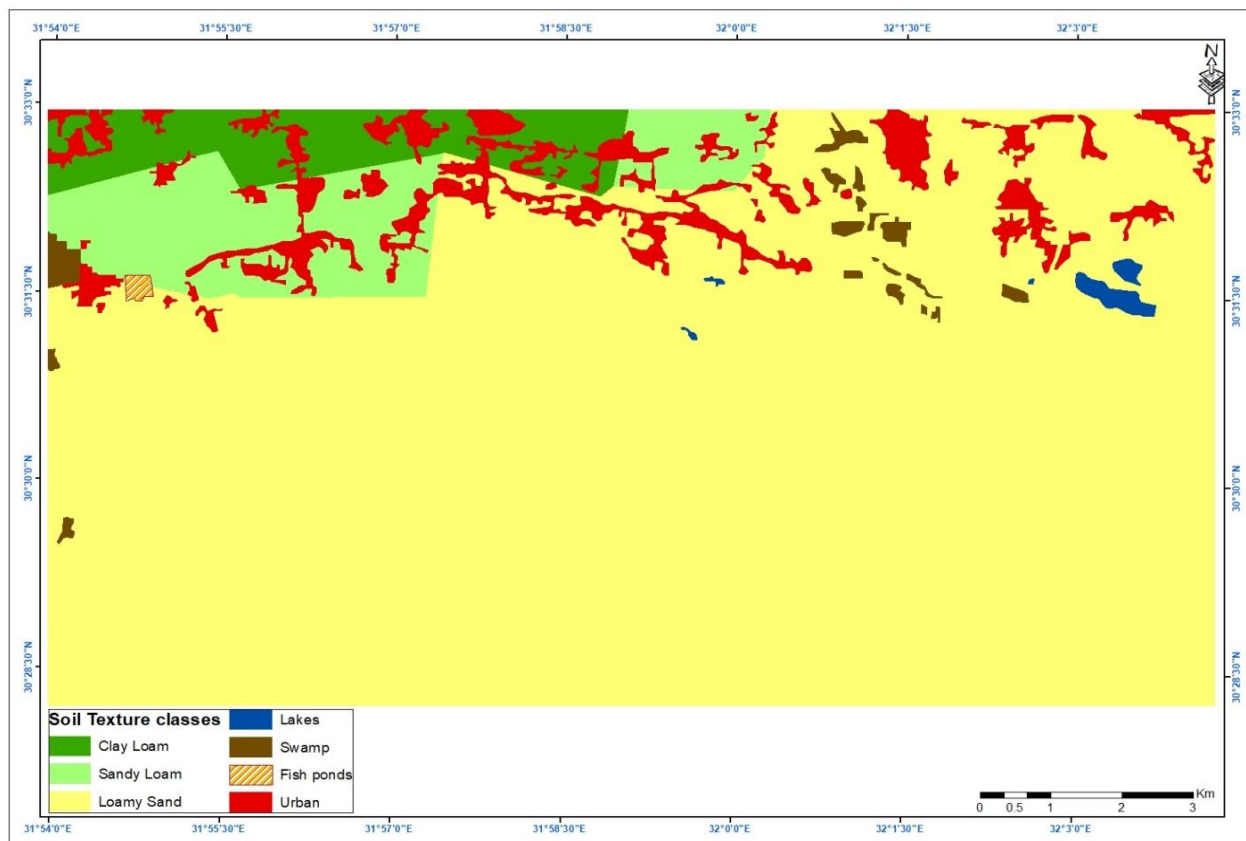
Profile No.	Soil depth (cm)	Particles size distribution (%)				Texture class
		Clay	Silt	Fine sand	Coarse sand	
7	0-15	7.3	15.8	40.3	36.6	Loamy sand
	15-50	6.5	15.0	40.7	37.8	Loamy sand
	Mean	6.9	15.4	40.5	37.2	
8	0-20	8.1	14.6	41.1	36.2	Loamy sand
	20-70	7.3	13.9	41.9	36.9	Loamy sand
	Mean	7.7	14.3	41.5	36.6	
9	0-15	6.7	15.2	40.4	37.7	Loamy sand
	15-50	6.1	14.2	41.0	38.7	Loamy sand
	50-80	5.9	14.1	40.5	39.5	Loamy sand
	Mean	6.2	14.5	40.6	38.6	
10	0-20	6.5	16.5	41.0	36.0	Loamy sand
	20-65	5.2	15.3	40.6	38.9	Loamy sand
	65-90	4.3	12.4	43.6	39.7	Loamy sand
	Mean	5.3	14.7	41.7	38.2	
11	0-25	6.3	16.5	40.0	37.2	Loamy sand
	25-50	5.9	15.9	39.7	38.5	Loamy sand
	50-75	5.6	13.3	42.1	39.0	Loamy sand
	Mean	5.9	15.2	40.6	38.2	
12	0-15	7.0	15.4	40.5	37.1	Loamy sand
	15-40	6.7	14.5	40.3	38.5	Loamy sand
	40-90	5.0	12.3	43.6	39.1	Loamy sand
	Mean	6.2	14.1	41.5	38.2	
13	0-25	7.8	15.1	40.3	36.8	Loamy sand
	25-60	6.5	14.3	40.5	38.7	Loamy sand
	60-100	5.3	12.0	42.4	40.3	Loamy sand
	Mean	6.5	13.8	41.1	38.6	
14	0-20	6.2	14.2	40.4	39.2	Loamy sand
	20-60	5.0	13.6	42.7	38.7	Loamy sand
	Mean	5.6	13.9	41.6	38.95	
15	0-25	8.3	16.9	40.3	34.5	Loamy sand
	25-70	7.0	15.3	39.3	38.4	Loamy sand
	70-90	6.1	14.3	42.1	37.5	Loamy sand
	Mean	7.1	15.5	40.6	36.8	
<b>General mean</b>		6.4	14.6	41.1	37.9	

