



ISSN Print: 2664-844X
 ISSN Online: 2664-8458
 NAAS Rating (2026): 4.97
 IJAFA 2026; 8(9): 880-886
www.agriculturaljournals.com
 Received: 27-06-2026
 Accepted: 25-08-2026
 Published: 25-09-2026

Ola Muayad Ali Altaie
 Department of Soil Science
 and Water, Faculty of
 Agriculture, University of
 Kufa, Najaf, Iraq

GIS-based spatial assessment of soil quality, salinity, and nutrient distribution in agricultural lands of rural Kufa, Najaf Governorate, Iraq

Ola Muayad Ali Altaie¹

DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i9l.1967>

ABSTRACT

Soil salinity and variation in nutrients are important factors influencing agricultural productivity in arid and semi-arid environments. This study integrates laboratory and geographical information system (GIS) approaches to evaluate soil quality, salinity and nutrient distribution in agricultural lands of rural Kufa, Najaf Governorate, Iraq. Twenty representative soil samples were collected from agricultural fields and georeferenced using GPS. The soil samples were analyzed for pH, electrical conductivity (EC), organic matter (OM), soil texture, available nitrogen (N), phosphorus (P), potassium (K), sodium (Na) and Sodium Adsorption Ratio (SAR). The results showed a distinct spatial variability of the studied soil properties. Soil pH ranged from 7.58 to 7.97 with a mean of 7.78 ± 0.12 , while EC ranged from 0.87 to 4.12 dS m⁻¹ with a mean of 2.21 ± 0.95 dS m⁻¹. Organic matter was in the range of 0.96-2.34% with an average of $1.61 \pm 0.39\%$. Available N ranged from 9 to 33 mg kg⁻¹, P from 8.9 to 27.8 mg kg⁻¹ and K from 320 to 550 mg kg⁻¹. The concentrations of sodium ranged from 4.6 to 17.2 mmolc L⁻¹, while the SAR ranged from 4.0 to 13.8. The GIS analysis showed clear spatial patterns of salinity and nutrients, which reflect the influence of irrigation, drainage, soil texture, and agricultural management practices. The integration of laboratory measurements with GIS has provided an efficient framework for the determination of spatially variable soil conditions and facilitation of site-specific irrigation, fertilization, drainage and salinity-management practices in rural Kufa. Additional sampling and seasonal monitoring are recommended to improve the spatial prediction and long-term assessment of soil quality.

Keywords: Soil quality, Soil salinity, Electrical conductivity, Soil nutrients, SAR, GIS, Spatial variability, Rural Kufa, Iraq

1. Introduction

Soil is one of the most essential natural resources for agricultural production, food security and ecosystem stability. Soil's capacity to support plant growth and maintain environmental functions is a function of the interaction of its physical, chemical, and biological properties. Agricultural intensification, inappropriate irrigation, over-fertilization and climatic pressures can increase soil degradation and reduce its productive capacity. Therefore, a systematic assessment of soil properties is required for sustainable agricultural management and soil resource conservation (Bünemann *et al.*, 2018) [1]. Soil quality is usually evaluated based on a combination of indicators, rather than on a single indicator. Some of the important indicators are pH, electrical conductivity (EC), organic matter, available nitrogen, phosphorus, potassium and exchangeable cations of soil. These features provide significant information on the fertility of the land, the availability of nutrients, the level of salinity and the capacity of the soil to sustain the growth of crops. Organic matter is especially important for the improvement of soil structure, retention of nutrients, water-holding capacity and biological activity (Bünemann *et al.*, 2018; Hopmans *et al.*, 2021) [1, 2]. Soil salinity is one of the major constraints affecting agricultural productivity particularly in arid and semi-arid regions. Causes of salt accumulation may be high evaporation, poor drainage, saline irrigation water and shallow groundwater. Excess soluble salts may reduce water availability to plants, cause ion toxicity, interfere with nutrient uptake, and adversely affect soil structure. Therefore, the evaluation of salinity by parameters such as EC, pH, and exchangeable sodium is crucial for the suitability and quality of agricultural soils (Hopmans *et al.*, 2021; FAO, 2024) [2, 3]. Another important factor in soil assessment is the spatial variability of soil properties. Differences in parent material, irrigation, drainage, land use, cropping history, and management practices can cause soil characteristics to vary considerably over short distances. Therefore, the average values for the soil may hide localized salinity or nutrient deficiency. Information on the spatial distribution of these properties can provide more accurate information for soil management and agricultural planning (FAO, 2021; Toor *et al.*, 2021) [4, 5]. Geographic Information Systems (GIS) have proved to be useful tools for studying spatial variability of soil properties. GIS enables the geographical referencing of field and laboratory measurements and their conver

