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° 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 km2 (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 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 is all influenced by its structure**(Bronick and Lal, 2005).**Addition of mineral fertilizers along with organic manure increased the Mean weight diameter and the available N, P, K and micronutrients **(Patial et al., 2022)**. While, 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 **(Massahand 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)**.The soil resistance to penetration increasedafter only 4 passes of a heavy machine **(Suzuki et al., 2022)**.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).**The soil physical and chemical properties vary between the samples obtained where the tractor's wheels crossed them and those taken elsewhere **(Bianchiniet al., 2022)**. 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

Location of the study area

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^2 (34345.1 Feddan) which falls in the semi-arid zone.**Fig (1)** shows the location of study area.

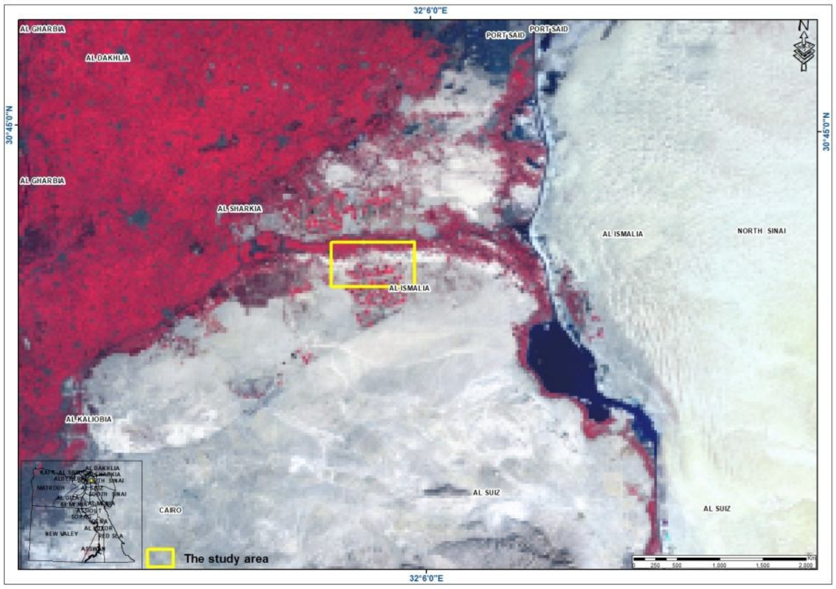

Fig. (1) Location of the study area.

Field Work

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. Disturbed and undisturbed soil samples were taken at different soil depths to determine some physical soil properties according to the standard procedures. The soil profiles were selected by using Global Position System (GPS) and their random distribution. Soil profiles were described and defined according to guideline of Soil Survey Manual (2017). Fig (2) shows the location of the studied soil profiles.

