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Sustainability of some Soils in the South Valley Region

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Abstract: Man/land ratio in Egypt has become one of the highest values in the world. So, the agriculture expansion in the desert should be continuous by one of the main fetal objects of the national plan to meet the food requirement for the tremendous increase in population. Now the desert adjacent to the Nile Valley, South Egypt is planed to be the most prospective area for agricultural expansion by Egypt government. The studied area located in the western part of southern portion of Egypt, from North of Bir Safsaf to south of Beris Oases, between latitudes 23° 30 and 24° 40 N and longitudes 29° 28 to 29° 47 E. It occupies about 7.000 feddan (the total area is, 30 km^2), the distance between each soil profile was 1km. The present study aims at evaluating the land potentiality for agricultural expansion. Thirty soil profiles were selected to represent the main soil physical and chemical properties and subjected to CORINE model and Erodibility Index to determine the qualities of the land and its protection from loss by wind erosion. The studied area is characterized by sandy to sandy clay loam textured, saline, non saline and it's slightly alkali in some soil profiles. The obtained results reveal that 56.66% of the studied area have high soil quality (class1), 33.33% have a moderate soil quality (class 2) and 10.0% have a poor soil quality (class3), while 90.0% of the studied area have high potential land quality (class1) and10.0% have a moderate quality (class 2). The correlation coefficient between (EI) and gravel content was non significant, while the correlation coefficient were negative and highly significant with coarse sand and T.sand %. Also, the correlation coefficient was positive and highly significant with fine sand and clay percent.

Key words: physical and chemical properties, CORINE model, and Erodibility factor.

INTRODUCTION

Soil depletion and degradation are increasingly recognized as important environmental issues in many parts of the world. Over the last decade a number of political and legislative measures were introduced to encourage and enforce sustainable soil management in many parts of the world. Application of the new legislation is highlighted gaps in knowledge of soil quality and a lack of scientific methods to assess and monitor soil quality. The legislative measures and scientific response are fostered a closer relationship between the policy and science communities, leading to more well-focused on knowledge of soil quality, in these respect, Sparling and Schipper. [1], Sanchez-Maranon, et.al [2] and Zobeck, et.al [3].

Andrews's et.al [4-5]] They clarified that, to an understanding of how to recognize, measure, and predict soil quality problems needed to be developed at scales where direct relationships between land use pressures and soil response could be determined. And they added, this understanding should be used as a basis for regional- and national-scale to prediction of soil quality. Soil quality has been defined by Karlen, et.al [6] as "the capacity of the soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal health."

Sparling and Shipper [7] illustrated that the concept of good or bad quality will depend upon the human activity for use i.e., is the soil well matched and suitable for a particular land use." Good" soil quality dose not always mean that a soil needs to be of high fertility, but low nutrient status and good infiltration. Also they added, soil quality has two components, the first one is a scientific understanding of the state of soil resources supporting above and below ground productivity and the second, the decisions made by society on the intended use for the soil. Dogan, et.al [8] clarified that the corine model is a standard method used by the countries of the European Community to determine the erosion risk and qualities of the lands. Using the methodology, countries of the European Community Sharing the coasts of Mediterranean Sea have completed their erosion risk maps, soil quality and classification of their lands.

The model CORINE,[9] involves a four steps, which are combined in the assessment procedure: 1- soil quality (assessed on the basis of soil texture, depth, drainage status and other modifying properties.2- climate quality 3- topography 4- irrigation status and drainage.

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CORINE model defined land quality on a three point scale, ranging from 1 (high quality) to 3 (low quality), with an additional class (0) for areas with no inherent quality (e.g. urban areas) fig. (1).

In respect of Erodibility index, wind and water erosion were discussed and explanted by many authors' by influences on cropland. Hagen, [10] and Hagen and Woodruff, [11] they point out that, about 70 million hectares are eroded by wind and water at rates that exceed twice the tolerance level for sustainable production and can increase markedly in drought years. According to the SCS – USDA, [12] National Resources Inventory (NRI), the estimated annual soil loss from wind erosion on nonfederal rural land in the United States was 2.5 tons per acre per year. Thus wind erosion reduces potential soil productivity and increases economic costs. Therefore, the soil erosion by wind is a serious problem in many parts of the world. On site damage, often reduces the potential to reduce crops by reduced water holding capacity, lost nutrients, degraded soil structure and reduced field soil uniformity, Beasley, et.al. [13] and Knuti, et.al. [14]. they showed that the surface soil is the first part erosive by water erosion and the soil becomes poor in several minerals. Also, they mentioned that clods larger than 0.84 mm in diameter were non erodible. Chepil [15] added that very coarse sand and gravel help reduce soil erodibility and the presence of large amounts of fine sand influences soil erodibility directly because these sizes can be saltate. Also, he found that a clay content of about 27% was best for clod development, while the value less than 15% clay almost precluded a good cloddy condition.

Bisal and Hesish [16] studied the effect of wind velocity on erodibility, of three soils with wind velocities ranges from 540 to 1250 cm/sec at 15 cm height, moisture contents from 0.23 to 1.46 times, and 15atm tension soil drifting, found was prevented the soil drafting. Hagen et.al. [17] Studied the effect of aggregates size on erodibility by wind. They found that the percentages of aggregates greater than 0.84 mm resistance the wind erosion. Arroug [18] in a study on the relation of some soil properties to erodibility found that soil erosion markedly affected particle size distribution, pore size distribution, total soil porosity, soil moisture contents and hydraulic conductivity.

The main target of this paper is using CORINE model as a tool to assessment soil quality in the western part of the desert area in South Egypt. And determine the Erodibility Index to protect the soil surface from wind erosion.

MATERIAL AND METHODS

The current investigation was carried out in the Western part of South Egypt .The studied area located in the western part of southern portion of Egypt, from North of Bir Safsaf to south of Beris Oases, between latitudes 23° 30 and 24° 40 N and longitudes 29° 28 to 29° 47 E. It occupies about 7.000 feddan (the total area is, 30 km^2), the distance between each soil profile was 1km.

Thirty soil profiles were dug deeps down from 10 cm to 150 cm depths. Field studies of the soils reveal that the soil can be divided according to the soil depth of profiles into four groups, as follows:

1- Soils having deep profiles (effective depth from 100-150cm), consisted of 14 soil profiles 11,12,13,16,17,18,20,21,22,26,27,28,29 and30.
2- Soils having moderate deep profiles (effective depth from 50-90cm), 9 soil profiles 3, 4,5,7,9,10,14,15 and 25.
3- Soils having shallow profiles (effective depth from 25-45cm), 4 soil profiles 1, 2, 6 and 19.
4- Soils having very shallow profiles (effective depth from 10-20cm), soil profiles 8, 23 and 24.

76 soil samples were collected. The laboratory analysis (particle size distribution%, bulk density g/cm^3, soil $_{P}$H, $CaCO_3$%, Total soluble salts and soluble cations and anions) were carried out using the soil survey laboratory methods manual, USDA [19].

Undisturbed soil samples were exposed to 0.10 atm (field capacity) and 15.0 atm (wilting point) by the pressure Cocker and pressure membrane apparatus, according to Klute [20].

Soil physical properties and other soil parameter subjected to analyzed by using CORINE model and Erodibility Index to know land quality and agricultural potentiality in the studied area.

