Journal homepage
www.ajas.uoanbar.edu.iq
Anbar Journal of Agricultural Sciences
(University of Anbar – College of Agriculture)

SPATIAL MODELING OF SOIL TEXTURE CLASSES FOR AL–NAJMI DISTRICT IN AL–MUTHANNA GOVERNORATE USING THE SPATIAL INTERPOLATION METHOD

A. A. Yassin [1] **A. R. Jubier** [2*] **A. K. Fazza** [1]

[1] **Department of Soil Sciences and Water Resources, College of Agriculture, Al-Muthanna University, Al - Muthanna, Iraq.**

[2] **Department of Soil Sciences and Water Resources, College of Agriculture, Al-Qasim Green University, Babylon 51013, Iraq.**

***Correspondence to:** Amal Radhi Jubier, Department of Soil Sciences and Water Resources, College of Agriculture, Al-Qasim Green University, Babylon 51013, Iraq.
Email: amelradha@agre.uoqasim.edu.iq

Article info

Received: 2024-06-19
Accepted: 2024-08-13
Published: 2025-06-30

DOI-Crossref:
10.32649/ajas.2025.186587

Cite as:
Yassin, A. A., Jubier, A. R., and Fazza, A. K. (2025). Spatial modelingg of soill texture classes for al–najmi district in al–muthanna governorate using the spatial interpolation method. Anbar Journal of Agricultural Sciences, 23(1): 131-146.

Abstract

This study was conducted to determine the spatial distribution of soil texture classes and their particales (sand, silt, and clay). The lands of the study area are confined between longitudes 44^0 26' 00" to 45^0 10' 00" east and two latitudes 31^0 30' 00" to 31^0 40' 00" north; after the field visit, the auger drilling sites were determined to a depth of 0 - 30, 30 - 60, 60 – 90, 90 -120 m, which the detection was done, about 8 pedons, and the coordinates of the sites and pedons were determined with a GPS device. Then samples were obtained from each approved site and brought to the laboratory and prepared ,then the texture types were determined on the standard texture triangle, as the results showed a variation in the distribution of Types of textures: The percentage of sand ranged between 0.88 -76.78%, and the percentage of silt ranged between 11.16 - 79.58%, It is noted that the percentage of partical silt It is high in the soil of the study area .while the percentage of clay in these soils ranged between 4.0 - 61.0%. The results showed that the dominant type of texture in the soil of the study area is the Silt type. Clay Loam with a percentage of 34.87%, followed by Silt Clay with a percentage of 25.56%, The other types of textures are ranked in terms of dominance. The lowest percentage in terms of dominance was the Sand Loam type with a percentage of 5.92% and the Clay type with a percentage of 0.21%.

Keywords: Sustainable development, Texture class, Spatial interpolation, Agriculture, Modeling.

النمذجة المكانية لاصناف نسجة التربة لناحية النجمي في محافظة المثنى بأستعمال طريقة الاستكمال المكاني

علي عبدالحسين ياسين [1] أمل راضي جبير [2]* احمد كاظم فزاع [1]

[1] قسم علوم التربة والموارد المائية، كلية الزراعة، جامعة المثنى، المثنى، العراق.

[2] قسم علوم التربة والموارد المائية، كلية الزراعة، جامعة القاسم الخضراء، بابل، 51013، العراق.

***المراسلة الى:** امل راضي جبير، قسم علوم التربة والموارد المائية، كلية الزراعة، جامعة القاسم الخضراء، بابل 51013، العراق.

البريد الالكتروني: amelradha@agre.uoqasim.edu.iq

الخلاصة

اجريت هذه الدراسة لمعرفة التوزيع المكاني لأصناف نسجة التربة تقع اراضي منطقة الدراسة بين خطي طول 44^{0} 26' 00" to 45^{0} 10' 00" شرقا ودائرتي عرض 31^{0} 30' 00" to 31^{0} 40' 00" شمالا، بعد الزيارة الميدانية حددت مواقع الحفر المتقابي لعمق 0 – 30 و30 – 60، 60 – 90 و90 – 120 سم بواسطة الة الحفر المثقابي (الاوكر) بعدها تم الكشف عن 8 بيدونات وتم تحديد احداثيات المواقع والبيدونات بجهاز GPS، ثم استحصلت العينات من كل موقع وافق وجلبت للمختبر وتم تهيئتها ومن ثم تحديد اصناف النسجة على مثلث النسجة القياسي، اذ بينت النتائج تباين في توزيع اصناف النسجات وان نسبة الرمل تراوحت بين 0.88 – 76.78 %، و نسبة الغرين تراوحت بين 11.16 – 79.58%. اذ كانت نسبة الغرين مرتفعة في ترب منطقة الدراسة، اما نسبة الطين في هذه الترب تراوحت بين 4.0 – 61.0%، وبينت النتائج ان صنف النسجة السائد في ترب منطقة الدراسة هو صنف النسجة المزيجية الطينية الغرينية بنسبة 34.87%، تليها صنف النسجة الطينية الغرينية بنسبة 25.56، وتتدرج أصناف النسجات الأخرى من حيث السيادة، وكانت اقل نسبة من حيث السيادة صنف النسجة المزيجية الرملية بنسبة 5.92% والنسجة الطينية بنسبة 0.21%.