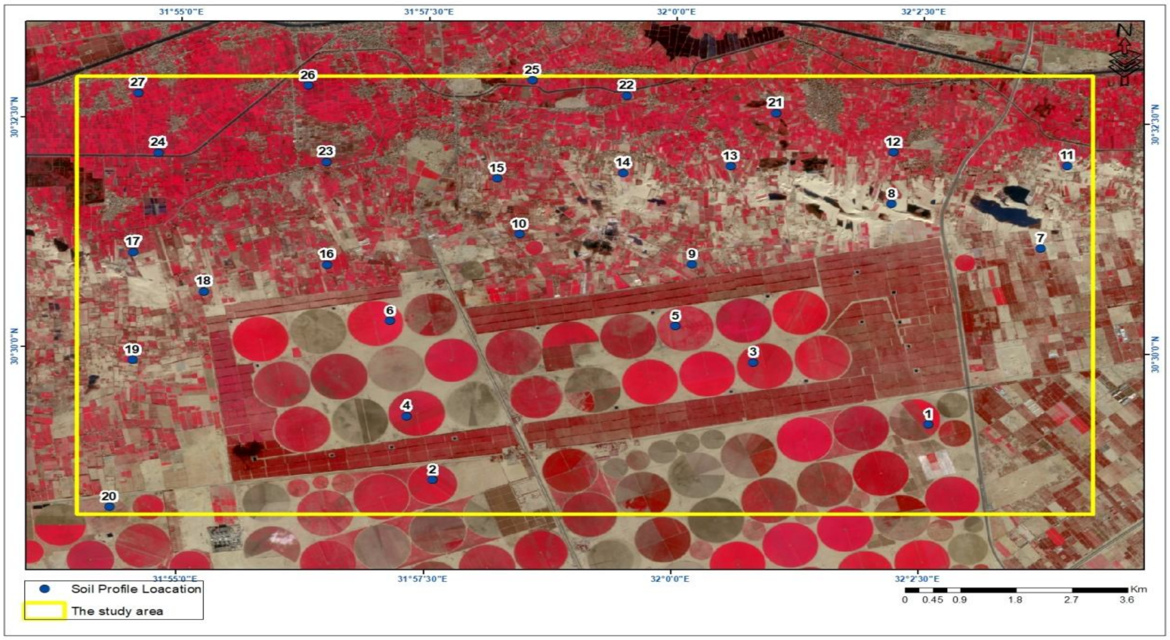

Fig (2) Locations of the studied soil profiles

The main water source in the studies area is Ismailia Canal. Both of mineral and organic fertilization are applied in the studied area.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.

The conventional tillage planting system is used in the B and D locations. Where tillage tools like plows, disks, or chisels are used seasonally.While in first and third sites light tillage is used commonly.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.

Laboratory Analyses

- The soil samples were analyzed for particle size distribution, soil bulk density (BD), and particles density (PD) **Burt (2004).**
- Total soil porosity was calculated as described in **Klute (1986).**
- The saturated hydraulic conductivity (HC) was measured 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)**.

Softwares

ERDAS Imagine version 2015 was used for Layer stacking, Pre- Processing, image enhancement. **Arc GIS** version 10.4.1 software was used for input data in various formats, and produce thematic maps in different formats. Microsoft office (Excel and Word)

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 (3) and Table (1) indicated that, the deep soil class dominated in the study area covered about 16533.33 feddans (Feddan = 4200 m^2) 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.