**Table (4): Particles size distribution (%) and soil texture in the selected soil profiles from the third location**

Profile No.	Soil depth (cm)	Particles size distribution (%)				Texture class
		Clay	Silt	Fine sand	Coarse sand	
16	0-25	4.2	15.1	42.4	38.3	Loamy sand
	25-60	3.2	13.1	41.2	42.5	Loamy sand
	60-120	2.5	12.4	44.0	41.1	Sandy
	Mean	3.3	13.5	42.5	40.6	
17	0-20	4.1	14.1	42.0	39.8	Loamy sand
	20-60	3.2	13.1	42.1	41.6	Loamy sand
	60-110	2.5	12.3	43.2	42.0	Sandy
	Mean	3.3	13.2	42.4	41.1	
18	0-25	3.7	15.1	42.4	38.8	Loamy sand
	25-75	3.3	13.9	41.2	41.6	Loamy sand
	75-125	2.5	12.3	43.2	42.0	Sand
	Mean	3.2	13.8	42.3	40.8	
19	0-15	3.4	13.7	44.0	38.9	Loamy sand
	15-60	4.6	12.6	44.3	38.5	Loamy sand
	60-120	2.2	12.5	42.8	42.5	Sandy
	Mean	3.4	12.9	43.7	39.97	
20	0-25	4.3	12.5	44.1	39.1	Loamy sand
	25-75	3.5	11.2	43.1	42.2	Sandy
	75-120	2.1	11.1	43.5	43.3	Sandy
	Mean	3.3	11.6	43.6	41.5	
<b>General mean</b>		3.3	13	42.9	40.8	