كلمات مفتاحية: التنمية المستدامة، صنف النسجة، الاستكمال المكاني، الزراعة، النمذجة.

Introduction

Soil is an important economic resource, especially in agricultural fields. It is in different forms and is studied and diagnosed by a specialist in soil management. Here, it is necessary to know what is present of these soils in the plot or geographical location designated by soil surveying and classification specialists, as sedimentary soils occupy areas Wide range of soil. The world is made up of transported soil materials, and these soils have played an important role in the development of agriculture since ancient times and before the emergence of the fertilization system. Therefore, they played a prominent role in the emergence of civilizations, as the newly formed sedimentary soils, the reaction of the soil formation factors in them is short, so the time available in them is not sufficient to form developed soils with horizons that we can recognize morphology (3). The physical properties of soil develop under natural conditions from the influence of permanent vegetation over a long period. These properties include soil texture, porosity, bulk density, aeration, and movement of soil components, as these physical properties largely control the size and arrangement of soil particles (14).

Knowing the distribution of soil content of separators is very important to study the effect of soil characteristics and the effect of the size distribution of soil particles in it, as well as knowing the effect of the interaction between the factors of increasing productivity represented by correct management of the soil and the relationship of soil texture to good crop productivity, especially in light of the increase in the proportion of the world's populationhas increased significantly in recent decades, especially in developing countries, which has led to an increase in the provision of food requirements in proportion to the rate of population increase. This situation has called for an expansion of the areas of land exploited for agricultural production, regardless of their suitability for the production of agricultural crops, which has led to To severe deterioration In the case of soil and its low productivity (5 and 6), soil surveying and classification undertake the tasks of diagnosing and describing these soils, and the description itself also has degrees of density, and the best descriptions are sufficient to serve the purposes of surveying, classification, and management together (3). Detecting and pedologically interpreting the soil and the accompanying changes in the chemical, physical and biological properties of the soil and the relationship of these properties to the soil texture is one of the most important tasks required to determine the administrative procedures required to be implemented to manage these lands (4).

Soil surveying depends to a large extent on the accuracy of the data obtained and how to deal with this data using modern technologies for the purpose of preparing maps, including the soil map, soil texture, land use, productive capacity, salinity, and others. As the number of sites examined increases and the accuracy of the data obtained increases, this leads to the production of maps with high accuracy (2). The particle-size distribution determines the soil's coarseness or fineness, or the soil's texture. Thus, soil texture is an important soil characteristic that drives crop production and field management.The importance of soil texture in various soil characteristics and its connection to chemical, biological and physical activities, such as aeration and exchange of nutrients and others. The aim of the research is to prepare a map of the spatial distribution of soil texture types and their various separations in the soil of Al-Najmi district in Al-Muthanna Governorate.

Materials and Methods

The study area is located in Al-Najmi district within Al-Muthanna Governorate, Iraq. The lands of the study area are confined between longitudes 440 26' 00" to 450 10' 00" east and two latitudes "30' 00 310 to 310 40' 00" north, based on the information obtained from the National Center for Water Resources Management Studies Department. After conducting field visits to the study area in Al-Najmi district of Al-Muthanna Governorate, the study area was identified and networked, a semi-detailed survey was conducted, and samples were obtained randomly using an auger drilling machine for the depths of 0 - 30, 30 - 60, 60 - 90, and 90 - 120 cm. Its coordinates were determined using a GPS device for thirty sites, the soil texture, salinity, content of carbonate minerals, gypsum, and organic matter, and variation in natural vegetation and land use were examined. After obtaining the necessary laboratory measurements, 8 pedons representative of the study area were detected and their horizons were described in a fundamental morphological manner according to (9 and 1) Samples were obtained from each location and horizon, preserved, numbered, and brought to the laboratory for the purpose of preparing them for the necessary laboratory measurements on them.

Laboratory procedures: All obtained soil samples were subjected to estimation of the size distribution of soil particles using the pipette method mentioned in (9), Soil reaction pH was measured in the saturated soil paste extract according to (17).

- Electrical conductivity was measured in the saturated soil paste extract according to the method mentioned in (17).
- Total calcium carbonate minerals were estimated according to (7).
- Gypsum was estimated by acetone precipitation according to the method given in (11), The exchange capacity of positive ions in the soil was estimated using ammonium acetate NH_4OH (1 molar) at 7 pH according to (9). As for the organic matter in the soil, it was estimated using the wet digestion method by titration with ammoniacal ferrous sulfate mentioned in (15).