CORINE Model: This based on the determinations of soil properties. The CORINE model involves the computation of four separate indices, which are then combined to give an assessment of actual soil quality:

1- Soil quality (defined on the basis of soil texture, depth, stoniness and Other modifying properties);
2- Climate quality (calculated from the Fournier index, Bagnouls-Gaussen Aridity index and vegetation index);
3- Topography; and
4- Land improvements.

Soil Quality: Soil quality as the product of three attributes ie, soil texture, soil depth and soil drainage, as follows in Table (1) and Fig. (1).

The climatic indices (Fournier index, Bagnouls-Gaussen aridity index and vegetation index) are classified and combined to give the climate quality index as follows in Table (2) and Fig. (1).

These two variables were then combined to an overall index of climatic quality as follows:

Climate quality = vegetative period class * aridity class

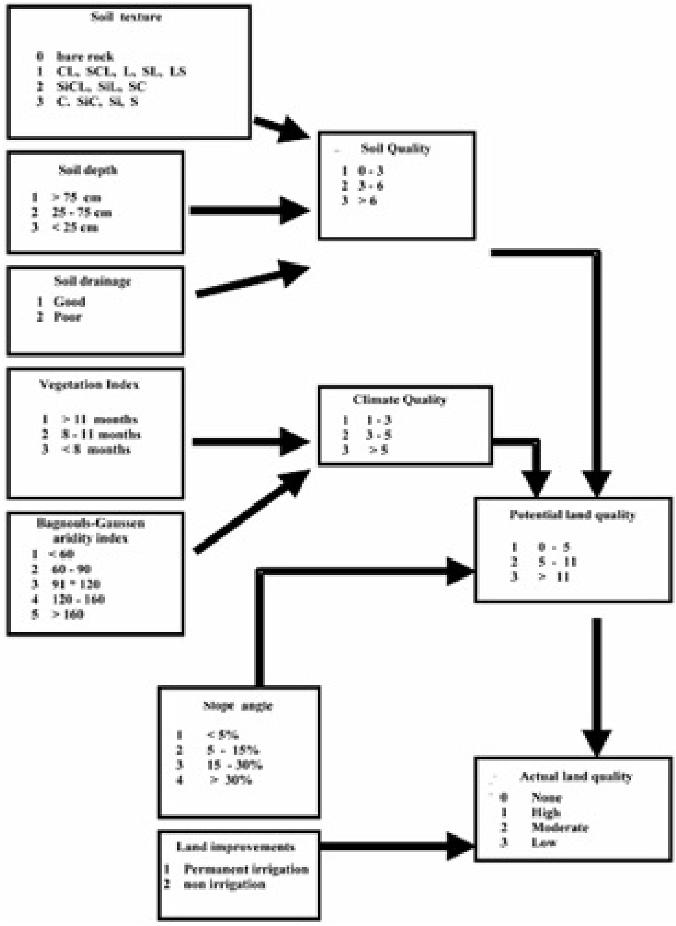

Fig. 1: Methodology for CORINE soil quality assessment (CORINE, 1997).

Table 1: Classes and assigned weighing indices for the various parameters used for assessment of soil quality (CORINE model).

Parameter	Classes	Scores
Soil texture	CL, SCL, L, LS, SL	1
	SiCL, SiL, SC	2
	C, Sic, Si, S	3
Soil depth	> 75 cm	1
	25-75 cm	2
	< 25 cm	3
Soil drainage	Soils with no drainage problems	1
	Soils with drainage problems	2

Soil quality index= texture class * depth class * drainage class

Soil quality classes are:

Classes	Ranges	Quality Index
High quality	< 3	1
Moderate quality	3-6	2
Poor quality	> 6	3

Table 2: Classes and assigned weighing index for the vegetative period and aridity parameters used for assessment of climate quality

Parameter	Classes	Scores
Vegetative period	> 11 Months	1
	8 to 11 Months	2
	< 8 Months	3
Aridity	< 60	1
	60-90	2
	90-120	3
	120-160	4
	> 160	5

Topography: The effects of regional topography are taken into account by the Climatic index. To allow for the direct physiographic influences, however, slope angle was also included. Four classes of slope angle are recognized, as follows in Table (3) and Fig. (1).

Table 3: Classes and assigned weighing index for the slope used for assessment of potential soil quality.

Parameter	Classes	Scores
Slope index	< 5%	1
	5-15%	2
	15-30%	3
	> 30%	4

Potential soil quality: Potential soil quality refers to the inherent physical quality of the land resources for agriculture, biomass production and vegetation growth. As Noted previously, this represents the product of the three basic indices: Soil quality, climatic quality and slope.

Potential soil quality index=Soil quality index*climatic quality index*slope index.

Actual Soil Quality: The actual soil quality relates to the current quality of the soil under Present management conditions. This takes account of the existing soil improvements. It is derived by adjusting the potential soil quality according to the soil improvements index, as follows:

Matrix defining Actual Soil Quality classes

Soil improvements Index	Potential soil quality index		
	High	Moderate	Low
1	1	2	3
2	1	2	3

Soil Erodibility Index (EI):

It was estimated according to Carreker equation [21] as follows:

$$\mathbf{EI = 174 - 4.64\ x + 0.03\ x^2}$$

Where I soil erodibility index (t/ha/year) and **x** the percentage of Coarse and very coarse sand. The obtained results were statistically correlated using the correlation coefficient and regression equations, according to Snedecor and Cochran [22].

RESULTS AND DISCUSSION

Climate: The climate of the area is typically similar to that prevailing in the southern portion of the western Desert. It is characterized by extreme aridity, long hot summer and short warm winter with practically scarcely rainfall. According the average last ten years for meteorological records of Al-Kharga station, the data reveal the following:

1. The mean monthly minimum temperature varies widely from 4.2°C to 21.7 °C, while the mean maximum temperature ranges from 13.1.2 to 39.2 °C. The highest temperature is recorded over the period from May-September, whereas the lowest temperature is recorded during December and January.
2. The relative humidity reaches a minimum of 15.3% in May and June and of maximum 46% in December and January. In general, the summer months are characterized by a relatively low humidity, whereas the winter months have relatively higher humidity.
3. Data of daily evaporation indicate a relatively low evaporation (5.6 – 7.2 mm/day) within winter months and relatively high evaporation (20.6 – 23.8 mm/day) during summer month, durig April to January. Undoubtedly, evaporation data coincide very well with temperature.
4. The mean monthly wind velocity varies from 6.0 to 10.7 knots, with its maximum in autumn and reaches its maximum during October to September, whereas the minimum wind velocity reaches in January. In other words, wind velocity is at its maximum in summer and autumn season and decrease the reach its minimum during winter season.
5. Duration bright sunshine records the highest values (12.05 – 12.45hr) within summer months, meanwhile the lowest value (9.49 – 9.77 hr) record within winter months.
6. The values of solar radiation are absolutely coinciding with duration bright sunshine. In general, their values increase during summer months and reach its maximum in June, while it decreases in winter to reach its minimum in December.
7. Soil air temperature increases in summer months and reach its maximum in June 33-37.1°C while it decreases in winter to reach its minimum in January, 12.7-17.1°C.