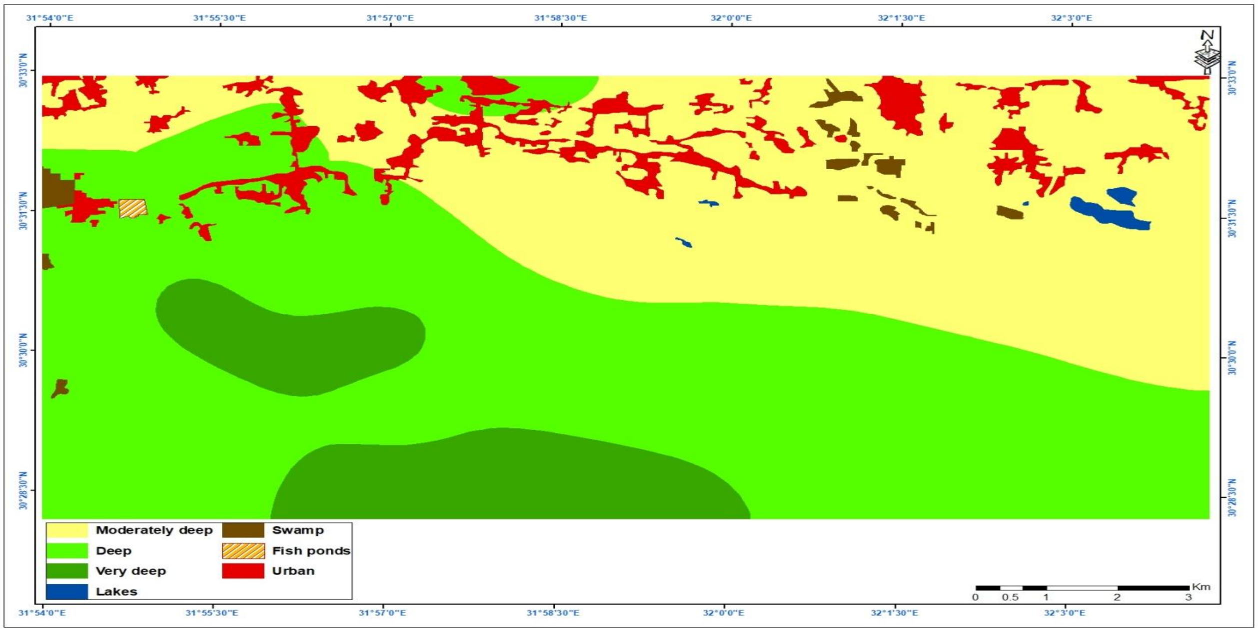

Fig (3)Profile depth of the surface layer of the studied area

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^2

Soil Texture

One of the most crucial factors influencing soil behavior and management is soil texture, which has 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 isloamy 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.

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	
General mean		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	
General mean		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	
General mean		3.3	13	42.9	40.8	

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 (4) and Table (6) showed that, the loamy sand class is prevalent in the study area. It covered an area of about 28447.0feddans and forms 82.8 % of the total study area. On the other hand, the sandy loam class covered an area of about 2276.0feddans 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 1357.9feddans and forms 4 % of the total studied area.

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	
General mean		19.9	25.6	30.6	23.9	