**Table (5): Particles size distribution (%) and soil texture in the selected soil profiles from the fourth location**

Profile No.	Particles size distribution (%)					Texture class
	Soil depth (cm)	Clay	Silt	Fine sand	Coarse sand	
21	0-20	8.5	15.6	40.6	35.3	Loamy sand
	20-70	7.3	14.1	39.4	39.2	Loamy sand
	70-90	6.0	13.2	41.1	39.7	Loamy sand
	Mean	7.3	14.3	40.4	38.1	
22	0-20	9.5	17.0	38.4	35.1	Sandy loam
	20-50	9.4	16.6	37.3	36.7	Sandy loam
	50-80	8.5	15.2	39.3	37.0	Sandy loam
	Mean	9.1	16.3	38.3	36.3	
23	0-30	11.5	23.5	36.4	28.6	Sandy loam
	30-70	10.1	22.6	34.3	33.0	Sandy loam
	70-100	8.3	17.3	38.0	36.4	Sandy loam
	Mean	9.97	21.1	36.2	32.7	
24	0-25	12.4	19.9	36.1	31.6	Sandy loam
	25-70	10.2	19.9	35.1	34.8	Sandy loam
	70-100	9.7	17.8	37.2	35.3	Sandy loam
	Mean	10.8	19.2	36.1	33.9	
25	0-20	35.3	37.3	23.8	3.6	Clay loam
	20-60	33.5	35.1	22.2	9.2	Clay loam
	60-115	25.2	29.3	31.5	14.0	Loamy
	Mean	31.3	33.9	25.8	8.9	
26	0-30	35.7	36.4	22.0	5.9	Clay loam
	30-70	34.9	35.5	19.6	10.0	Clay loam
	70-100	31.2	35.3	18.3	15.2	Clay loam
	Mean	33.93	35.7	19.97	10.4	
27	0-25	38.4	39.8	16.5	5.3	Clay loam
	25-65	37.6	39.5	15.2	7.7	Clay loam
	65-95	35.2	37.5	19.5	7.8	Clay loam
	Mean	37.1	38.9	17.1	6.9	
<b>General mean</b>		19.9	25.6	30.6	23.9	



**Fig (3) Soil texture map of the studied area**

**Table (6): Soil texture classes of the studied area and the area of each class as feddan and percent (%) of all area**

Texture Classes	Area-(F)	Percent (%)
Clay Loam	1357.9	4.0
Loamy Sand	28447.0	82.8
Sandy Loam	2276.0	6.6

### **Bulk density (BD)**

Soil bulk density which considered as an indicator on soil compaction is a form or one indicator of physical degradation resulting in distortion of the soil. This could be reduced the biological activity, total porosity and permeability of agricultural soils. The soil compaction process can be resulting from using heavy agricultural machines and animals as well as from high agriculture intensity and use massive quantity of mineral fertilizers. According to the values of general mean of BD Fig (4), the four locations representing the studied area may be arranged as follows: the third ( $1.65 \text{ g/cm}^3$ ) > the second ( $1.64 \text{ g/cm}^3$ ) > the first ( $1.60 \text{ g/cm}^3$ ) > the fourth ( $1.41 \text{ g/cm}^3$ ). Increasing the sand fraction percentage in the first three places (A, B and C) led to raising the values of BD in their profiles and vice versa in the fourth location (D). The highest value of BD recorded in the C location was attributed to increasing the sand fraction. While increasing BD values in the B site are interpreted not only by increasing sand percentage, but

also by increasing agricultural service intensity using heavy machines in tillage that compact the soil layers.

### Total porosity (TP)

Total porosity of the soil samples under study calculated based on soil BD at each soil depth and real density of 2.6 g/cm<sup>3</sup> and found values were listed in Table (7). This Table shows a wide range of TP in the values of TP within the studied soil samples which ranged between 51.54 % at soil depth of 0-30 cm of profile number 26 in the fourth location and 35.77% in soil profile number 17 at soil depth 20-60 and 60-110cm of the third location. Based on the general mean of TP values in the four locations, these locations take the order: the fourth (45.64%) >the first (38.39%)> the second (36.89%) >the third (36.67%). This order is reversible with that recorded with soil BD. In all soil profiles under study, TP were decrease with increase in soil depth. Therefore, TP values may be used as an indicator for soil compaction and its degradation degree which decreased with the increase in TP.

**Table (7): Total porosity "TP" % in the different soil depths (cm) in the soil profiles representing the four locations in the studied area**