Soil physical properties: Field studies of the soils reveal that the soil can be divided according to the soil depth of profiles into four groups, as follows:

1- Soils having deep profiles (effective depth from 100-150cm), consisted of 14 soil profiles 11,12,13,16,17,18,20,21,22,26,27,28,29 and30.
2- Soils having moderate deep profiles (effective depth from 50-90cm), 9 soil profiles 3, 4,5,7,9,10,14,15 and 25.
3- Soils having shallow profiles (effective depth from 25-45cm), 4 soil profiles 1, 2, 6 and 19.

4- Soils having very shallow profiles (effective depth from 10-20cm), soil profiles 8, 23 and 24.

The first group of soils (deep soil profiles) displays numerous textural classes varying from coarse to fine texture. These soil profiles are presented in table (4), contain gravel, sand and fine fraction that vary from one layer to another within the same soil profiles and consequently between soil profiles. Therefore, the mean weighted average for each soil profiles was calculated. The soil textures of soil profiles No, 11, 20, 28 and 30 are loamy sand texture except the upper layer of soil profile No, 28 is sandy loam texture. But are sandy texture for soil profiles No, 12 and13. While the heavy textures are presented at soil profiles No, 16, 17, 21, 22, 26 and 27. And the weighted mean for soil fractions of soil profiles No,11, 20, 28 and 30 were 81.88, 82.24, 76.77 and 81.05% for total sand, 9.05, 8.27, 13.47 and 13.18% for silt and 9.08, 9.49, 9.74 and 5.74% for clay content in the same sequences, respectively. Bulk densities for this area under the first group ranged from 1.43 to 1.61 $g/cm^{3.}$

Soil field capacity ranged from 4.23 to 19.58%, while available water range was 1.89 to 12.6%. The weighted mean for soil fractions, T. sand, silt and clay% of soil profiles No, 12 and 13 were 86.66, 9.27 and 4.07 % for soil profiles No, 12 and 87.49, 8.14 and 4.37% for soil No, 13 in the same sequences, respectively. While the average of weighted mean of soil fractions of soil profiles No, 16, 17,21,22,26 and 27, ranged between 52.41 to 69.28% for T.sand, 8.19 to 19.92% for silt and 13.1 to 28.34% for clay content.

With respect to second group having moderate soil profiles(50-90 cm), data in Table(4) reveal that this area is characterized by loamy sand texture in the majority of all soil layers except the upper soil layer at soil profiles No,3,14 and 25 which have a high sand content and low clay percent. And the mean weighted average of soil fractions for all soil profiles No,3, 4, 5, 7, 9, 10, 14, 15 and 25 were,83.34, 83.62, 84.87, 87.40, 82.10, 76.34, 86.42, 84.08 and 80.54% for T.sand, 5.33, 6.44, 6.29, 6.25, 8.74, 11.92, 7.61, 5.51 and 8.88% for silt and 11.33, 9.94, 8.84, 6.35, 9.16, 11.74, 5.97, 10.41 and 10.59% for clay content, respectively. While, bulk densities were ranged between 1.52 to 1.69 g/cm^3.

For the third group (shallow profiles, 25-45cm), data in Table (4) indicate that the texture are loamy sand in majority of all soil layers except the soil profile No, 1, is sandy texture class and the bottom soil layer at profile No, 19 which have a high clay content and low T.sand percent, the values of field capacity and available water at profile No, 19 are high. These findings clarified that as soil clay content increased water movement decreased due to the relative decrease in soil pores. Also, data illustrated that the mean weighted for T.sand were 85.53, 84.0, 78.76 and 63.23%, for soil profiles No, 1, 2, 6, and 19 in the same sequences, respectively. While the percentage of clay content ranged from 7.05 to 20.34%, in this group. Also field capacity ranged from 3.99 to 16.55%.Remarkably, the gravel percentage is low and clay content is high in the bottom soil layer (15-40cm) at soil profile No, 19 meanwhile, the sand content is high in the upper soil layer (0-15 cm). So, the ability of pores to retained the water is low in the upper soil layer, the opposite is true in the bottom soil layer.

Owing to the very shallow profiles, (10-20cm, soil profiles 8, 23 and 24), data in Table (4) delineated that the area under these group, is characterized by homogenous soil profile (sandy textured).Except the soil profile No, 24 is sandy clay loam textured.

Soil Chemical Composition: Values of the total soluble salts (EC ds/m), Table (5) indicates that most soils are slightly to moderately saline. The exception is soil profiles No, 17 and 27 which shows a relatively high content of saline. With EC ds/m values ranging between 0.39 to 33.06 ds/min the whole studied area. Soil reaction ($_{P}$H) of the studied soil profiles is moderately alkaline, where the values range between 7.6 to 8.2. The cationic composition could be arranged in the descending order, Na^+, Ca^{++}, Mg^{++} and K^+ while the anionic composition is dominated by CL^- followed by $So_4^{--}$and $H2O^-_3$. While the Co_3 is the absent. Total calcium carbonate content % is being in the range of 0.58 to 33.49 %. But quite low in the most of soil layers.

For previous results. It is evident that the important role of coarse, and fine fractions which reflection water movement into soil. Therefore, measures and practices should be applied to desert areas subjected to wind erosion such as protection, mulching, deep plugging and adding organic amendments. Thus, the drip irrigation could be the suitable system for this area to avoid deep percolation and seepage of irrigation water.

Soil Quality: Sanchez-Maranon, et.al. [2] They concluded the definition of soil quality; it is the ability of a soil to perform functions that are essential to people and the environment. And added that quality of a soil is a combination of inherent and dynamic soil properties. With land use or management practices, they may include Soil, depth to bedrock, and type of clay, CEC, and drainage class soils form depends on the five soil-forming:

Table 4: Soil physical properties of the studied soil profiles.