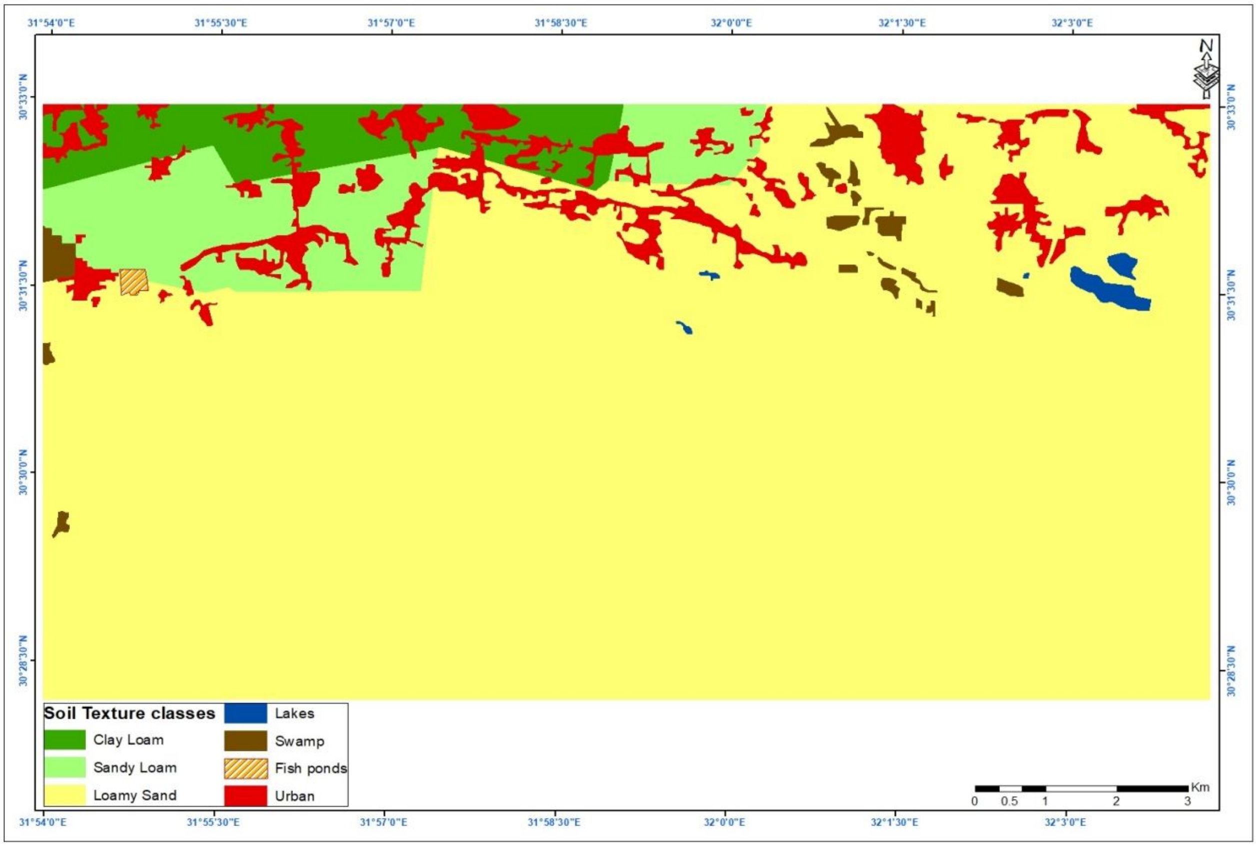

Fig (4) Soil texture map of the studied area

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 BDFig (5), the four locations representing the studied area may be arranged as follows: the third (1.65 g/cm^3) >the second (1.64 g/cm^3) > the first (1.60 g/cm^3) > the fourth (1.41 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 thatcompact 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^3 and found valueswere listed in Table (7). This Table shows a wide range of TP in the values of TP within the studiedsoil 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	8	0-20	36.92		Mean	36.67		Mean	39.87
2	0-25	38.08		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		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	10	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		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	11	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
	Mean	38.75		50-75	36.54	20	0-25	36.54	25	0-20	49.62
5	0-15	39.23		Mean	36.67		25-75	36.54		20-60	49.23
	15-60	38.85	12	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
	90-150	38.08		40-90	36.15	General mean		36.67	26	0-30	51.54
	Mean	38.65		Mean	36.28					30-70	50.77
6	0-20	40.38	13	0-25	36.92					70-100	50.38
	20-50	40.00		25-60	36.92					Mean	50.90
	50-125	38.08		60-100	36.54				27	0-25	51.15
	Mean	39.49		Mean	36.79					25-65	50.38
General mean		38.39	14	0-20	36.92					65-95	50.38
				20-60	36.54					Mean	50.64
				Mean	36.73				General mean		45.64
			15	0-25	36.92						
				25-70	36.54						
				70-90	36.54						
				Mean	36.67						
			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 (5)show that, the arrangement of the four locations under study based on the general mean values of their HC was the third (4.747 cm h^{-1}) >the first (4.425 cm h^{-1}) > the second (4.078 cm h^{-1}) > the fourth (3.029 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 cm h^{-1}) > the first (5.9 cm h^{-1}) > the second (4.3 cm h^{-1}) > the fourth (2.5 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.