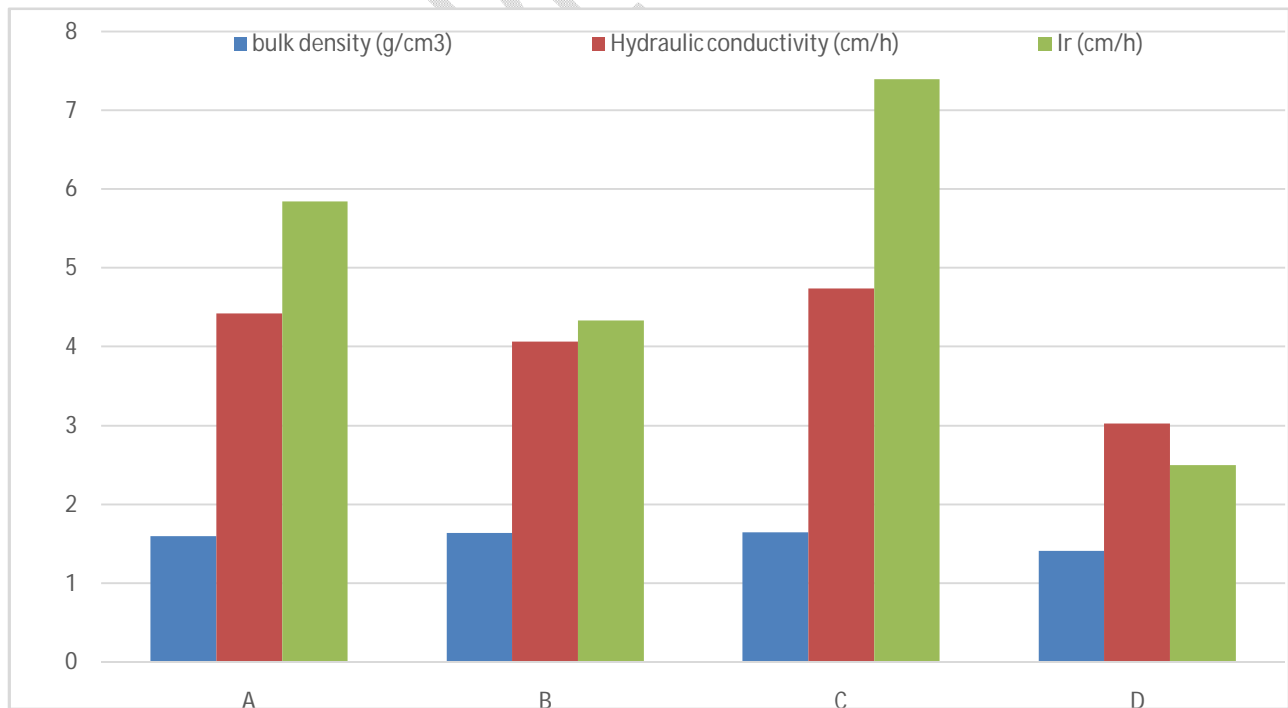
Location number												
First			Second			Third			Fourth			
Profile No.	Soil depth (cm)	TP %	Profile No.	Soil depth (cm)	TP %	Profile No.	Soil depth (cm)	TP %	Profile No.	Soil depth (cm)	TP %	
1	0-30	38.46	7	0-15	38.46	16	0-25	36.92	21	0-20	41.15	
	30-60	38.08		15-50	38.08		25-60	36.54		20-70	40.38	
	60-120	36.92		Mean	38.27		60-120	36.54		70-90	38.08	
	Mean	37.82		0-20	36.92		Mean	36.67		Mean	39.87	
2	0-25	38.08	8	20-70	36.92	17	0-20	36.15	22	0-20	41.54	
	25-75	36.92		Mean	36.92		20-60	35.77		20-50	40.77	
	75-130	36.92		9	0-15		36.92	60-110		35.77	50-80	40.38
	Mean	37.31			15-50		36.54	Mean		35.90	Mean	40.90
3	0-20	39.23	10	50-80	36.54	18	0-25	36.92	23	0-30	45.77	
	20-50	38.85		Mean	36.67		25-75	36.92		30-70	45.00	
	50-120	36.92		11	0-20		38.08	75-125		36.54	70-100	41.92
	Mean	38.33			20-65		36.54	Mean		36.79	Mean	44.23
4	0-25	39.62	11	65-90	36.54	19	0-15	38.08	24	0-25	45.77	
	25-70	39.62		Mean	37.05		15-60	37.31		25-70	45.38	
	70-90	38.85		12	0-25		36.92	60-120		36.92	70-100	42.31
	90-120	36.92			25-50		36.54	Mean		37.44	Mean	44.49
5	Mean	38.75	12	50-75	36.54	20	0-25	36.54	25	0-20	49.62	
	0-15	39.23		Mean	36.67		25-75	36.54		20-60	49.23	
	15-60	38.85		13	0-15		36.54	75-120		36.54	60-115	46.54
	60-90	38.46			15-40		36.15	Mean		36.54	Mean	48.46
6	90-150	38.08	13	40-90	36.15	General mean	36.67	General mean	36.67	0-30	51.54	
	Mean	38.65		Mean	36.28					30-70	50.77	
	0-20	40.38		0-25	36.92					70-100	50.38	
	20-50	40.00		25-60	36.92					Mean	50.90	
General mean	50-125	38.08	14	60-100	36.54	15	General mean	45.64	General mean	0-25	51.15	
	Mean	39.49		Mean	36.79					25-65	50.38	
	15	0-20		36.92	65-95					50.38		
		20-60		36.54	Mean					50.64		
General mean	0-25	36.92	Mean	36.73								
	25-70	36.54	0-25	36.92								
General mean	70-90	36.54	25-70	36.54								
	Mean	36.67	Mean	36.67								
General mean	Mean	36.89	General mean	36.89								