Prof. No	Depth cm	Gravel %	Particle size distribution (%)				T.C	Bulk density g/cm^3	Soil moisture %			E.I t/ha/year
			Cs	Fs	St	Cl			F.C 0.1 atm	W.P 15 atm	A.W	
1	0-10	5.50	42.60	44.00	5.10	8.30	s	1.56	4.66	2.33	2.33	30.78
	0-30	6.30	24.78	60.22	10.00	5.00	S	1.57	3.99	2.05	1.94	77.44
2	0--25	9.90	23.00	61.00	8.95	7.05	ls	1.61	6.05	4.17	1.88	83.15
3	0-5	3.56	49.50	37.20	7.30	6.00	s	1.62	4.66	2.34	2.32	17.83
	5--30	3.25	34.30	51.50	5.21	8.99	ls	1.59	6.25	2.36	3.89	50.14
	30-65	2.66	35.90	45.20	5.14	13.76	ls	1.55	10.36	4.00	6.36	46.09
4	0-15	2.20	41.70	40.30	7.00	11.00	ls	1.54	10.36	4.00	6.36	32.68
	15-50	4.66	42.30	42.02	6.20	9.48	ls	1.59	8.91	3.98	4.93	31.41
5	0-15	5.00	33.00	56.89	3.40	6.71	s	1.62	4.69	2.67	2.02	53.55
	15-60	15.66	38.20	45.00	7.25	9.55	ls	1.57	6.99	3.55	3.44	40.53
6	0-18	11.32	29.30	51.33	5.69	13.68	ls	1.55	11.36	4.22	7.14	63.80
	18-45	10.30	37.22	40.30	11.50	10.98	ls	1.53	8.24	4.00	4.24	42.86
7	0-25	4.50	50.50	33.60	7.00	8.90	ls	1.59	8.88	4.19	4.69	16.19
	25-50	4.80	29.50	61.20	5.50	3.80	s	1.65	5.79	2.56	3.23	63.23
8	0-20	2.97	19.40	70.20	4.50	5.90	s	1.65	6.21	2.78	3.43	95.27
9	0-50	4.80	35.20	47.80	9.00	8.00	ls	1.60	9.65	4.96	4.69	47.84
	50-80	9.58	32.70	47.90	8.30	11.10	ls	1.58	10.65	5.32	5.33	54.35
10	0-35	9.59	36.50	44.00	7.70	11.80	ls	1.56	8.87	4.31	4.56	44.61
	35-90	13.59	36.80	36.90	14.60	11.70	ls	1.55	11.24	5.97	5.27	43.88
11	0-50	1.25	31.00	50.20	13.00	5.80	ls	1.61	4.23	2.34	1.89	58.99
	50-80	3.10	43.50	38.68	7.70	10.12	ls	1.54	7.69	4.55	3.14	28.93
	80-100	11.29	32.70	50.10	6.80	10.40	ls	1.53	8.06	5.09	2.97	54.35
	100-150	8.99	48.10	33.90	6.80	11.20	ls	1.53	10.90	5.12	5.78	20.22
12	0-40	7.70	20.00	60.22	13.70	6.08	ls	1.66	6.12	2.66	3.46	93.20
	40-90	11.23	30.50	56.98	10.00	2.52	s	1.67	3.69	1.58	2.11	60.39
	90-140	9.78	41.00	50.00	5.00	4.00	s	1.67	4.01	3.00	1.01	34.19
13	0-15	1.60	39.00	46.66	10.00	4.34	s	1.66	4.19	2.31	1.88	38.67
	15-70	11.26	29.40	59.80	8.10	2.70	s	1.68	3.69	2.30	1.39	63.51
	70-110	13.26	35.60	50.22	7.50	6.68	s	1.60	4.69	2.68	2.01	46.84
14	0-20	11.60	25.00	65.00	7.00	3.00	s	1.63	3.60	2.11	1.49	76.75
	20-45	8.07	27.10	57.22	6.50	9.18	ls	1.52	6.99	3.12	3.87	70.29
	45-70	6.01	40.00	45.66	9.20	5.14	s	1.61	4.98	2.41	2.57	36.40

Table 4: Continued

Prof. No	Depth cm	Gravel %	Particle size distribution (%)				T.C	Bulk density g/cm³	Soil moisture %			E.I t/ha/year
			Cs	Fs	St	Cl			F.C 0.1 atm	W.P 15 atm	A.W	
15	0-25	1.10	41.00	41.00	11.00	7.00	ls	1.56	8.36	5.00	3.36	34.19
	25-50	5.20	39.00	40.10	6.90	14.00	sl	1.52	12.68	5.51	7.17	38.67
	50-90	4.80	42.30	46.20	1.20	10.30	s	1.53	11.72	5.64	6.08	31.41
16	0-25	1.01	25.33	46.58	7.20	20.89	scl	1.45	14.55	6.88	7.67	75.72
	25-60	0.98	14.69	40.20	21.70	23.41	scl	1.46	16.87	7.66	9.21	112.31
	60-120	0.77	41.02	10.55	23.00	25.43	scl	1.41	18.69	9.01	9.68	34.15
17	0-30	11.30	34.00	50.10	8.33	7.57	ls	1.59	4.25	2.95	1.30	50.92
	30-85	1.09	31.33	24.99	24.60	19.08	sl	1.46	16.59	7.69	8.90	58.08
	85-150	1.05	26.98	33.15	15.00	24.87	scl	1.43	20.36	8.25	12.11	70.65
18	0-40	2.10	33.69	36.95	13.80	15.56	sl	1.49	12.36	6.58	5.78	51.73
	40-90	11.25	24.30	35.66	17.50	22.54	scl	1.43	19.58	6.98	12.60	78.96
	90-150	1.70	29.66	33.69	19.10	17.55	sl	1.46	12.39	5.67	6.72	62.77
19	0-15	8.60	44.00	42.00	8.00	6.00	ls	1.61	4.56	2.31	2.25	27.92
	15-40	3.70	8.20	41.36	21.50	28.94	scl	1.41	16.55	9.55	7.00	137.97
20	0-25	8.30	39.00	44.50	6.50	10.00	ls	1.57	9.68	4.69	4.99	38.67
	25-65	8.30	37.50	45.50	7.00	10.00	ls	1.56	8.99	4.52	4.47	42.19
	65-120	7.70	24.70	56.00	10.70	8.60	ls	1.58	7.59	4.68	2.91	77.69
	120-150	5.50	35.40	47.60	7.00	10.00	ls	1.59	7.23	4.70	2.53	47.34
21	0-15	5.10	13.10	41.90	19.60	25.40	scl	1.40	18.25	9.36	8.89	118.36
	15-45	0.55	23.10	44.90	13.40	18.60	sl	1.41	14.56	8.77	5.79	82.82
	45-150	8.10	26.60	57.00	5.60	10.80	ls	1.59	8.39	5.61	2.78	71.80
22	0-15	6.00	49.00	30.50	10.50	10.00	ls	1.62	8.65	4.73	3.92	18.67
	15-45	0.48	28.10	45.00	14.20	12.70	sl	1.59	7.36	4.23	3.13	67.30
	45-90	0.39	10.60	38.20	25.20	26.00	scl	1.41	16.58	8.36	8.22	128.19
	90-150	0.29	2.30	35.70	19.50	42.50	c	1.31	29.05	19.25	9.80	163.49
23	0-10	10.30	19.00	66.88	8.00	6.12	s	1.63	4.66	2.17	2.49	96.67
24	0-20	1.37	23.22	41.00	13.10	22.68	scl	1.46	19.26	9.68	9.58	82.43
25	0-15	2.30	32.00	55.20	10.00	2.80	s	1.69	3.21	0.89	2.32	56.24
	15-60	7.10	34.00	44.32	8.50	13.18	ls	1.58	7.69	3.25	4.44	50.92
26	0-10	13.06	33.22	40.32	13.25	13.21	sl	1.56	8.69	3.68	5.01	52.97
	10--50	1.35	13.55	35.36	19.25	31.84	scl	1.40	25.10	11.69	13.41	116.64
	50-120	0.59	23.50	36.50	21.26	18.74	sl	1.49	13.25	7.98	5.27	81.53