Office procedures: A database was created for the study area, which included a file of the quantitative soil characteristics that were measured in the laboratory, and the file was created in the Excel program. After that, the data obtained in the laboratory is linked or called to the spatial data in the Arc Map program within the Geographic Information Systems (GIS) program. And it was corrected the coordinates are in the UTM metric system, and a shepfile was created to determine and deduct the study area. After that, maps of soil separations and texture classes were produced. The inverse distance weighting (IDW) method was used in drawing maps. Added the equations that used for calculation the percentage of texture distribution as well as the area of study by hectare were added by GIS.

Results and Discussion

Classify soil texture: The results of Table 1 indicate that the dominant textural type in the soil of the study area is the Silt Clay Loam type with a percentage of 34.87%, followed by the Silt Clay type with a percentage of 25.56%. The other types of textural range in order of dominance, with the lowest percentage being for the Sand Loam type with a percentage of 5.92% and the Clay type. By 5.0%, the reason is attributed to the rule of the textures in which silt is dominant are due to the nature of the sedimentary soils, which are characterized by their moderately fine textures. The results of Table 2 and Figure 1 show that the spatial distribution of the soil texture types in Horizon A is that the Silt Clay Loam texture type occupied the largest area, amounting to 7021.26

hectares, or 34.89% of the total area of the study area. The smallest area in Horizon A was occupied by the Sand Loam texture type, as it amounted to 237.42 hectares, or 1.18% of the area Overall, the dominant textural class in Horizon C1 is Silt Clay Loam, as it occupied the largest area, amounting to 9176.72 hectares, or 45.60% of the total area occupied by this horizon. The smallest area occupied by the Loam textile class in this horizon amounted to 290.33 hectares, or 1.44% of The area of this horizon is C1, and the prevailing texture type is in The C2 horizon was the texture variety Silt Clay, as it occupied the largest area in this horizon, amounting to 7987.39 hectares, or 39.69% of the total area of the C2 horizon, while the clay variety occupied the smallest area of the C2 horizon, amounting to 13.13 hectares, or a percentage of 0.21%. As for the dominant texture type On the C3 horizon is Silt Clay, as it takes up the largest area in this the horizon amounted to 6471.72 hectares, representing 32.16% of the total area of the C3 horizon. As for the Silt Loam textile type, it occupied the smallest area in this horizon, amounting to 329.90 hectares, representing 1.64% of the total area of the C3 horizon. The reason for the dominance of the moderately fine texture type in the soil horizons of the study area is attributed to the nature of deposition conditions and environmental conditions prevailing in the region, and these results agree with what I found (13).

Table 1: The soil particale size distribution and texture types of soils in the study area.

Coordinate		Horizon C1				Horizon A			
Y	X	Texture	Clay %	Silt %	Sand %	Texture	Clay %	Silt %	Sand %
3486438.35	541943.04	SiCL	35	61.02	3.98	SiCL	35	60.44	4.56
3499995.33	547931.51	SiL	21	52.26	26.74	L	21	44.88	34.12
3497404.99	542551.85	SiC	42	50.42	7.58	Si.L	23	54.18	22.82
3490776.74	542943.74	CL	29	48.96	22.04	SiCL	36	57.24	6.76
3489527.90	536615.62	SiC	53	44.22	2.78	SiC	43	45.7	11.3
3494065.33	538755.62	SiCL	33	51.04	15.96	SiL	26	53.46	20.54
3500549.28	543441.94	SiCL	32	55.02	12.98	SiL	25	51.42	23.58
3497605.73	546948.10	SiC	48	47.6	4.4	SiCL	32	62.64	5.36
3501120.17	549621.35	SiCL	36	57.56	6.44	SiCL	29	53.64	17.36
3501032.16	546717.03	SiC	45	48.16	6.84	SiL	24	59.2	16.8
3500900.15	545176.86	SiC	48	49.04	2.96	SiCL	36	55.64	8.36
3500856.14	541876.50	SiC	52	42.1	5.9	SiCL	34	47.74	18.26
3483097.02	540712.51	SiCL	38.2	37	24.8	SiCL	35.38	37.12	27.5
3486039.20	537664.51	SiC	49	46.28	4.72	SiL	14	54.26	31.74
3487584.37	536077.00	SiCL	32	57.58	10.42	SiCL	31	61.24	7.76
3488515.70	538934.51	SiCL	38	46.46	15.54	SiCL	32	57.58	10.42
3488177.03	541178.18	SiL	14	54.26	31.74	SiL	6	49.66	44.34
3488685.03	543739.35	CL	34	34.02	31.98	L	17	48.56	34.44
3490547.70	540479.68	SiCL	35	58.94	6.06	SiC	46	51.34	2.66
3491733.04	538236.01	SiCL	33	55.08	11.92	SiL	19	60.06	20.94
3493130.04	541093.51	SiCL	34	49.5	16.5	SiL	17	50.84	32.16
3493341.71	544670.69	SiL	16	69.18	14.82	SiL	14	59.6	26.4
3494929.21	546321.69	SiCL	39	47.7	13.3	L	26	46.24	27.76
3497067.05	544691.85	CL	36	43.56	20.44	SiC	48.4	44.48	7.12
3495098.55	542024.85	SiL	26	54.34	19.66	SiC	47	47.56	5.44
3497067.05	540522.01	SiCL	31	58.7	10.3	SL	4	26.98	69.02
3499056.72	540924.18	SiL	20	59.88	20.12	SiCL	29	58.58	12.42
3499226.06	542998.52	SiCL	34	52.44	13.56	SiCL	29	58.58	12.42