## Hydraulic conductivity (HC)

Soil hydraulic conductivity "HC" of soil considered one important of soil physical properties, where it's related with many chemical and physical properties of the agricultural soils. Fig (4) show that, the arrangement of the four locations under study based on the general mean values of their HC was the third ( $4.747 \text{ cm h}^{-1}$ ) > the first ( $4.425 \text{ cm h}^{-1}$ ) > the second ( $4.078 \text{ cm h}^{-1}$ ) > the fourth ( $3.029 \text{ cm h}^{-1}$ ). Generally, the four locations arranged in the rank  $C > A > B > D$  according to the mean values of H.C. Increasing the values of H.C of the C site may be attributed to 1) increasing of sand percentage 2) using low tillage system by light machines 3) there is no agriculture intensification and no need to use the heavy machines.

## Infiltration rate (IR)

Infiltration rate (IR) consider good indicator for many soil physical and chemical properties. Therefore, it's played a major role in the management of agricultural soil as well as in crops rotation. Fig (4) show that based on the general mean value of IR separately for each location, may be observed that these location takes the order: the third ( $7.4 \text{ cm h}^{-1}$ ) > the first ( $5.9 \text{ cm h}^{-1}$ ) > the second ( $4.3 \text{ cm h}^{-1}$ ) > the fourth ( $2.5 \text{ cm h}^{-1}$ ). These variations may be used as indicator for soil health and soil degradation, where the degree of soil degradation is negatively related with its IR value. The mean values of IR followed the identical order of hydraulic conductivity;  $C > A > B > D$ . This finding is attributed to the same reasons that affect the H.C values as mentioned before. Seasonal tillage with heavy machines coupled with the surface irrigation method (wet conditions) could be responsible for the compaction of soil layers and the slowdown of the infiltration rate.



**Fig (4): Bulk density "BD" (g/cm<sup>3</sup>), hydraulic conductivity "HC" (cm/h) and infiltration rate "IR" (cm h<sup>-1</sup>) in the four locations of the studied area.**

## CONCLUSION

Some improper farming practices like using heavy machines in tillage, adding excessive quantity of fertilizers, irrigation by flooding method and intensity cultivation could affect the soil physical properties. Increasing the sand fraction percentage in the first three places (A, B and C) led to raising the values of BD in their profiles and vice versa in the fourth location (D). The highest value of BD recorded in the C location was attributed to increasing the sand fraction. While increasing BD values in the B site are interpreted not only by increasing sand percentage, but also by increasing agricultural service intensity using heavy machines in tillage that compact the soil layers. Increasing the values of HC and IR of the C site may be attributed to 1) increasing of sand percentage 2) using low tillage system by light machines 3) there is no agriculture intensification and no need to use the heavy machines. Generally, seasonal tillage with heavy machines coupled with the surface irrigation method (wet conditions) could be responsible for the compaction of soil layers and the slowdown of the infiltration rate. These findings should be considered in future research to improve the soil management programs in these examined areas particularly the fourth location that should stop flooding technique and turn to the drip or springer method.

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