Corresponding Author:
Ola Muayad Ali Altaie
 Department of Soil Science
 and Water, Faculty of
 Agriculture, University of
 Kufa, Najaf, Iraq

sion to spatial distribution maps through the application of interpolation and geostatistical techniques. These maps can locate areas with high salinity, low nutrient availability or other soil-quality limitations providing useful information for site-specific soil management and sustainable agricultural methods (Toor *et al.*, 2021; Piikki *et al.*, 2021) [5, 6]. Najaf Governorate is an important agricultural region where the soil conditions are highly affected by the arid climatic conditions, the irrigation practices and the variations of the soil and water resources. Previous studies reported that the agricultural areas of Al-Najaf Governorate have significant spatial heterogeneity of soil salinity, pH, and concentrations of the major exchangeable elements at different sites, indicating the spatial heterogeneity of agricultural soils of the region (Abadelah, 2021) [7]. An integrated GIS based assessment combining soil quality, salinity and nutrient distribution can provide better understanding of the condition of agricultural lands. Therefore, this study intends to perform a GIS-Based Spatial Assessment of Soil

Quality, Salinity and Nutrients Distribution in Agricultural Lands of Najaf Governorate, Iraq.

2. Study area

The research area was in the rural parts of Kufa District, Najaf Governorate, central Iraq. The study area is marked by vast agricultural lands around the city of Kufa and along the Euphrates River, which is a major source of irrigation water for local agricultural activities. The region is arid, with high temperatures, low annual rainfall and high rates of evaporation which can result in the build-up of soluble salts in agricultural soils. The rural landscape is dominated by cultivated fields, irrigation channels and scattered agricultural settlements and variation of soil properties is related to the irrigation practices, drainage conditions, land use and cropping patterns. So the selected site is appropriate for studying the spatial variability of soil quality, salinity and nutrient availability. The location and spatial extent of the study area are presented in Figure 1.

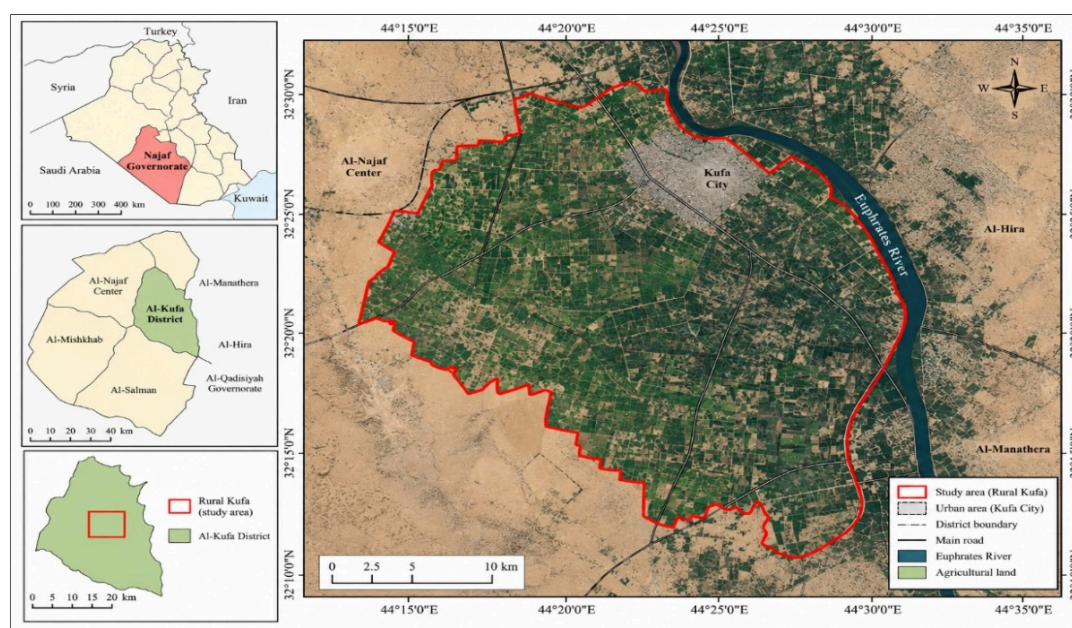


Figure 1. Geographic Location and Spatial Extent of the Rural Kufa Study Area, Najaf Governorate, Iraq

3. Materials and methods

3.1 Sampling and preparation of soil

Soil samples were collected from the representative agricultural fields distributed in the rural Kufa area, Najaf Governorate, Iraq. The sampling sites were selected to represent the variation in conventional agricultural methods, irrigation conditions, and soil characteristics. Representative samples of surface soil were taken at each site, with clean sampling tools, and placed in labeled polyethylene bags, and their geographical coordinates were recorded by GPS. The samples were carried to the laboratory and air-dried at room temperature. They were gently crushed and sieved through a 2-mm sieve for analysis. The prepared samples were stored in clean containers until the completion of the physicochemical and nutrient analysis (Estefan *et al.*, 2013; Soil Science Division Staff, 2017) [8, 9].