3499141.39	546131.19	SiCL	34	52.44	13.56	SiCL	40	50.66	9.34
3502432.81	542509.04	SiCL	36	60.74	3.26	SiCL	37	59.08	3.92
3484536.36	538934.51	SiCL	35	52.88	12.12	CL	33	40.74	26.26
3486589.53	540162.18	L	17	30.02	52.98	CL	36	37.08	26.92
3490124.37	538574.67	SiCL	35	63.64	1.36	SiC	51	42.54	6.46
3491330.87	545284.52	SiCL	39	53.12	7.88	SiL	23	54.8	22.2
3493320.54	542702.18	SiCL	31	54.5	14.5	CL	30	49.76	20.24
3495310.21	544120.35	SiCL	35	58.4	6.6	SiL	7	79.58	13.42
3495373.71	540035.18	SiCL	39	44.1	16.9	L	20	40.32	39.68
3502189.39	545176.04	SiL	9	30.94	60.06	SiCL	38	42.58	19.42

Coordinates		Horizon C3				Horizon C2			
Y	X	Texture	Clay %	Silt %	Sand %	Texture	Clay %	Silt %	Sand %
3486438.35	541943.04	SiCL	32	65.56	2.44	SiCL	36	56.32	7.68
3499995.33	547931.51	SiC	42	55.44	2.56	SL	12	11.22	76.78
3497404.99	542551.85	C	57	38.86	4.14	C	51	36.68	12.32
3490776.74	542943.74	SiCL	39	49.38	11.62	L	21	44.52	34.48
3489527.90	536615.62	SiC	49	45.44	5.56	SiC	52	47.22	0.78
3494065.33	538755.62	SiC	48	43.16	8.84	SiC	51	40.92	8.08
3500549.28	543441.94	SL	14	29.78	56.22	SiCL	29	59.71	11.29
3497605.73	546948.10	SiC	47	50.82	2.18	SiC	52	46.04	1.96
3501120.17	549621.35	SiCL	35	59.54	5.46	SiCL	39	56.66	4.34
3501032.16	546717.03	CL	35	44.54	20.46	CL	29	41.72	29.28
3500900.15	545176.86	C	58	37.5	4.5	SiC	56	41.5	2.5
3500856.14	541876.50	SiCL	35	59	6	SiC	49	46.04	4.96
3483097.02	540712.51	SiC	47	46.6	6.4	SiC	47	47.08	5.92
3486039.20	537664.51	SiC	50	45.32	4.68	SiC	47	47.08	5.92
3487584.37	536077.00	SiCL	38	61.34	0.66	SiCL	37	59.8	3.2
3488515.70	538934.51	L	20	44.4	35.6	CL	33.18	45.62	21.2
3488177.03	541178.18	CL	32	45.84	22.16	SL	9	19.4	71.6
3488685.03	543739.35	C	47.1	39.2	13.7	CL	33	38.02	28.98
3490547.70	540479.68	SiCL	33	55.68	11.32	SiCL	38	51.58	10.42
3491733.04	538236.01	SiC	43	56.42	0.58	SiC	48	47.8	4.2
3493130.04	541093.51	SiC	48	43.92	8.08	SiC	48	48.86	3.14
3493341.71	544670.69	SiC	54	39.62	6.38	SiCL	39	50.52	10.48
3494929.21	546321.69	CL	34	41.44	24.56	SiCL	38	48.1	13.9
3497067.05	544691.85	SiCL	34	58.04	7.96	L	18	33.7	48.3
3495098.55	542024.85	L	11	47.64	41.36	SiL	13	58.92	28.08
3497067.05	540522.01	SL	4	28.62	67.38	SiL	19	52.1	28.9
3499056.72	540924.18	L	15	42.56	42.44	SL	18	25.94	56.06
3499226.06	542998.52	SL	4	11.16	84.84	L	15	42.56	42.44
3499141.39	546131.19	SiC	44	50.9	5.1	L	17	43.22	39.78
3502432.81	542509.04	C	61	38.04	0.96	SiCL	32	67.36	0.64
3484536.36	538934.51	SiL	19	52	29	SiCL	35	60.2	4.8
3486589.53	540162.18	SiC	41	52.1	6.9	SiC	46	46.86	7.14
3490124.37	538574.67	SiCL	43	53.5	3.5	SiC	44.8	49.04	6.16
3491330.87	545284.52	SiCL	39	49.54	11.46	SiC	44.6	44.12	11.28
3493320.54	542702.18	SiC	46	41.42	12.58	SiC	49	45.44	5.56
3495310.21	544120.35	SiC	51	48.62	0.38	SiC	54	44.5	1.5
3495373.71	540035.18	SL	13	21.6	65.4	L	22	36.2	41.8
3502189.39	545176.04	SL	8	20.1	71.9	SL	12.7	30.96	56.34