Table 4: Continued

Prof. No	Depth cm	Gravel %	Particle size distribution (%)				T.C	Bulk density g/cm^3	Soil moisture %			E.I t/ha/year
			Cs	Fs	St	Cl			F.C 0.1 atm	W.P 15 atm	A.W	
27	0.15	2.33	33.25	52.11	8.44	6.20	s	1.62	4.39	2.36	2.03	52.89
	15-70	1.54	25.15	42.20	13.66	18.99	sl	1.49	9.69	4.38	5.31	76.28
	70-110	3.40	21.30	44.60	18.91	15.19	sl	1.48	11.36	6.98	4.38	88.78
28	0-20	1.11	25.63	41.55	15.60	17.22	sl	1.46	12.69	6.89	5.80	74.78
	20-60	1.20	34.99	44.99	12.21	7.81	ls	1.59	4.69	2.09	2.60	48.38
	60-150	3.22	36.20	41.28	13.59	8.93	ls	1.58	6.59	4.03	2.56	45.35
29	0-25	0.28	25.36	33.25	26.59	14.80	sl	1.48	9.59	4.23	5.36	75.62
	25-60	6.08	33.12	43.55	17.60	5.73	ls	1.63	4.68	2.03	2.65	53.23
	60-100	1.90	51.01	20.36	22.16	6.47	sl	1.66	4.76	2.11	2.65	15.37
30	0-30	2.11	34.68	46.59	14.35	4.38	ls	1.59	3.56	1.19	2.37	49.17
	30-60	3.55	26.25	50.23	14.99	8.53	ls	1.57	5.89	2.18	3.71	72.87
	60-120	4.01	33.65	49.58	11.69	5.08	ls	1.56	4.09	1.59	2.50	51.83

Cs: Coars sand Fs: Fine sand St: Silt Cl: Clay T.C: Texture Class E.I: Erodibility Index

Table 5: Soil chemical properties of the studied soil profiles.

Prof. No.	Depth cm	EC dS/m	pH	Cations meq / L				Anions meq / L				CaCo3
				Ca++	Mg++	Na+	K+	CO3--	HCO3-	Cl-	SO4--	%
1	0-10	1.51	7.8	4	2.9	7.7	41	0	1.5	11.3	2.3	3.91
	0-30	7.2	7.6	19	9.7	40.7	0.69	0	1.55	49.66	19.69	7.99
2	0--25	0.51	7.9	0.9	0.91	2.9	0.39	0	1.11	2.55	1.44	5.78
3	0-5	0.72	7.9	1.99	0.99	3.69	0.53	0	1.31	4.3	1.59	4.55
	5--30	2.99	7.7	9.47	3.91	15.01	0.79	0	1.4	22.09	6.67	6.12
	30-65	3.7	7.5	7.01	5.6	23.5	0.9	0	1.2	26.7	9.11	7.21
4	0-15	0.4	8	0.99	0.69	2.02	0.3	0	1.1	1.7	1.2	2.68
	15-50	0.42	8	1.3	0.7	1.9	0.3	0	1.22	1.59	1.39	4.68
5	0-15	0.71	8	1.29	0.69	4.83	0.29	0	1.31	4.09	1.7	3.16
	15-60	0.6	7.9	1.3	0.72	3.49	0.49	0	1.21	3.4	1.39	6.89
6	0-18	0.45	7.8	1.29	1.06	1.76	0.39	0	1.12	2.41	0.97	10.1
	18-45	1.35	7.6	3.99	2.31	6.98	0.22	0	1.32	7.55	4.63	21.99
7	0-25	1.01	8	2.69	1.39	5.68	0.34	0	1.5	5.99	2.61	3.49
	25-50	0.64	7.9	1.69	0.98	3.44	0.29	0	1.4	2.91	2.09	7.91
8	0-20	0.38	8	1.29	1.01	1.29	0.21	0	1.12	1.81	0.87	3.97
9	0-50	1.22	7.8	3.85	1.79	6.2	0.36	0	2.1	5.56	4.54	11.56
	50-80	5.4	7.61	19.99	3.03	29.78	1.2	0	1.5	41.26	11.24	19.46

Table 5: Continued

Prof. No.	Depth cm	EC dS/m	pH	Cations meq / L				Anions meq / L				CaCo3
				Ca++	Mg++	Na+	K+	CO3--	HCO3-	Cl-	SO4--	%
10	0-35	0.39	8	0.99	0.8	1.71	0.4	0	1	1.52	1.38	13.56
	35-90	1.03	7.5	2.98	1.19	5.53	0.6	0	1.2	4.99	4.11	33.49
11	0-50	0.71	7.8	1.89	0.81	4.2	0.2	0	1.51	3.69	1.9	3.58
	50-80	0.72	7.8	2.02	1.01	3.57	0.6	0	1.51	3.56	2.13	13.64
	80-100	1.02	7.65	3.61	1.45	4.44	0.7	0	1.6	4.06	4.54	12.5
	100-150	1.31	7.6	3.56	1.24	7.4	0.9	0	1.56	8.09	3.45	10.26
12	0-40	0.91	7.6	2.35	1.21	5.14	0.4	0	1.2	4.69	3.21	4.26
	40-90	1.34	7.5	3.68	2.02	7.09	0.61	0	1.21	9.26	2.93	15.86
	90-140	1.91	7.6	7.65	3.56	7.27	0.62		1.32	14.06	3.72	22.68
13	0-15	0.51	7.9	1.5	0.69	2.71	0.2	0	1.51	1.79	1.8	3.11
	15-70	3.91	7.6	9.99	4.56	23.15	1.4	0	1.51	29.06	8.53	2.01
	70-110	7.56	7.5	26.55	11.2	36.05	1.8	0	1.6	55.26	18.74	3.09
14	0-20	5.31	7.5	4.99	19.05	25.96	3.1	0	1.41	37.66	14.03	3.23
	20-45	8.01	7.6	16.89	25.06	37.71	0.44	0	1.81	60.66	17.63	3.63
	45-70	9.06	7.4	10.66	30.66	48.62	0.66	0	1.92	71.66	17.02	2.09
15	0-25	0.71	7.7	1.8	0.91	4.08	0.31	0	1.11	6.03	1.56	3.68
	25-50	0.82	7.4	2.33	1.31	4.16	0.4	0	1	5.66	1.54	4.92
	50-90	0.93	7.7	2.56	1.66	4.58	0.5	0	1.3	5.09	2.91	5.09
16	0-25	1.39	7.7	5.66	1.21	6.53	0.5	0	2.1	9.5	2.3	9.02
	25-60	16.09	8.1	67.66	6.99	85.05	1.2	0	2.4	100	58.47	11.06
	60-120	13.05	8	51.88	5.99	71.33	1.3	0	2.3	76.26	51.94	15.08
17	0-30	5.69	7.6	19.01	1.25	36.14	0.5	0	1.2	47.1	8.6	3.04
	30-85	33.06	8	134.7	23.59	171.41	0.9	0	2.2	189.4	139.04	3.55
	85-150	29.02	8	135.87	13.69	139.54	1.1	0	3.4	161.2	125.58	3.06
18	0-40	2.02	7.9	3.22	1.3	15.08	0.6	0	1.1	9.36	9.74	4.09
	40-90	1.99	7.9	3.06	1.71	14.63	0.5	0	1.7	13.26	4.94	4.88
	90-150	3.89	8.1	9.01	2.36	26.93	0.6	0	1.3	26.99	10.61	5.05
19	0-15	5.69	8.2	12.03	3.69	39.97	1.21	0	4	52.36	0.54	2.57
	15-40	9.06	8	26.99	8.99	54.12	0.5	0	3.1	73.92	13.58	3.66
20	0-25	5.51	7.9	13.06	3.16	37.98	0.9	0	3.5	44.39	7.21	2.06
	25-65	9.8	7.7	19.68	5.33	72.15	0.82	0	2.4	81.36	14.22	3.63
	65-120	0.66	7.7	1.32	1.03	3.36	0.89	0	1.2	4.33	1.07	1.99