3.2. Soil physicochemical properties

A calibrated digital pH meter was used to determine soil pH following the preparation of a soil-water suspension at a standardized ratio. Electrical conductivity (EC) was determined in a soil-water extract using a calibrated conductivity meter and expressed in dS m^{-1} as an indicator of soluble salt concentration and soil salinity (Rhoades, 1982; Richards, 1954) [10, 11]. The soil organic matter was determined by Walkley-Black wet oxidation method [12]. Soil organic carbon was oxidized by potassium dichromate and sulfuric acid, and then deter-

mined by titration method. Soil texture was determined using the hydrometer method estimating the proportions of sand, silt and clay and classified according to the USDA soil-texture system. The choice of these physicochemical properties was justified because they are important indicators of soil reaction, salinity, fertility, water movement and nutrient retention (Soil Science Division Staff, 2017; Gee *et al.*, 1986) [9, 13].

3.3 Analysis of soil nutrients and sodium

Nitrogen, phosphorus and potassium availability were determined using standard soil analytical procedures Nitrogen was extracted and analyzed by an appropriate method for the available nitrogen fraction and available phosphorus was determined by the Olsen sodium bicarbonate extraction method followed by spectrophotometric measurement (Page *et al.*, 1982; Olsen *et al.*, 1954) [14, 15]. Potassium was extracted with an appropriate standard extractant and quantified using a calibrated flame photometer. Flame photometry was used for the determination of sodium. Calcium and magnesium were also determined where applicable for the computation of Sodium Adsorption Ratio (SAR). The SAR was computed using the following equation:

$$\text{SAR} = \text{Na}^+ / \sqrt{(\text{Ca}^{2+} + \text{Mg}^{2+}) / 2}$$

where Na^+ , Ca^{2+} , and Mg^{2+} are expressed in mmolc L^{-1} . These measurements were used to evaluate soil fertility, nutrient availability,

salinity, and potential sodicity conditions (Estefan *et al.*, 2013; Walkley *et al.*, 1934) [8, 12].