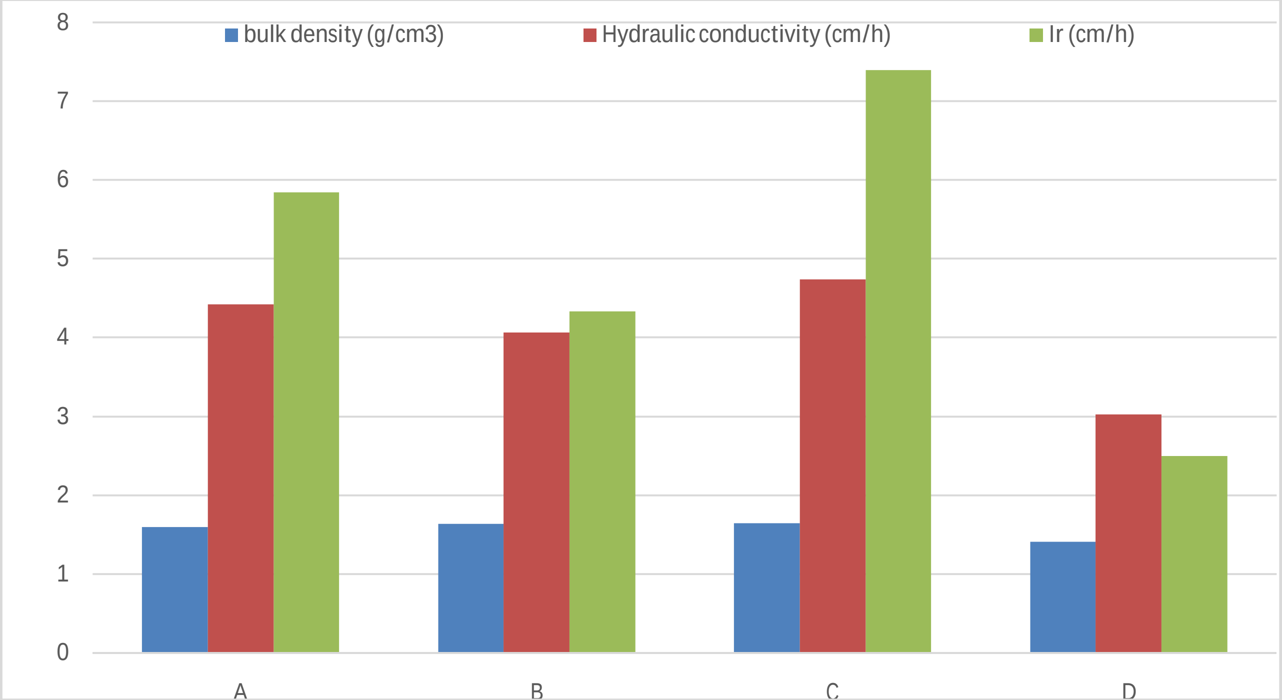

Fig (5): Bulk density "BD" (g/cm^{3}), hydraulic conductivity "HC" (cm/h) andinfiltration rate "IR" (cm h^{-1}) in the four locations of the studied area.

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 terns to the drip or springer method.

REFERENCES

Abdel Rahman, M. A., Natarajan, A. and Hegde, R. (2016). Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India. The Egyptian Journal of Remote Sensing and Space Science, 19(1), 125-141.

Abdollahi, L., Schjønning, P., Elmholt, S. and Munkholm, L. J. (2014). The effects of organic matter application and intensive tillage and traffic on soil structure formation and stability. Soil and Tillage Research, 136: 28-37.

Amini, S., Ghadiri, H., Chen, C. and Marschner, P. (2016). Salt-affected soils, reclamation, carbon dynamics, and biochar: a review. Journal of Soils and Sediments, 16(3), 939-953.

Augustin, K., Kuhwald, M., Brunotte, J. and Duttmann, R. (2019). FiTraM:A model for automated spatial analyses of wheel load, soil stress and wheel pass frequency at field scale. Bio Systems Engineering, 180, pp.108-120.

Bianchini, L., Alemanno, R., Di Stefano, V., Cecchini, M., &Colantoni, A. (2022). Soil Compaction in Harvesting Operations of Phalarisarundinacea L. Land, 11(7), 1031.

Botta, G. F., Becerra, A. T. and Tourn, F. B.(2009).Effect of the number of tractor passes on soil rut depth and compaction in two tillage regimes. Soil and Tillage Research, 103(2), 381-386.

Bronick, C. J. and Lal, R. (2005). Soil structure and management: a review. Geoderma, 124(1-2), 3-22.

Burt, Rebecca, Ed. (2004). Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report No. 42, Version 4.0, USDA-NRCS, Lincoln, Nebraska.

Chehaibi, S., Hamza, E., Pieters, J.G. and Verschoore, R. A. (2005). Tassement du sol par les passages répétés des matériels de traction dans le secteurmaraîcher. Revue de l’INA de Tunisie (20) 1: 7-18.

Culman, S. W., Young-Mathews, A., Hollander, A. D., Ferris, H., Sánchez-Moreno, S., O’Geen, A. T. and Jackson, L. E. (2010). Biodiversity is associated with indicators of soil ecosystem functions over a landscape gradient of agricultural intensification. Landscape Ecology, 25(9), 1333-1348.

Devkota, M., Martius, C., Gupta, R. K., Devkota, K. P., McDonald, A. J. and Lamers, J. P. A. (2015). Managing soil salinity with permanent bed planting in irrigated production systems in Central Asia. Agriculture, Ecosystems and Environment, 202: 90-97.