Table 2: Area and percentage of texture classes of soils in the study area

Horizon C1			Horizon A		
Percentage %	Area (hectar)	Texture Class	Percentage %	Area (hectar)	Texture Class
45.60	9176.72	SiCL	25.99	5229.93	SiL
36.47	7340.49	SiC	24.84	4999.18	SiC
13.62	2739.68	SiL	34.89	7021.26	SiCL
2,87	577.54	CL	10.25	2062.98	L
1.44	290.33	L	2.85	573.99	CL
-	-	-	1.18	237.42	SL
100	20124.76	Sum	100	20124.76	Sum
Horizon C3			**Horizon C2**		
Percentage %	Area (hectar)	Texture Class	Percentage %	Area (hectar)	Texture Class
5.47	1100.85	L	8.44	1698.85	SL
13.71	2758.35	C	28.55	5745.68	L
26.86	5404.66	SiCL	39.69	7967.39	SiC
32.16	6471.72	SiC	17.66	3554.64	SiCL
14.38	2894.85	SL	4.11	827.86	CL
5.79	1164.43	CL	1.33	267.21	SiL
1.64	329.90	SiL	0.21	43.13	C
100	20124.76	Sum	100	20124.76	Sum

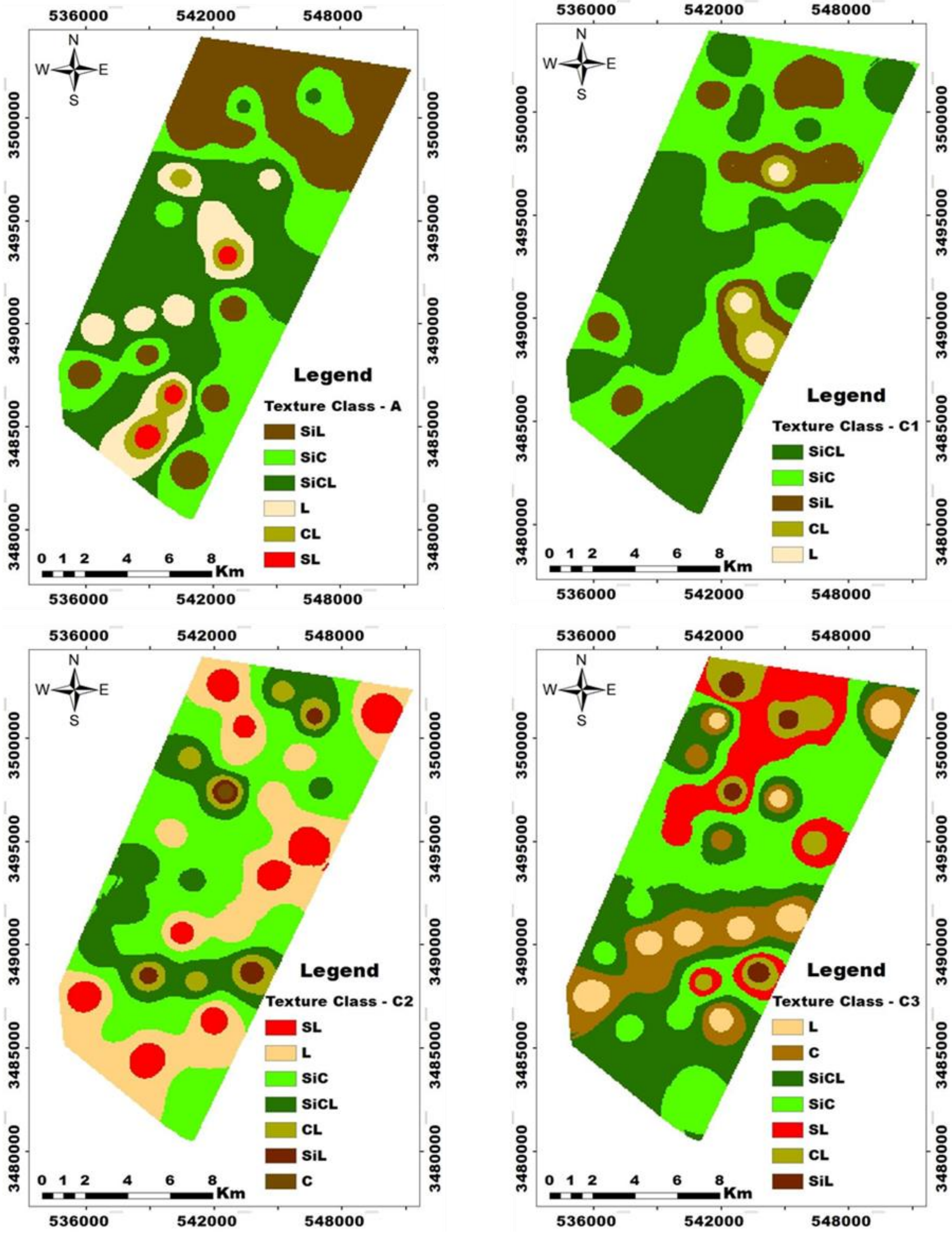

Figure 1: Spatial distribution of soil texture types for the study area.