3.4 GIS-based spatial analysis

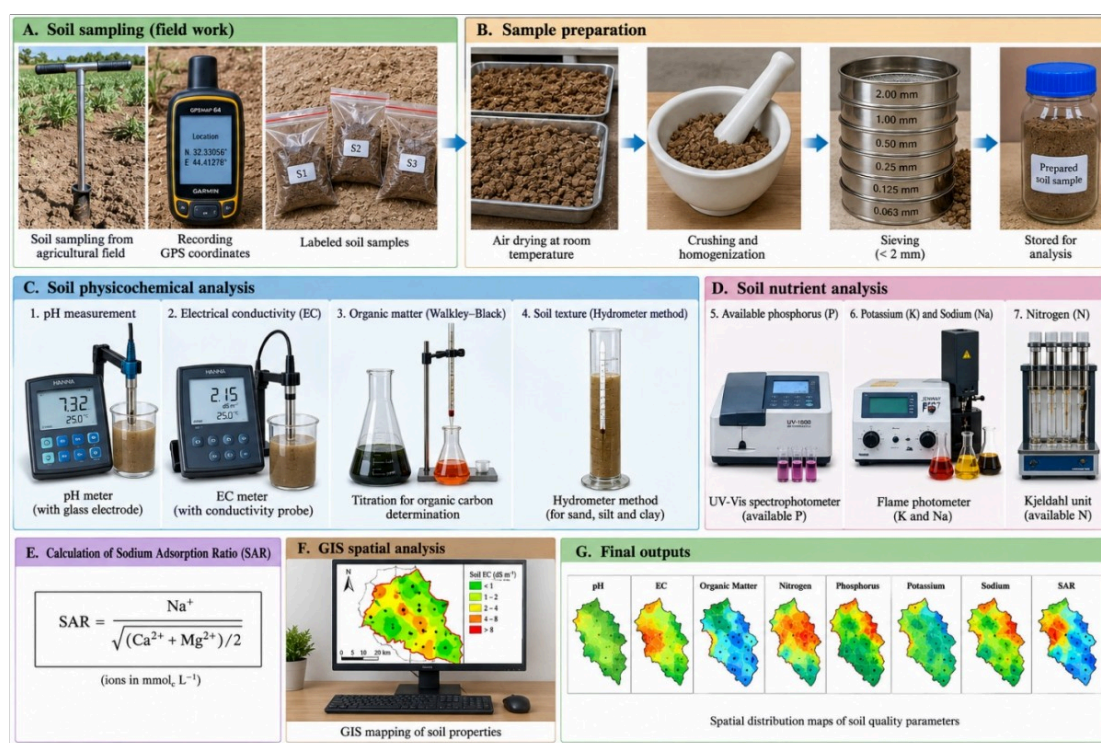


Figure 2. Field Sampling, Soil Sample Preparation, Physicochemical and Nutrient Analysis, SAR Calculation, and GIS-Based Spatial Mapping Workflow.

The geographic coordinates of all sampling locations were overlaid with the corresponding laboratory results using a Geographic Information System (GIS). Distribution maps for pH, EC, organic matter, soil texture, N, P, K, Na and SAR were produced using spatial interpolation methods. The produced maps were used to identify spatial patterns of soil fertility and salinity and to identify areas with relatively high or low nutrient availability. The GIS-based approach gave a comprehensive spatial evaluation of soil quality and allowed the identification of zones needing improved irrigation, fertilization, and soil-management practices (Soil Science Division Staff, 2017) [9].

4. Results and discussion

The physico-chemical properties of the studied agricultural soils showed a clear spatial variation between the sampling locations in rural Kufa. The pH of the soils ranged from 7.58 to 7.97 with mean

value of 7.78 ± 0.12 showing the dominance of neutral to slightly alkaline soil conditions. The electrical conductivity (EC) varied from 0.87 to 4.12 dS m^{-1} with a mean of $2.21 \pm 0.95 \text{ dS m}^{-1}$, which reflected a large spatial variation in the accumulation of soluble salts. The highest EC was at S17 and the lowest at S14. The organic matter content ranged from 0.96 to 2.34% with an average of $1.61 \pm 0.39\%$. These variations can arise from differences in irrigation, drainage, crop residues, fertilizer application and local soil management practices. Also, the particle size distribution differed among the different sampling sites. Sand content ranged from 9 to 33%, silt from 33 to 48% and clay from 34 to 43%. The prevalence of finer fractions suggests that the soils studied are generally of relatively fine texture, which can affect water retention, drainage, nutrient storage and salt accumulation. These properties spatially vary and highlight the need for GIS-based assessment for identification of areas with different soil-management needs (Gee *et al.*, 1986) [13].

Table 1. Physicochemical properties of agricultural soils in rural Kufa

Sample	pH	EC (dS m^{-1})	OM (%)	Sand (%)	Silt (%)	Clay (%)
S1	7.82	2.35	1.42	18	42	40
S2	7.74	1.86	1.67	22	39	39
S3	7.91	3.42	1.18	12	45	43
S4	7.68	1.24	1.93	28	36	36
S5	7.87	2.76	1.35	16	43	41
S6	7.59	0.98	2.21	31	34	35
S7	7.96	3.85	1.05	10	47	43
S8	7.72	1.67	1.78	24	38	38
S9	7.85	2.18	1.55	20	41	39
S10	7.63	1.15	2.05	29	35	36
S11	7.93	3.18	1.22	14	44	42
S12	7.69	1.52	1.86	26	37	37
S13	7.79	2.94	1.48	18	42	40

(continued on next page)

Sample	pH	EC (dS m ⁻¹)	OM (%)	Sand (%)	Silt (%)	Clay (%)
S14	7.58	0.87	2.34	33	33	34
S15	7.88	2.51	1.39	17	43	40
S16	7.75	1.98	1.64	23	39	38
S17	7.97	4.12	0.96	9	48	43
S18	7.66	1.31	2.08	30	35	35
S19	7.83	2.63	1.31	15	44	41
S20	7.71	1.73	1.74	25	38	37
Mean ± SD	7.78 ± 0.12	2.21 ± 0.95	1.61 ± 0.39	21.00 ± 7.20	40.15 ± 4.39	38.85 ± 2.83

The concentrations of soil nutrients in the study area showed large spatial variability. Available nitrogen ranged from 9.0 to 33.0 mg kg⁻¹ with a mean of 21.00 ± 7.20 mg kg⁻¹ while available phosphorus ranged from 135 to 260 mg kg⁻¹ with a mean of 196.85 ± 35.14 mg kg⁻¹. Potassium varied from 320 to 550 mg kg⁻¹ with an average of 429.50 ± 63.16 mg kg⁻¹. Sites may differ because of differences in fertilizer application, organic-matter content, crop uptake, irrigation, and nutrient cycling.