Table 5: Continued

Prof. No.	Depth cm	EC dS/m	pH	Cations meq / L				Anions meq / L				CaCo3
				Ca++	Mg++	Na+	K+	CO3--	HCO3-	Cl-	SO4--	%
	120-150	3.5	7.9	10.01	3.33	20.75	0.91	0	1.2	19.06	14.74	2.99
21	0-15	3.52	7.6	7.77	5.61	20.92	0.9	0	2.9	23.06	9.24	2.59
	15-45	6.78	7.6	14.66	10.03	42.2	0.91	0	3.3	41.33	23.17	2.68
	45-150	5.99	7.7	11.32	11.03	36.95	0.6	0	1.5	36.22	22.18	3.09
22	0-15	3.7	7.7	6.39	1.39	27.72	1.5	0	6.2	29.34	1.46	3.33
	15-45	7.6	8.1	14.22	3.03	54.85	3.9	0	4	59.06	12.94	4.69
	45-90	10	8.1	31.26	15.026	52.01	1.7	0	5.5	59.02	35.48	1.09
	90-150	13.58	7.7	37	36	60.5	2.3	0	4.5	78.02	53.28	1.03
23	0-10	3.61	7.2	6.23	4.01	25.06	0.8	0	1.8	27.66	6.64	3.99
24	0-20	1.21	7.8	2.91	0.88	7.71	0.6	0	2.1	6.66	3.34	4.69
25	0-15	1.4	7.3	4.01	1.06	8.53	0.4	0	1.4	8.07	4.53	3.56
	15-60	1.65	7.4	4.56	3.68	7.86	0.4	0	1.9	8.9	5.7	3.66
26	0-10	17.09	7.8	24.69	8.91	136	1.3	0	2.2	158.3	10.38	2.95
	10--50	19.19	7.9	33.69	13.69	160	0.7	0	2.1	169.3	20.47	3.58
	50-120	25.59	7.8	71.66	19.99	163.55	0.7	0	3	190.4	62.54	3.69
27	0.15	15.66	7.8	30.01	16.32	110.23	2.6	0	4.5	140.3	11.77	2.05
	15-70	29.05	7.7	59.33	26.06	205.66	1.3	0	3.1	211.1	76.29	0.58
	70-110	14.66	7.7	37.59	20.36	91.66	1.5	0	5	120.3	21.27	1.01
28	0-20	4.67	8	5.01	10.3	30.29	1.1	0	2.2	33.64	10.86	5.69
	20-60	7.99	8.1	5.63	11.2	62.07	1	0	2.5	59.99	17.41	10.36
	60-150	8.68	7.4	8.55	27.99	49.75	0.51	0	1.89	69.55	15.36	2.09
29	0-25	1.69	7.9	4.01	2.16	9.93	0.8	0	3.2	10.02	3.68	7.59
	25-60	10.99	8.1	10.33	2.99	95.38	1.2	0	5.4	98.67	5.83	3.06
	60-100	0.45	8	1.07	0.87	2.15	0.41	0	1.12	2.45	0.93	13.68
30	0-30	3.78	7.4	7.51	5.2	24.39	0.7	0	1.6	20.3	15.9	12.09
	30-60	6.81	7.6	15.72	10.8	39.68	1.9	0	3.6	36.8	27.7	19.09
	60-120	5.69	7.6	11.12	11.4	31.88	2.5	0	4	35.2	17.7	22.09

1-Claimat (precipitation and temperature).
2-Topography (shape of the land).
3- Biota (native vegetation, animals, and microbes).
4- Parent material (geologic and organic precursors to the soil).
5-Time (time that the parent material is subjected to soil formation processes).

Soil quality is not limited to agriculture soils, although most soil quality work has been done in agricultural systems. Also soil quality assessments focus on the management- affected, properties of soil such as nutrient status, salinity, and Water-holding capacity. So, soil quality assessments go beyond measuring degradation (erosion, compaction, or contamination).But also water quality protection, or preservation of soil productivity for future generations, Zobeck, et al. [3].

Thus, at the level of analysis employed here, it was felt legitimate to consider only three properties: soil texture, soil depth and soil drainage.

It is known that CORINE model using the surface soil layer only for each soil profile. From the above mentioned results, Table (4) showed that, nine soil samples are sandy textured (30 %), fourteen soil samples are loamy sand (46.67 %), four soil samples are sandy loam (13.33 %) and three soil samples are sandy clay loam (10.0 %). Therefore, according to CORINE model, table (1) and Fig. (1) The results pointed out that 70 % of the studied soils having highly quality texture (class 1). But 30 % having poor quality texture (class 3). Also, the data clarified that 56.67 % of the studied 17 soil profiles having depth > 75 cm (class 1), 33.33 %(10 soil profiles) having depth 25-75 cm (class 2), and 10.0 %, (3 soil profiles) having depth < 25 cm (class 3).

Regarding soil drainage, the area under study performed two statuses, one soils with drainage problems (shallow and very shallow soil profiles). Second, soils have no drainage problems (deep and moderately deep soil profiles). CORINE model, table (1and 4a & b) and Fig. (1) Data according to CORINE model illustrated that 76.67 % of the studied soil profiles has no drainage problems (class 1) and 23.33% of the studied soil profiles with drainage problems (class 2).

Topography, the whole area under study is generally almost flat (class 1). According to CORINE model, table (3) and Fig. (1) Data delineated that the area under study is considered low slope steepness soils < 5 %.

Also, values of soil quality according to CORINE model, Fig. (1) The results of soil texture, soil depth and soil drainage were computed and plotted as a follow: 56.67 % of the studied soil profiles have high quality (class 1), 33.33 % have moderate quality (class 2) and 10.0 % have poor quality (class 3).

Climate Quality Index:: The main factors which need to be included in the assessment of climate quality are nevertheless clear. They must include a measure of both energy and moisture availability, and of any climate hazards which might inhibit plant growth. The vegetative period represent all months when the mean air temperature exceeds 5^0C, as above. the obtained results from the vegetative period, the all studied are classified as class1(Fig.1) of the vegetative period index. The calculation of aridity index according to Fournier index and Bagnouls-Gaussen index, clarified that the Fournier index ranging between 199 to 422, this means that the area under study are classified as class 5 . While the results were calculated by Bagnouls-Gaussen ranged from 144 to 502, the soils classified as class 4. Therefore, the aridity index= 1 * 4 = 4. According to the climatologically data and CORINE model, (table (2) and Fig. (1)) the area under study lay in the moderately climatic zone, (class 2).

Potential Land Quality: It is depend on three basic indices: soil quality, climatic quality and slope. Potential land quality was calculated as above mentioned, and the values were, 90.0 % of the studied area had a high potential land quality according to CORINE model Fig. (1), 10.0 % of soils had a moderate Potential land quality and no soils occupy in the low Potential land quality class.

