Characterization of Quality Indices for Some Soils of The Middle Euphrates Plain By Adopting Morphophysiochemical Criteria

N. Sh. Alrawi* and M. K. Alrawi

1 Anbar Agriculture Directorate, Ministry of Agriculture, Iraq
2 College of Agriculture, University of Anbar, Iraq
*Corresponding author's e-mail: nuna.alrawi@uoanbar.edu.iq

Abstract. The aim of this study is to determine Soil quality standards that can be used to develop a better soil quality index that can be relied upon for future evaluation. Three different methods which varied criteria were used to choose soil quality index for some soils of the middle Euphrates plain. (parent material, slope, texture, gravel and stones, drainage condition and soil depth) used a criteria to explain morphological soil quality index. Physical soil quality used a criteria (structure, texture and consist); while chemical quality used (EC, lime, Ph and % organic matter) and, Results showed physical soil quality index varied between (0.47-0.79) with rang 0.32; and the series varied within class at rang 0.11. Morphology soil quality index varied between (1.29-1.61) at rang 0.32 and soil series varied at 0.16. Soil chemical quality index varied at rang 1.20-1.59 and the soil series varied at rang 0.10 within class. Soil series distributed between high quality to low quality.

1. Introduction
Soil quality is a complex functional concept that cannot be measured directly, but can be inferred using different soil characteristics and administrative methods used, and among the many methods used for characterization and evaluation, soil quality is the most appropriate indicator for quantitative soil evaluation.

A variety of definitions have been proposed for this term. [1]; [2]; [3], of which, when [4], indicated that the soil quality index is an administrative method that requires strict requirements, but that it has a positive and broad return It is one of the guides used for the purpose of calculating the environmental sensitivity index to desertification and the general equation for calculating soil quality, an equation that can be removed, added and modified.

In 1999 the USDA defined soil quality simply as: "the capacity of a specific kind of soil to function [5]."

Garrigues [6], and Garrigues [7],and Rahmanipour [8] agreed to define soil quality as "the capacity of soil to function within the boundaries of an ecosystem and to use land to conserve Biological productivity, preserving environmental quality, and promoting plant and animal health.

Used methods of quantitative analysis of information by linking the geographic-geological-pedological trend by adopting some pedagemorphological indices, which includes (the index of the material of origin, the index of the slope of the land, the index of soil depth and the index of soil texture) expressed in the index of soil quality (guide Volumetric coverage of plants, drought index, and erosion protection index) expressed in the quality of vegetation cover index for the purpose of giving a characterization and classification of the environmental sensitivity of desertification, and classifying the study areas into five degrees distributed between very low quality to very good quality. Its results showed that there are four main regions that differed in their sensitivity to desertification, ranging from very sensitive to low sensitivity [9].

Al-Hiti and AL-rawi used the Soil Quality Index (SQI) in a study assessing the state of desertification in the East Al-Haffar project by adopting the pedogiomorphological indices,
which includes the origin material index, the slope index, the soil depth index and the tissue index expressed in the soil quality index (SQI). And the results of the study showed that there are three types of high, moderate and low soil quality [10].

Other researchers have adopted three indicators to measure soil quality, which are chemical, physical and biological indicators [11]. R. Ouachoua and J. Al Karkouri, based on four main indicators of desertification: the Vegetation Quality Index (VQI), the Soil Quality Index (SQI), and the Climate (CQI) and Land Administration Quality (MQI) for the purpose of mapping the desertification sensitivity index using the MEDALUS model in southeast Morocco, the results indicated that only 19.59% of the sites in the study were classified as moderately sensitive to desertification; And 78.30% was done [12]; [13]. Classifying them as highly sensitive areas, the results also showed that climate factors and human pressure are among the most important indicators that affect the sensitivity of desertification in the study area.

2. Materials and Methods
2.1. Location and Area
The area was chosen because it is considered irrigated agricultural land, which has been largely neglected in recent years and the closure of most of the drainage, which helped to salinize it and turn it into unproductive land, as well as the urban sprawl, which increased the impotence of farmers and their inability to restore it to its previous state. The study area is located in the central part of Iraq within the Anbar governorate in the countryside of Ramadi district, and it represents the northwestern tip of the Mesopotamian plain and the front of the flood plain of the Euphrates River, of which the western plateau occupies a large area of it, and the study area includes (10) provinces and has an area The college (2504.4) hictar. The borders of Heet district represent the northwestern side, the Jazirah plateau and the Saqlawiya sub-district, the northeastern side, while the southeastern side is bordered by the Habbaniyah sub-district, and on the west and south sides, bounded by the eastern edge of the plateau as shown in Map (1).
The astronomical position of the study area is confined between two Latitudes (43°4'42.935"E  33°31'38.959"N) north and longitudes between (43°28'35.4"E  33°27'3.389"N) east.