The sodium concentrations ranged from 4.6 to 17.2 mmolc L⁻¹ and the calculated SAR values ranged from 4.0 to 13.8 with an average of 7.77 ± 2.67. Some areas have relatively high values of sodium and SAR indicating that more attention needs to be paid to quality of irrigation water and drainage conditions in these areas. In contrast, sites with lower sodium and SAR values had relatively lower potential of sodicity-related limitations (Page *et al.*, 1982) [14].

Table 2. Nutrient concentrations and sodium-related indicators

Sample	N (mg kg ⁻¹)	P (mg kg ⁻¹)	K (mg kg ⁻¹)	Na (mmolc L ⁻¹)	Ca (mmolc L ⁻¹)	Mg (mmolc L ⁻¹)	SAR
S1	18.0	14.2	410	9.1	18.0	8.5	6.8
S2	22.0	18.5	435	7.8	16.0	7.1	6.1
S3	12.0	11.8	360	13.5	20.0	10.9	9.1
S4	28.0	21.6	480	6.2	14.0	5.5	5.7
S5	16.0	13.5	390	11.2	19.0	9.0	8.1
S6	31.0	25.1	525	5.1	13.0	4.4	4.9
S7	10.0	9.7	335	15.8	22.0	12.5	10.3
S8	24.0	19.2	455	7.0	15.0	6.3	5.9
S9	20.0	15.6	425	8.8	17.0	7.7	6.8
S10	29.0	23.4	505	5.8	13.0	5.0	5.3
S11	14.0	12.1	375	12.7	20.0	10.2	8.8
S12	26.0	20.3	465	6.7	15.0	6.0	5.7
S13	18.0	14.9	400	10.5	18.0	8.8	7.8
S14	33.0	27.8	550	4.6	12.0	4.0	4.0
S15	17.0	13.1	385	10.1	18.0	8.4	7.8
S16	23.0	17.4	445	7.9	16.0	6.9	6.3
S17	9.0	8.9	320	17.2	23.0	13.8	13.8
S18	30.0	22.6	495	5.4	13.0	4.7	4.7
S19	15.0	12.8	375	11.0	19.0	9.1	8.4
S20	25.0	18.8	460	7.3	15.0	6.5	6.2
Mean ± SD	21.00 ± 7.20	17.07 ± 5.26	429.50 ± 63.16	9.19 ± 3.55	16.80 ± 3.12	7.77 ± 2.67	7.77 ± 2.67

(continued on next page)

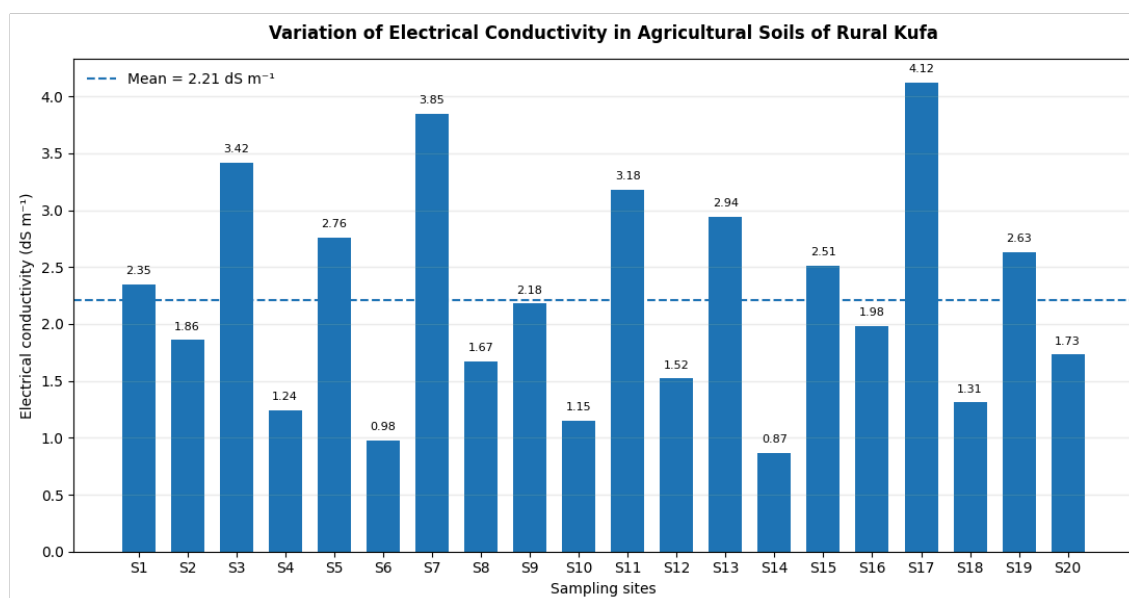


Figure 3. Variation of Electrical Conductivity (EC) in Agricultural Soils of Rural Kufa.