The Sand: The results of Table 1 show that the percentage of sand in the soil of the study area ranged between 0.58 - 76.78%, as the lowest percentage was in the depth of 90 - 120 cm, while the highest percentage of sand was in horizon C2 of pedon 2. The distribution of the percentage of sand in the horizons and depths of the soil of the study area. It depends on the nature of sedimentation in the area, as agriculture has a clear effect on the movement of fine particles with irrigation water and their descent to the bottom, while the coarse particles of sand remain, as in site 12 of the cultivated (abandoned) of sites there was no mechanical transport of fine particles, as for Al-pedon. The lowest percentage was in the depth of 90 - 120 cm, while the highest percentage of sand was in the C2 horizon of pedon 2. The distribution of the sand percentage in the horizons and depths of the soil of the study area. It depends on the nature of sedimentation in the area, as agriculture has a clear effect on the movement of fine particles with irrigation water and their descent to the down, while the coarse particles of sand remain, as in site 12 of the cultivated (abandoned) of sites there was no mechanical transport of fine particles, as for Al-pedon. 2 implants moved fine particale down, and these results are consistent with what found in (3 and 12).

The results of the table 2 and figure 2 indicate the spatial distribution of sand percentage in the study area It was distributed in horizon A in five ranges, as the range 15.93 – 29.18% occupied the largest area, amounting to 12514.40 hectares, percentage 62.18% of the total area in horizon A. As for the smallest area, it was occupied by the range 55.70 - 68.95%, amounting to 77.36 hectares, percentage 0.38% of the area. Horizon A, while the distribution of sand in Horizon C1 is distributed in five ranges, occupying range 13.11- 24.82%. The largest area was 10.615.47 hectares, representing 52.75% of the area of the C1 horizon. The smallest area, occupied by the range 48.27 - 60.00%, amounted to 84.48 hectares, representing 0.42% of the area of the C1 horizon. The sand was distributed in the C2 horizon in five ranges, occupying the range 15.89 – 10.31%. The largest area amounted to 6744.71 hectares, percentage 33.51%, while the area occupied 6153 - 76.74%. The smallest area in this horizon, C2, amounted to 120.49 hectares, at a rate of 0.60%. As for the distribution of sand in horizon C3, it is also distributed in five ranges, occupying the range 0.45 - 17.30 %. The largest area amounted to 13810.43 hectares, at a rate of 68.62% of the total area of horizon C3, while the range is 88.67 - 84.73%, it occupied the smallest area in this horizon, amounting to 74.69 hectares At a rate of 0.37%, it is noted from the above results that the spatial distribution of the sand percentage was distributed in homogeneous proportions, due to the fact that most of the study area is not cultivated and abandoned, which means that fine particles are not transported with irrigation water and plant roots (4 and 16).

Table 3: Area and percentage of partical Sand of soils in the study area.

	Horizon C1			Horizon A	
Percentage%	**Area (hectar)**	**Range %**	**Percentage%**	**Area (hectar)**	**Range %**
40.37	8124.78	13.10-137	30.0	6038.23	5.92- 2.6
52.75	10615.47	24.82-13.11	62.81	12514.40	29.18 -15.93
5.35	1076.84	36.55-24.83	6.52	1311.60	42.43 - 29.19
1.11	223.19	48.27- 36.56	0.91	183.18	55.69 - 42,44
0.42	84.48	60.00- 48.27	0.38	77.36	68.95 - 55.70
100	20124.76	Sum	100	20124.76	Sum
	Horizon C3			**Horizon C2**	
Percentage%	**Area (hectar)**	**Range %**	**Percentage%**	**Area (hectar)**	**Range %**
68.62	13810.43	17.30- 0.45	50.67	10196.65	15.88- 0.67
17.75	3571.54	34.16- 17.30	33.51	6744.71	31.10- 15.89
10.06	2023.86	51.01- 34.16	13.03	2621.86	46.31- 31.10
3.20	644.24	67.87- 51.02	2.19	441.05	61.52- 46.32
0.37	74.69	84.73- 67.88	0.60	120.49	76.74- 61.53
100	20124.76	Sum	100	20124.76	Sum