The soil dissection processes was carried out in eleven sites within the countryside of Ramadi district (Map 1) with reliance on studies and were morphologically characterized, and then the chains were identified according to the Iraqi soil classification system. and it was classified to the family level according to the modern American classification system, and chemical and physical analyzes were conducted and the general average was taken for each pedon and for each characteristic and the soil quality index (SQI) was calculated using three formulas with different criteria:

\[
\text{SQI} = \left( \text{Ph} , \text{EC} , \text{Lime} , \text{Organic Mater} \right)^{1/4}
\]

2.2. Chemical properties

1. Morphological characteristics

\[
\text{SQI} = \left( \text{Parent material} , \text{Texture} , \text{Slop} , \text{Drainage} , \text{depth} , \text{Stone and Gravel} \right)^{1/6}
\]

2. Physical properties

\[
\text{SQI} = \left( \text{Texture} , \text{structure} , \text{consist} \right)^{1/3}
\]

As each indicator was given a weighted index according to Table (1), as when the value of the index decreased, this indicated that it was of high quality, and then computed the soil quality index for each equation. The total area and area of each type were classified from highest to low and very low quality, as in Table (2), which shows the ranges of each index. The chemical properties such as EC were measured in the saturated pulp extract using the conductivity bridge, according to the method mentioned, lime was Calculated by the method of acetone precipitation in while pH was measured in the saturated pasta filter using the pH meter contained And the organic matter was measured by the recombination method of potassium dichromate

3. Result and Discussion

3.1. Chemical SQI:

Chemical properties:

3.1.1. Soil pH: The pH values of the study area ranged from 6.98 to 8.2, This means that the soil ranges from neutral to slightly alkaline because it contains gypsum and lime, which contain the element calcium, which makes the soil with a high regulatory capacity

3.1.2 Electric Conductivity (EC): The electrical conductivity values of the study area ranged between 0.1 – 13.39 ds, Pedon 2 (Al Boasaf P2) was distinguished by its high electrical conductivity values was ranged between 5.26- 13.39, The reason is due to the decrease in the area, the rise of the groundwater, and the inactive faucets, which causes the high salts of the capillary property.

3.1.3 Lime: Calcium carbonate values ranged from 36.44 – 344.88 gm/kg, where was the highest on the horizon 220-170 gm/kg In pedon 5 And the lowest percentage on the horizon 0-50 gm/kg Bidon5.

3.1.4 Organic matter: The study area is generally characterized by its low content of organic matter due to high temperatures and lack of rain, and this applies to the lower horizons, but in the surface horizons it was characterized by a markedly high content of organic matter, as it ranged between 0.2-12.8 the reason is the agricultural exploitation of some pedons sites, The fourth pedon had the lowest organic matter content at a rate of 0 because it had not been exploited for five years since the events of ISIS, and the ninth pedon scored the highest content of organic matter at a rate of 7.5 for being an exploiter of citrus cultivation.

The chemical SQI was calculated For 11 Pedons their locations and weights are shown in Table (1) using the equation:

\[
\text{SQI} = \left( \text{Ph} , \text{EC} , \text{Lime} , \text{Organic Matter} \right)^{1/4}
\]
Table 1. points, weights and ranges of study pedons according to chemical characteristics

| Area   | Classes    | Ranges         | GPS point                  | Weights | Series | P.N. |
|--------|------------|----------------|---------------------------|---------|--------|------|
| 132    | High quality | 1.20 < SQI < 1.29 | 43°10'22.433"E, 33°30'49.124"N | 1.29426 | TW345  | p1   |
| 61.2   | Medium quality | 1.30 < SQI < 1.39 | 43°15'5.490"E, 33°31'31.815"N | 1.49213 | DW105  | p2   |
| 32.7   | Low quality   | 1.40 < SQI < 1.49 | 43°28'20"E, 33°26'52"N     | 1.41279 | MW8    | p6   |
| 24.4   | Very low quality | 1.50 < SQI < 1.59 | 43°15'5.503"E, 33°30'15.379"N | 1.24466 | DM85   | p10  |

Map 2. shows the spatial distribution of soil chains in the study area according to the chemical characteristics. As well as Table (1) shows the areas formed by each class and the percentages. Soil chains have varied, As it ranged from high quality to very low quality between range 1.20– 1.59, with general ranges 0.10 and the soil series varied at range 0.11 with in class , as P10 Pedon was of high quality due to the high percentage of organic matter and low salinity percentage. As for the Bidoon P2 and P3 It was of very low quality. This is due to the higher salinity and lower organic matter content in both pedons. High quality took up space 132 in the rate of 53% And an area of medium quality 61 m2 in the rate of 24% As for the low quality 32.7 it took up space in the rate of 13% And the very low quality was its area 24.4 m2 And in proportion 10%.