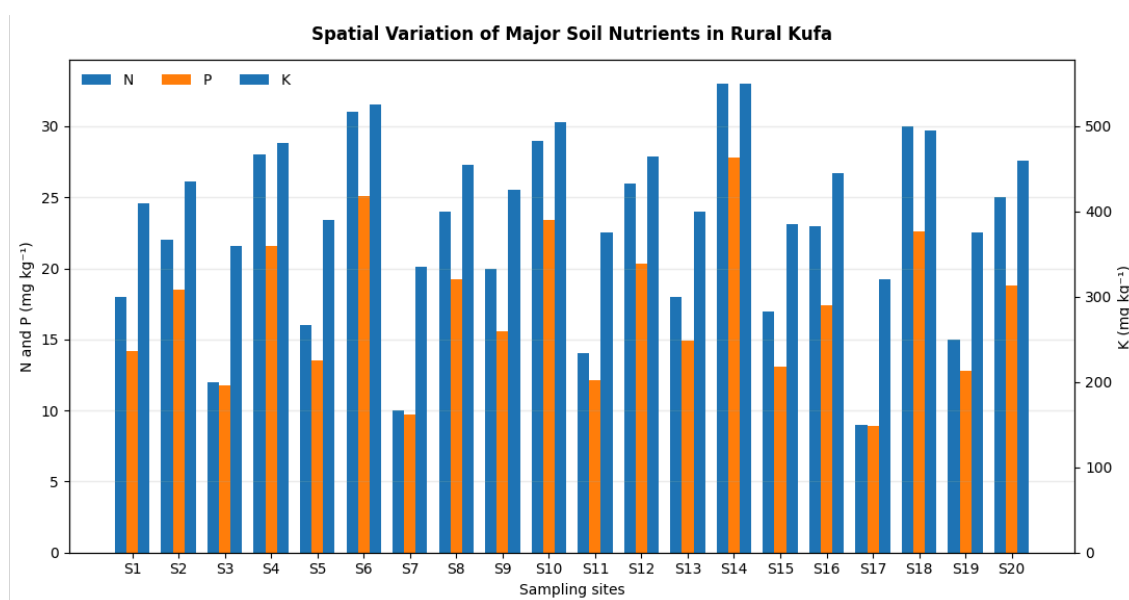


Figure 4. Spatial Variation of Major Soil Nutrients (N, P, and K) in Rural Kufa.

5. GIS-based spatial analysis

5.1 Maps and spatial distribution of soil salinity and nutrients

The laboratory results of the collected soil samples were integrated with their geographical coordinates using a Geographical Information System (GIS) for spatial variability assessment of soil properties in the agricultural lands of rural Kufa. Continuous distribution maps of electrical conductivity (EC), pH, organic matter (OM), available nitrogen (N), phosphorus (P), potassium (K) and Sodium Adsorption Ratio (SAR) were prepared using spatial interpolation. Digital soil mapping provides an effective framework to convert point-based soil observations into spatially continuous information for supporting agricultural management and land-resource assessment (Chen *et al.*, 2022; Pouladi *et al.*, 2023) [16, 17]. The spatial distribution of EC presented a clear variation among sampling locations, indicating differences in soluble salt accumulation in the study area. High EC values

were found to be spatially related to locations with higher sodium and SAR values which indicates that irrigation practices, drainage conditions, evaporation and accumulation of soluble salts might be factors responsible for the observed spatial pattern. Soil salinity is of particular significance in arid and semi-arid agricultural environments where high evaporative demand and poor drainage can lead to salt accumulation in the root zone (Mulder *et al.*, 2023) [18]. GIS allows for the identification of these potential salt-affected zones in a spatial context and for targeted soil and water-management practices. Also, the nutrient distribution maps showed heterogeneity in space of N, P and K availability. This variability can be due to differences in soil texture, organic matter content, irrigation, crop management, fertilizer application and nutrient retention. Digital mapping approaches are increasingly used to characterize the spatial distribution of soil properties and to support site-specific agricultural management (Chen *et al.*, 2022; Arrouays *et al.*, 2020) [16, 19]. The generated nutrient maps can thus be a useful basis for identifying areas with relatively low or high nutrient availability and improving fertilizer-management strategies.