The Silt: The results of Table 4 indicate that the percentage of silt in the soil of the study area ranged between 11.16 - 79.58%, as the lowest percentage was in site 20 at a depth of 60 - 90 cm, while the highest percentage was in site 28 at a depth of 0 -30 cm. It is noted that the percentage of partical silt It is high in the soil of the study area, and the reason is attributed to the high percentage of silt resulting from the conditions Sedimentation, and the nature of land use or the results of Table 5 and Figure 3 made it clear that the spatial distribution of silt in the soil of the study area was distributed in three ranges in each of horizons A, C1, C2, and C3, as the range 44.52 - 62.00% occupied the largest area in horizon A, which amounted to 17530.02 hectares, or a percentage of 87.11%. , while filling the range 0162-79.49% of the smallest area in horizon A reached 248.09, percentage of 1.23% of the area of this horizon. The range is 43.09-56.12%, the occupancy of the largest area in horizon C1 reached 16,827.99 hectares, percentage of 83.62% of the area of this horizon. The range is 30.03-43.08%, smollest occupancy. The area of Horizon C1 amounted to 1521.89 hectares, at a rate of 7.56%. The largest area is on Horizon Range C2 was occupied by 29.94 - 48.63%, amounting to 14966.41 hectares, percentage of 74.37%. As for the smallest area in horizon C2, it was occupied by 11.25 - 29.94%, amounting to 399.70 hectares, percentage of 1.99%. As for horizon C3, it occupied the largest area of 47.44 - 65.54% 10153.97 hectares - by 50.46%, while the occupancy range 11:22 - 29.33 is smaller an area of 507.30 hectares, at a rate of 2.52% of the total area of horizon C3.

The reason for the distribution of silt and its dominance in the horizons of the study soils is attributed to the nature of the carrier factor and the periods of deposition during which the soils were formed. Also, the location of the area within the sedimentary layer, which distinguishes it from the rest of the soils as it has a wide variation in Soil Textures (10). As well as the nature of the source material and the prevailing environmental conditions, such as high temperatures and low precipitation, which reduces the processes of physical, chemical and biological weathering, which reflects the dominance of these parts in the soil.

Table 4: Area and percentage of partical Silt of soils in the study area.

Horizon C1			Horizon A		
Percentage%	Area (hectar)	Range %	Percentage%	Area (hectar)	Range %
7.56	1521.89	43.08-30.03	11.66	2346.64	44.51-27.02
83.62	16827.99	56.12-33.09	87.11	17530.02	62.00-44.52
8.82	1774.88	69.18-56.13	1.23	248.09	79.49-62.01
100	20124.76	Sum	100	20124.76	Sum
Horizon C3			Horizon C2		
Percentage%	Area (hectar)	Range %	Percentage%	Area (hectar)	Range %
2.52	507.30	29.33- 11.22	1.99	399.70	29.94- 11.25
47.02	9463.49	47.43- 29.34	74.37	14966.41	48.63- 29.94
50.46	10153.97	45.54- 47.44	23.65	4758.64	67.34- 48.64
100	20124.76	Sum	100	20124.76	Sum