Map 1. Geographical distribution of the quality index according to the chemical characteristics

3.2. Morphology SQI
Some Morphology properties that have a direct effect on soil quality were selected such as parent material, slope, texture, gravel and stones, soil depth and drainage condition was calculated For 11 Pedons their locations and weights are shown in Table (2) using the equation:

\[ SQI = \left( \frac{1}{6} \right) \left( \text{Parent material} + \text{Texture} + \text{Slop} + \text{Drainage} + \text{depth} + \text{Stone and Gravel} \right) \]
Based on the data obtained from the application of the soil quality index, it is clear that the quality of the soil has changed between high and low quality. Among the causes of the variation in morphological characteristics are the proximity or distance from the source of sedimentation, the fluctuation of the height of the groundwater, and the change in the texture between the sites taken perpendicular to the river. Soil chains have varied between range 1.29-1.61 with general ranges 0.32 and the soil series varied at range 0.16 with in table (2).

As well as map (3) shows the areas formed by each class and the percentages. As P4, P5, P11 Pedons were of high quality due to the high percentage due to its texture that contains a high percentage of sand with good drainage. As for the pedon P2 and P3 It was of low quality. This is due to the which is characterized by its clay texture and its proximity to the river due to the flooding of the river in the nearby areas.

The high quality took up space 77.71 m² in the rate of 31% and an area of medium quality 163.67 m² in the rate of 65%. As for the low quality, it took up space 9.59 in the rate of 4%.

### Table 2. Points, weights and ranges of study pedons according to morphology characteristics

| Quality       | Weight | Range            | Coordinates               | Score  |
|---------------|--------|------------------|---------------------------|--------|
| High          | 1.29   | 1.29 < SQI < 1.45| 43°10'22.433"E, 33°30'49.124"N | 1.51882 |
| Medium        | 1.45   | 1.45 < SQI < 1.61| 43°7'41.549"E, 33°3'13.815°N | 1.51617 |
| Low           | 1.61   | 1.61 < SQI       | 43°15'5.037"E, 33°30'15.379"N | 1.519712|

3.3. Physical SQI

Some of the physical characteristics were measured that have an effect on soil tillth and the linkage of the tillth to the management aspect that greatly affects the quality of the soil. These indicators were chosen and their weights were determined according to Appendix (2) which included (Texture, structure and consisty) and the soil quality was calculated according to the following equation:

$$SQI = (Texture, structure, consisty)^{1/3}$$

Map 2. Geographical distribution of the quality index according to the morphological characteristics
Table (3) showed physical soil quality index varied between (0.47-0.79) with rang 0.32; and the series varied within class at rang 0.11, as well it is the quality of the soil has changed between high and low quality.

Table 3. points, weights and ranges of study pedons according to physical characteristics

| Area | Classes                  | Ranges            | GPS point                      | Weights  | Series |
|------|--------------------------|-------------------|--------------------------------|-----------|--------|
| 128  | High quality             | 0.47<SQI<0.57     | 43°10'22.433" E 33°30'49.124" N | 0.549183  | TW345  |
|      |                          |                   | 43°10'58.043" E 33°31'51.492" N | 0.557923  | DW105  |
|      |                          |                   | 43°7'41.549" E 33°31'31.815" N | 0.496616  | DM125  |
|      |                          |                   | 43°7'46.896" E 33°32'29.26" N  | 0.532883  | TW342  |
| 76.87| Medium quality           | 0.58<SQI<0.68     | 43°11'58.024" E 33°31'52.368" N | 0.638775  | 133SCW |
|      |                          |                   | 43°11'5.972" E 33°30'26.572" N | 0.697677  | MW5    |
|      |                          |                   | 43°27'33" E, 33°27'20" N       | 0.735229  | TW464  |
|      |                          |                   | 43°27'00" E, 33°26'31" N       | 0.626015  | TW464  |
| 45.47| Low quality              | 0.69<SQI<0.79     | 43°15'5.503" E 33°30'15.379" N | 0.790522  | DM85   |
|      |                          |                   | 43°14'21.41" E 33°28'36.136" N | 0.7025    | DM85   |

Map (3) shows the spatial distribution of soil chains in the study area according to the physical characteristics , as P1 , P2 , P3 , P4 Pedons were of high quality while al bouabed pedons and P10 were low quality due to the heterogeneity of the texture with its consist, it has a good combination compared to low-quality pedons.

Map 3. Geographical distribution of the quality index according to the physical characteristics

High soil quality occupied an estimated area was 128m2 which 51% And medium quality area was 76.87 Which 30% As for the low-quality area 45.47 it was 19%.

4. Conclusions
The need to expand the study on soil quality in different regions of Iraq Expanding the preparation of soil models used. The possibility of developing tools for measuring soil quality as a real examination tool without referring to laboratory analyzes. Raise the quality levels of soil chains with low qualities and give them sufficient attention so that they do not lose them as productive land over time.
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