Soil improvement: Improvement of soil including: structure, infiltration, drainage, water and nutrient holding capacity, and soil fertility, all benefits that promote a variable rooting environment for plants. Both texture and structure influence the drainage capacity of a soil. Adequate soil drainage enables a plant to access the air, water, and nutrients it needs to survive and flourish. Poor soil drainage can inhibit a Plant's access to air, water, and nutrients, causing stress, and sometimes, decline or death. Also Soil improvement depends on climate, topography, land reclamation and human activities. Irrigation one of the most important to improvement of soil. Theoretically, a wide range of permanent or semi- permanent Improvements are possible, including Irrigation, soil drainage and land reclamation. The area under study is classified as land with permanent irrigation (it is depend on the dug of wells) according to CORINE model Fig. (1), the area occupy in class (1).

Actual Soil Quality: It is derived by adjusting the potential land quality according to the land Improvements index.

From previous results, data presented in table (6) show that the largest area of high quality occurs in the whole studied area except 33.33 % in sandy soils show poor Soil quality and 66.66% moderate Soil quality. In other words, 78.57%, 100.0% and 66.66% high Soil quality are presented in soils loamy sand, sandy loam and sandy clay loam in the same sequences, respectively.meanwihle, the moderate soil quality are shown in loamy sand and sandy clay loam, 21.43%and33.33% in the same sequences, respectively. Also, the majority of the high potential and actual soil quality is found in whole the studied soils except sandy soils.

Table 6: Distribution of soil quality index, potential land quality index and actual soil quality index in the studied are according to their texture.

Soil texture	Soil Quality Index			Potential Soil Quality Index			Actual Soil Quality Index		
	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low
S	-	6	3	6	3	-	6	3	-
LS	11	3	-	14	-	-	14	-	-
SL	4	-	-	4	-	-	4	-	-
SCL	2	1	-	3	-	-	3	-	-

Erodibility Index: Soil erosion is a global issue because of its severe adverse economic and environmental impacts. Economic impacts on productivity may be due to direct effects on crops/plants on-site and off-site, and environmental consequences are primarily off-site due either to pollution of natural waters or adverse effects on air quality due to dust and emissions of radioactively active gases. Off-site economic effects of erosion are related to the damage to civil structure, salutation of water ways and reservoirs, and additional costs involved in water treatment.

Highly erodible lands are land areas that have an erodibility index of eight or more. The soil erodibility index provides a numerical expression of the potential for a soil to erode considering the physical and chemical properties of the soil and the climatic conditions where it is located. The higher index, greater the investment needed to maintain the sustainability of the soil resource base if intensively cropped. Again Erodibility Index scores equal too greater than 8 are considered highly erodible land.

In this study the calculation of (EI) is depend on the formula cited in the above mentioned as follow:

According to Carreker, [21]. $E\ I = 174 - 4.64\ x + 0.03\ x^2$.

With respect the calculated values of soil erodibility index (EI) for the studied soil profiles are presented in table (4), data reveal that the values of such parameter are ranged between 15.37 and 137.97 t/hr/year. It is obvious that the value of (EI) generally increases with the increase of soil depth in majority of the studied soil profiles. In other words, the lowest value of (EI) is clarified at the upper soil layer; meanwhile the highest value is noticed at the deep soil layers. Also, it is shown that the highest values are 137.97 and 63.49 at > 90 cm soil depth which have clay and sandy clay loam soil texture for soil profiles No. 22 and No. 19 respectively. This behavior may be due to prevailing nonerodible soil fraction >0.84 mm in the surface soil layer as compared to the subsurface soil layers.

In this respect; Abdel-Rahman [23] mentioned that soil erodibility factor is related to the percentage of soil clods or aggregates in the surface soil layer that are greater than about 0.84 mm are too large to be moved by ordinary erosive wind.

The simple correlation coefficients and regression equation between each of the above mentioned soil physical properties and soil erodibility index for each soil layer of the studied soil profiles. Table (7) and Fig. (2a), indicate that the simple correlation coefficient between (EI) and each of Coarse sand %, and gravel content are negative and highly significant correlation (r=0.98904) for Coarse sand, but non significant correlation with gravel content (r=0.2088). The derived regression equation are a linear function, whereas it is positively correlated at highly significant level with clay % (r=0.6258) and fine sand % (r=0.6629) the regression equation are a power function for fine sand content, meanwhile was linear function with clay %. In other words, the value of (EI) decreases with increasing the coarseness of soil texture. On the other hand, data show no significant correlation between (EI) and silt percentage.

Regarding to the Table (7) and Fig. (2b), show a highly significant negative Correlation between (EI), gravel plus coarse sand % (r = 0.9360) and T. sand % (r=0.6323), the drive regression equation is a linear function. While the Correlation are positively correlated with silt % (r=0.4873) and silt plus clay %, (r=0.63135) the silt % show less significant positive correlation.

Using previously published data, can be evaluated the soil quality index as a tool to assess a wide range of management practices in the Southern part of Egypt, soil quality index shows potential for use as a management assessment tool.

Also, from previous results, it is evident that the important role of coarse, fine sand and gravel which reflection clay and silt content in performance and expect soil erodability. Therefore, measures and practices should be applied to desert areas subjected to wind erosion such as protection, mulching, deep plugging and adding organic amendments, because wind erosion physically removes the lighter, less dense soil constituents such as organic matter, clays, and silts. Thus it removes the most fertile part of the soil and lowers soil productivity.