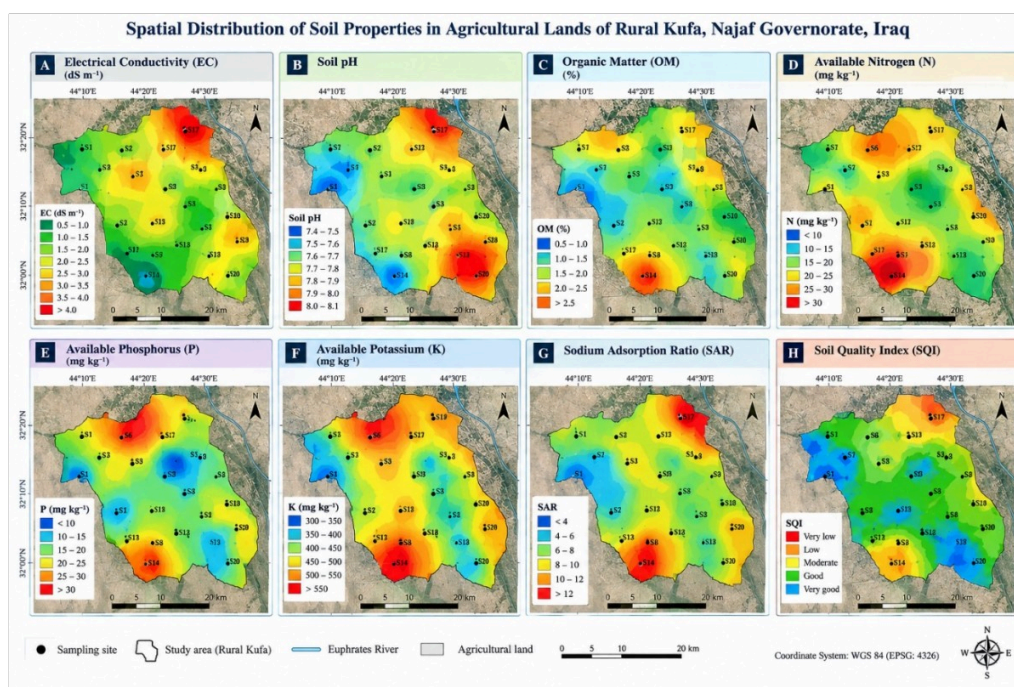


Figure 5. Spatial Distribution of Soil Physicochemical Properties, Nutrients, Salinity, and Soil Quality Index in Agricultural Lands of Rural Kufa, Najaf Governorate, Iraq.

5.2 Soil quality assessment

The soil quality was assessed by an integrated interpretation of the physicochemical and chemical properties measured, viz. pH, EC, organic matter, texture, N, P, K, Na and SAR. These indicators provide complementary information on soil fertility, salinity, nutrient availability, and on the physical and chemical conditions that affect agricultural productivity. The assessment of soil health is usually based on the integration of several measurable indicators, rather than a single soil property (Xia *et al.*, 2022) [20]. GIS-based assessment showed that the soil quality in rural Kufa was spatially heterogeneous. Areas with relatively low EC and SAR values and relatively high organic matter and nutrient availability suggest better soil conditions whereas areas with high salinity or sodium-related constraints need more consideration for irrigation and drainage management. The spatial approach is of particular use because soil properties can vary considerably over relatively short distances and digital soil mapping can translate this variation into useful management information (Pouladi *et al.*, 2023; Mat Su *et al.*, 2023) [17, 21]. Therefore, the derived GIS maps can be used as a decision support tool for agricultural land management in Kufa rural. However, the spatial prediction maps need to be validated by independent field observations or additional sampling points to evaluate prediction accuracy and uncertainty. Validation is an important component of digital soil mapping. The reliability of continuous soil property maps is usually assessed with cross-validation and independent validation (Pouladi *et al.*, 2023) [17]. The combination of field measurements, laboratory analysis, GIS and spatial validation offers a more robust structure for soil quality assessment and sustainable agricultural management (FAO, 2022) [22].

6. Conclusion The laboratory and GIS combined evaluation revealed a significant spatial variation in the physicochemical, salinity and nutrient characteristics of agricultural soils in rural Kufa. The spatial patterns of electrical conductivity, pH, organic matter, N, P, K, Na, and SAR were jointly influenced by irrigation, drainage, soil texture, fertilizer application, and local agricultural methods. GIS proved to be a useful tool for transforming point-based soil measurements into spatially continuous information and identifying areas potentially affected by salinity or nutrient limitations. The generated maps can be used for site-specific decisions on irrigation, drainage, fertilization and soil management. Future studies should incorporate additional sampling sites and independent validation datasets to improve the reliability of the spatial predictions.