ERDAS "Earth Resources Data Analysis System", Inc., (2015) ERDAS Imagine version 2015, Field Guide, Fourth Edition ERDAS, Inc., Atlanta, Georgia. USA. ESRI" Environmental Systems Research Institute "(2017) Arc Map version 10.4.1 User Manual.

ESRI" Environmental Systems Research Institute "(2017) Arc Map version 10.4.1 User Manual. ESRI, 380 New York Street, Redlands, California, 92373 - 8100, USA. Copyright © 2017 Esri. Printed in the United States of America.

FAO, (1990). Guidelines for soil description.3rd (Ed).revised, *Soil Resources, Management and Conservation Service, Land and Water Development Division, Rome*, Italy.

Hajabbasi, M. A. (2001). Tillage effects on soil compactness and wheat rootmorphology. Journal of Agricultural Science and Technology, 3(1), 67-77.

Klute, A. (1986). Methods of Soil Analysis: Part I: Physical and mineralogical Methods.(2ndEd), Amer. Soc. Agron. Monograph No. 9, Madison, Wisconsin. U.S.A.

Klute, A. and Dirksen C (1986). Hydraulic conductivity and diffusivity: laboratory methods. In: Klute A (Ed), Methods of Soil Analysis, Part 1, second ed. Am SocAgron Pub1 Madison, WI, p 687–734.

Li, Y., Pang, H., Zhang, H. and Chen, F. (2008). Effect of irrigation management on soil salinization in Manas River Valley, Xinjiang, China. Frontiers of Agriculture in China, 2(2) 216- 223.

Massah, J. and Azadegan, B.(2016). Effect of chemical fertilizers on soil compaction and degradation. Agricultural Mechanization in Asia, Africa, and Latin America, 47(1) 44-50.

Nawaz, M. F., Bourrie, G.andTrolard, F. (2013). Soil compaction impact and modelling.A review. *Agronomy for sustainable development*, *33*(2), 291-309.

Patial, D., Sankhyan, N. K., Sharma, R. P., Dev, P., & Anjali. (2022). Assessing Soil Physical and Chemical Properties Under Long Term Fertilization After Forty-Eight Years in North-Western Himalayas. Communications in Soil Science and Plant Analysis, 1-14.

Rietz, D. N., and Haynes, R. J.(2003). Effects of irrigation-induced salinity and sodicity on soil microbial activity.*Soil Biology and Biochemistry*, *35*(6), 845-854.

Shah, A. N., Tanveer, M., Shahzad, B., Yang, G., Fahad, S., Ali, S. and Souliyanonh, B. (2017). Soil compaction effects on soil health and crop productivity: an overview. Environmental Science and Pollution Research, 24(11), 10056-10067.

Shoba, P. and Ramakrishnan, S. S. (2016). Modeling the contributing factors of desertification and evaluating their relationships to the soil degradation process through geomatic techniques. *Solid Earth*, *7*(2), 341-354.

Soil Survey Manual (2017). Soil Science Division Staff.United States Department of Agriculture Handbook No. 18.

Suzuki, L. E. A. S., Reinert, D. J., Alves, M. C., & Reichert, J. M. (2022). Medium-Term No-Tillage, Additional Compaction, and Chiseling as Affecting Clayey Subtropical Soil Physical Properties and Yield of Corn, Soybean and Wheat Crops. Sustainability, 14(15), 9717.

Weisskopf, P., Reiser, R., Rek, J. and Oberholzer, H. R.(2010). Effect of different compaction impacts and varying subsequent management practices on soil structure, air regime and microbiological parameters. *Soil and Tillage Research*, *111*(1), 65-74.

Xu, X., Huang, G., Sun, C., Pereira, L. S., Ramos, T. B., Huang, Q. and Hao, Y.(2013). Assessing the effects of water table depth on water use, soil salinity and wheat yield: Searching for a target depth for irrigated areas in the upper Yellow River basin *Agricultural water management*, *125*: 46-60.