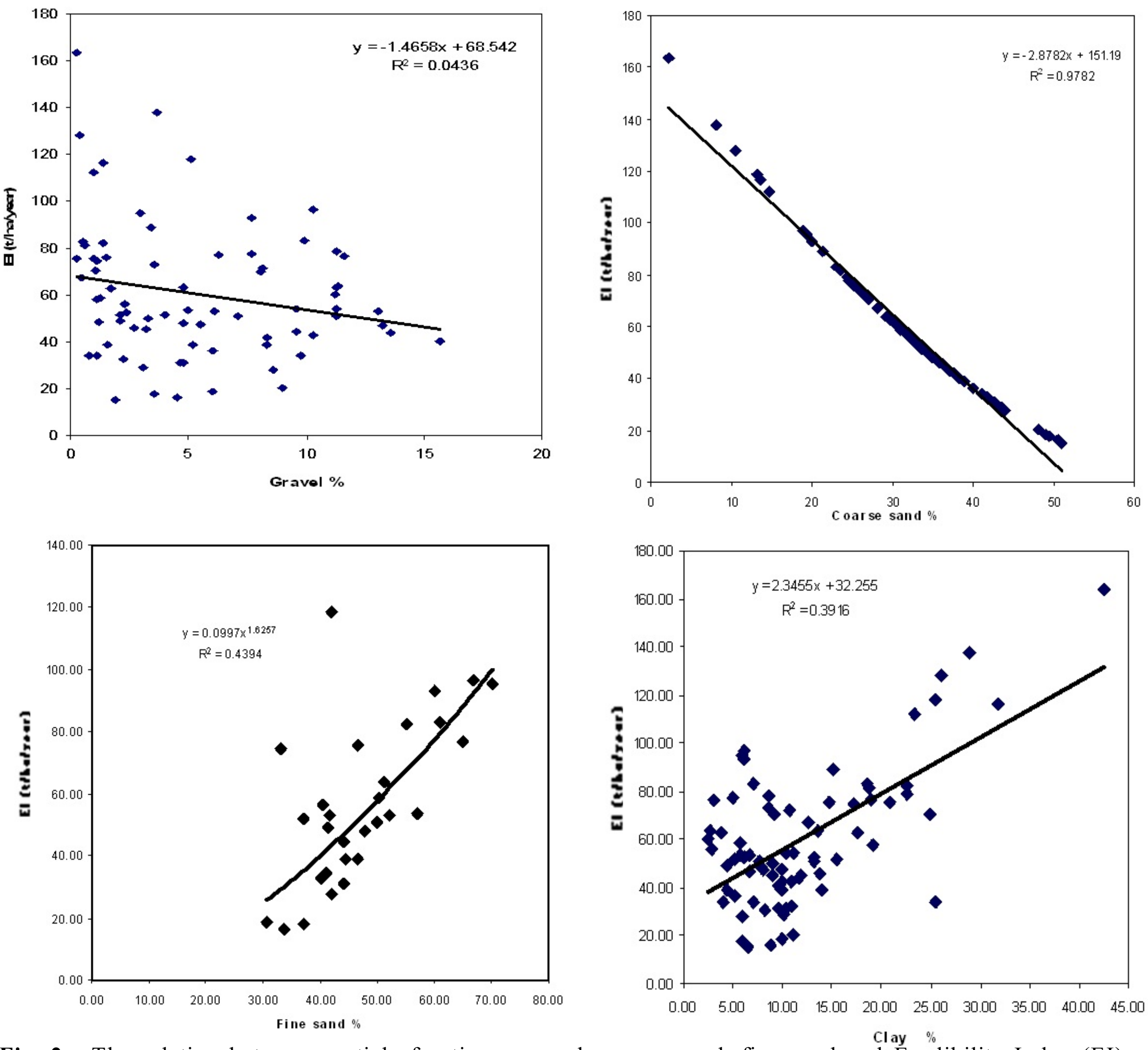

Fig. 2a: The relation between particle fractions, gravel, coarse sand, fine sand and Erodibility Index (EI) of the studied area.

Table 7: Correlation Coefficient, Coefficient of determination (C.D), regression equation for the relation between Erodibility Index (Y) and the studied soil variables (Xi).

Soil Factors.	Type of relation	Correlation Coefficient	The regression equation	C.D
Gravel % X_1	Yx_1	0.20881	Y=-1.4658x +68.54	4.36
C.sand % X_2	Yx_2	0.98904**	Y=-2.8782x +151.19	97.82
F.sand % X_3	Yx_3	0.6629*	$Y=0.09970000x^{1.6.257}$	43.94
Clay % X_4	Yx_4	0.6258*	Y=2.3455x +32.255	39.16
Silt % X_5	Yx_5	0.48734	Y=2.3999x +32.783	23.75
Silt+Clay % X_6	Yx_6	0.63135*	Y=1.49889x +25.182	39.86
T.sand % X_7	Yx_7	0.63230*	Y=-1.49889x +175.07	39.98
Gravel+C.sand% X_8	Yx_8	0.93600**	Y=-2.3705x +147.84	87.61

* Significant at 5%

** Significant at 1%

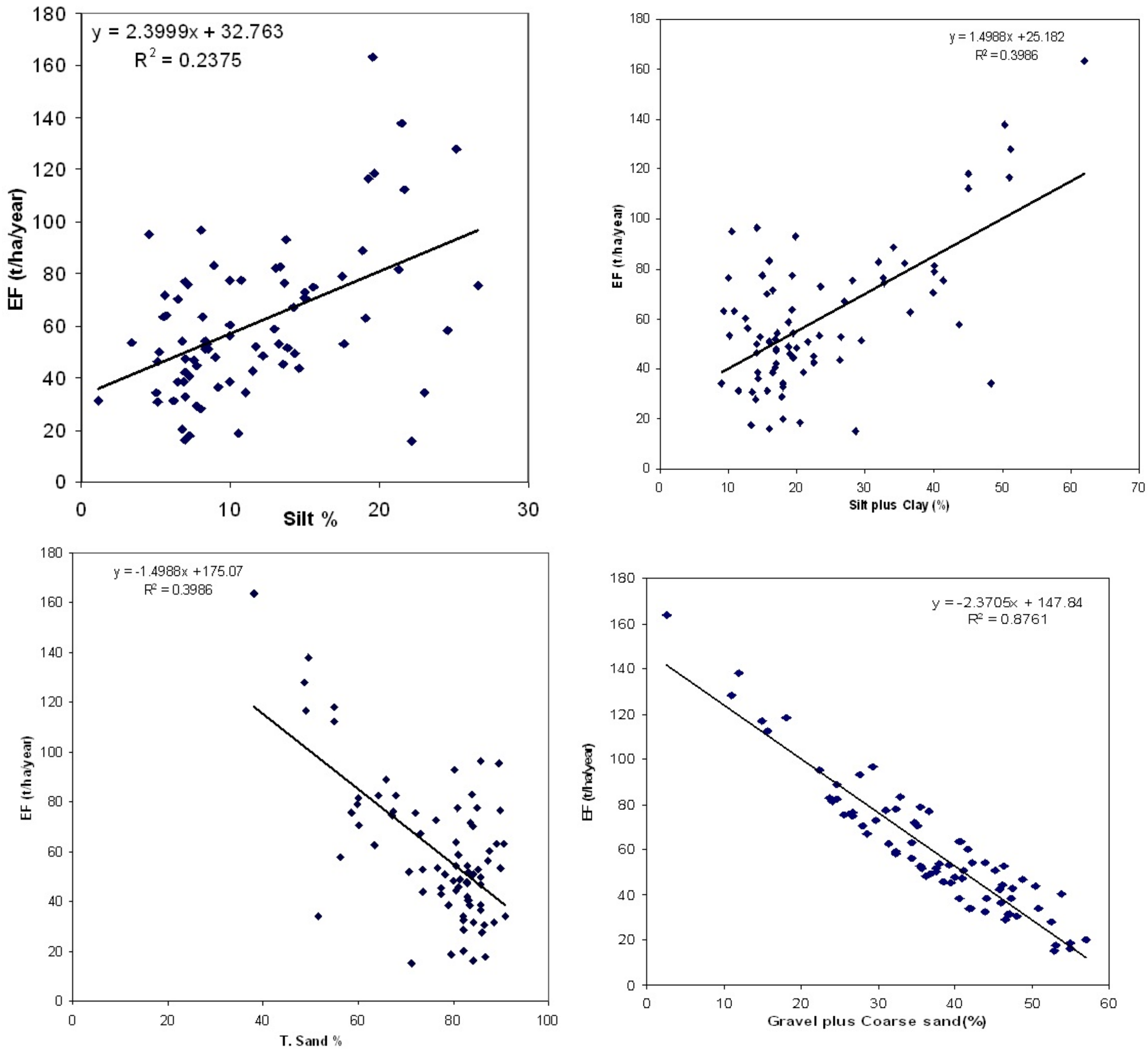

Fig. 2b: The relation between particle fractions, silt, silt plus clay, T.sand, gravel plus coarse sand and Erodibility Index (EI) of the studied area.

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