References

- Bünemann EK, Bongiorno G, Bai Z, Creamer RE, De Deyn G, de Goede R, Flesskens L, Geissen V, Kuyper TW, Mäder P, Pulleman M, Sukkel W, van Groenigen JW, Brussaard L. Soil quality—A critical review. *Soil Biology and Biochemistry*. 2018;120:105–125.
- Hopmans JW, Qureshi AS, Kisekka I, Munns R, Grattan SR, Rengasamy P, Ben-Gal A, Assouline S, Javaux M, Minhas PS, Raats PAC, Skaggs TH, Wang G, de Jong van Lier Q, Jiao H, Lavado RS, Lazarovitch N, Li B, Taleisnik E. Critical knowledge gaps and research priorities in global soil salinity. *Advances in Agronomy*. 2021;169:1–191.
- Food and Agriculture Organization of the United Nations (FAO). Global Status of Salt-Affected Soils. FAO, Rome; 2024.
- Food and Agriculture Organization of the United Nations (FAO). World Map of Salt-Affected Soils. FAO, Rome; 2021.
- Toor GS, Yang YY, Das S, Dorsey S, Felton G. Soil health in agricultural ecosystems: Current status and future perspectives. *Advances in Agronomy*. 2021;168:157–201.
- Piikki K, Wetterlind J, Söderström M, Stenberg B. Perspectives on validation in digital soil mapping of continuous attributes—A review. *Soil Use and Management*. 2021;37(1):7–21.
- Abadelah MAA. A survey study of soil salinity and pH in some agricultural areas within the Al-Najaf Governorate. *Kufa Journal for Agricultural Sciences*. 2021;13(1):16–21.
- Estefan G, Sommer R, Ryan J. *Methods of Soil, Plant, and Water Analysis: A Manual for the West Asia and North Africa Region* (3rd ed.). International Center for Agricultural Research in the Dry Areas (ICARDA), Beirut, Lebanon; 2013.
- Soil Science Division Staff. *Soil Survey Manual* (USDA Handbook No. 18). U.S. Department of Agriculture, Washington, DC; 2017.
- Rhoades JD. Soluble salts. In: Page AL, Miller RH, Keeney DR, editors. *Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties* (2nd ed.). American Society of Agronomy and Soil Science Society of America; 1982:167–179.
- Richards LA, editor. *Diagnosis and Improvement of Saline and Alkali Soils* (USDA Agriculture Handbook No. 60). U.S. Department of Agriculture, Washington, DC; 1954.

12. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Science*. 1934;37(1):29–38.
13. Gee GW, Bauder JW. Particle-size analysis. In: Klute A, editor. *Methods of Soil Analysis, Part 1: Physical and Mineralogical Methods* (2nd ed.). American Society of Agronomy and Soil Science Society of America; 1986.
14. Page AL, Miller RH, Keeney DR, editors. *Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties* (2nd ed.). American Society of Agronomy and Soil Science Society of America, Madison, WI; 1982.
15. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate. USDA Circular No. 939. U.S. Department of Agriculture, Washington, DC; 1954.
16. Chen S, Arrouays D, Mulder VL, Poggio L, Minasny B, Roudier P, Libohova Z, Lagacherie P, Shi Z, Hannam J, Meersmans J, Richer-de-Forges AC, Walter C. Digital mapping of GlobalSoilMap soil properties at a broad scale: A review. *Geoderma*. 2022;409:115567.
17. Pouladi N, Gholizadeh A, Khosravi V, Borůvka L. Digital mapping of soil organic carbon using remote sensing data: A systematic review. *CATENA*. 2023;232:107409.
18. Mulder VL, Roudier P, Arrouays D. Editorial: Digital soil mapping—Advancing the knowledge frontiers. *Frontiers in Soil Science*. 2023;3:1225672.
19. Arrouays D, Poggio L, Salazar Guerrero OA, Mulder VL. Digital soil mapping and GlobalSoilMap: Main advances and ways forward. *Geoderma Regional*. 2020;21:e00265.
20. Xia Y, McSweeney K, Wander MM. Digital mapping of agricultural soil organic carbon using soil forming factors: A review of current efforts at the regional and national scales. *Frontiers in Soil Science*. 2022;2:890437.
21. Mat Su AS, Adamchuk VI. Temporal and operation-induced instability of apparent soil electrical conductivity measurements. *Frontiers in Soil Science*. 2023;3:1137731.
22. Food and Agriculture Organization of the United Nations (FAO). *The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point*. FAO, Rome; 2022.

How to cite this article: Altaie OMA. GIS-based spatial assessment of soil quality, salinity, and nutrient distribution in agricultural lands of rural Kufa, Najaf Governorate, Iraq. *International Journal of Agriculture and Food Science*. 2026;8(9):880-886. doi: <https://www.doi.org/10.33545/2664844X.2026.v8.i9l.1967>