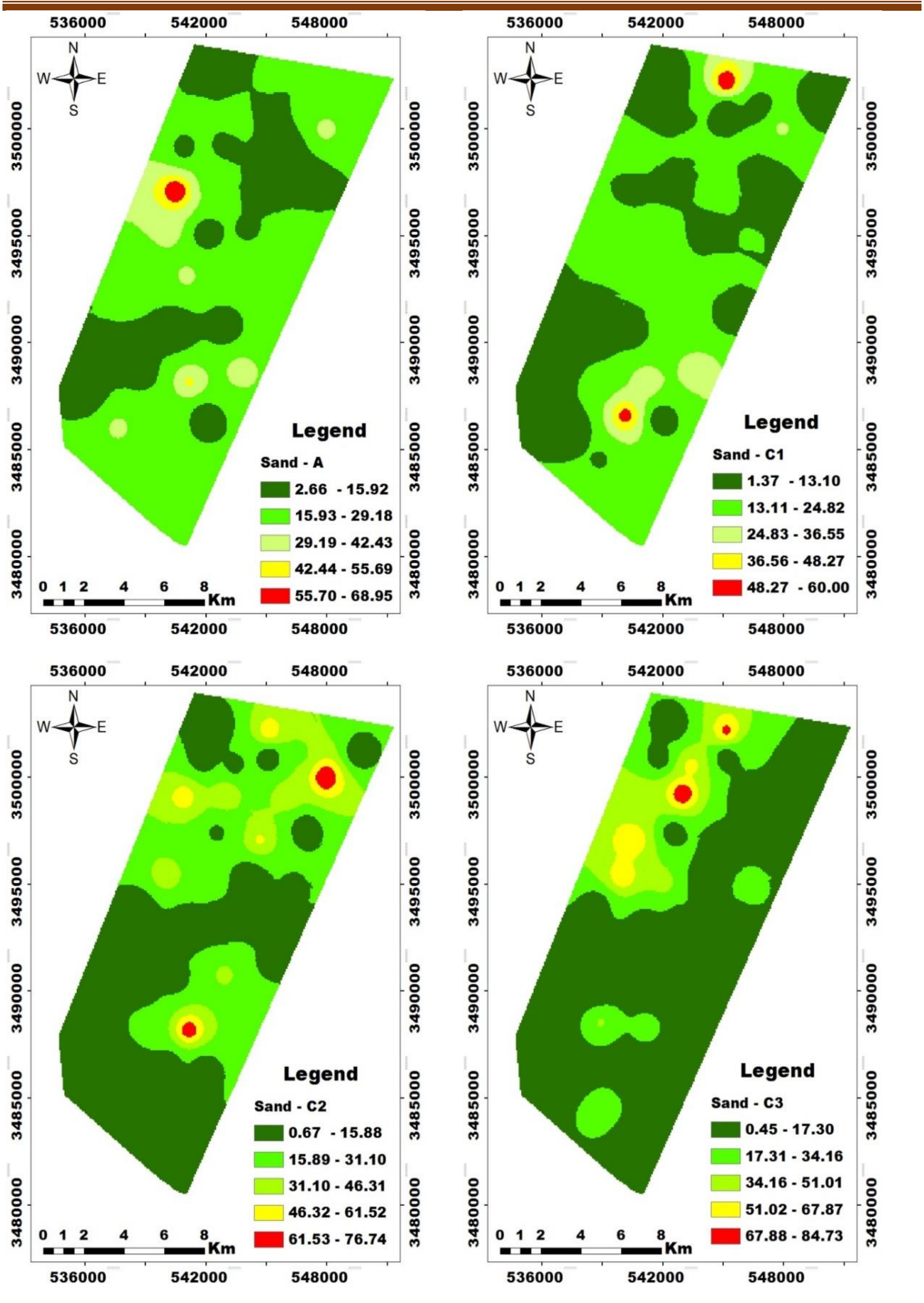

Figure 2: Spatial distribution of partical Sand for the study area.

The Clay: The results of Table 1 indicate that the percentage of clay in the soil of the study area ranged between 4.00 - 61.00%, as the lowest percentage was in site 18 at a depth of 0 - 30 cm and at a depth of 90 - 120 cm for the same site and in site 20 at a depth of 90 - 120 cm, but the highest A percentage was in site 22 from depth 90 – 120 cm, as the lowest percentage was of a texture It was Sand Loam, but in a high percentage it was of a clay texture. The reason is attributed to the nature of deposition in the study area and the diversity of soil texture types in it.

The results are presented in Table 5 and Figure 4. The spatial distribution of clay in the soil of the study area was distributed in three ranges in all horizons. The range is 19.69 – 35.33%, the largest area in Horizon A amounted to 16826.65 hectares, with a percentage of 83.61%, and the smallest area in this horizon was occupied by the range 4.04 - 19.68%, amounting to 310.71 hectares, with a percentage of 6.51%. As for Horizon C1, and the range was occupied by 23.70 - 38.35%, the largest area amounted to 16,686.60 hectares, with a percentage of 82.92%. 9.04 - 23.69%, the smallest area was 753.61 hectares, or 3.74% of the total area of horizon C1, while in horizon C2, occupied the range 24.68 - 40.29%, the largest area amounted to 12,355.23 hectares, percentage of 39.61%, and the range occupied 9.06 - 24.67%. The largest area Horizon C3 amounted to 13862.0 hectares, with a rate of 68.88%, while occupancy Range 4.04 – 23.01%. The smallest area in this horizon amounted to 2032.31 hectares, representing 10.10% of the total area of horizon C3. It is noted that the distribution of soil particles, especially clay, varies. The reason for this is attributed to the proximity and distance from the source of precipitation and the area's impact on ancient floods, in addition to the effect of the agricultural process in some agricultural sites (8)

Table 5: Area and percentage of partical Clay of soils in the study area.

	Horizon C1			Horizon A	
Percentage%	**Area (hectar)**	**Range %**	**Percentage%**	**Area (hectar)**	**Range %**
3.74	753.61	23.69-9.04	6.51	1310.71	19.68 - 4.04
82.92	16686.60	38.35-23.70	83.61	16826.65	35.33-19.69
13.34	2684.55	53.00-38.36	9.88	1987.40	50.98- 35.34
100	20124.76	Sum	100	20124.76	Sum
	Horizon C3			**Horizon C2**	
Percentage%	**Area (hectar)**	**Range %**	**Percentage%**	**Area (hectar)**	**Range %**
10.10	2032.31	23.01- 4.04	9.04	1818.89	24.67-9.06
68.88	13862.0	41.98-23.02	61.39	12355.23	40.29-24.86
21.02	4230.45	60.96- 41.99	29.57	5950.64	55.91- 40.29
100	20124.76	Sum	100	20124.76	Sum

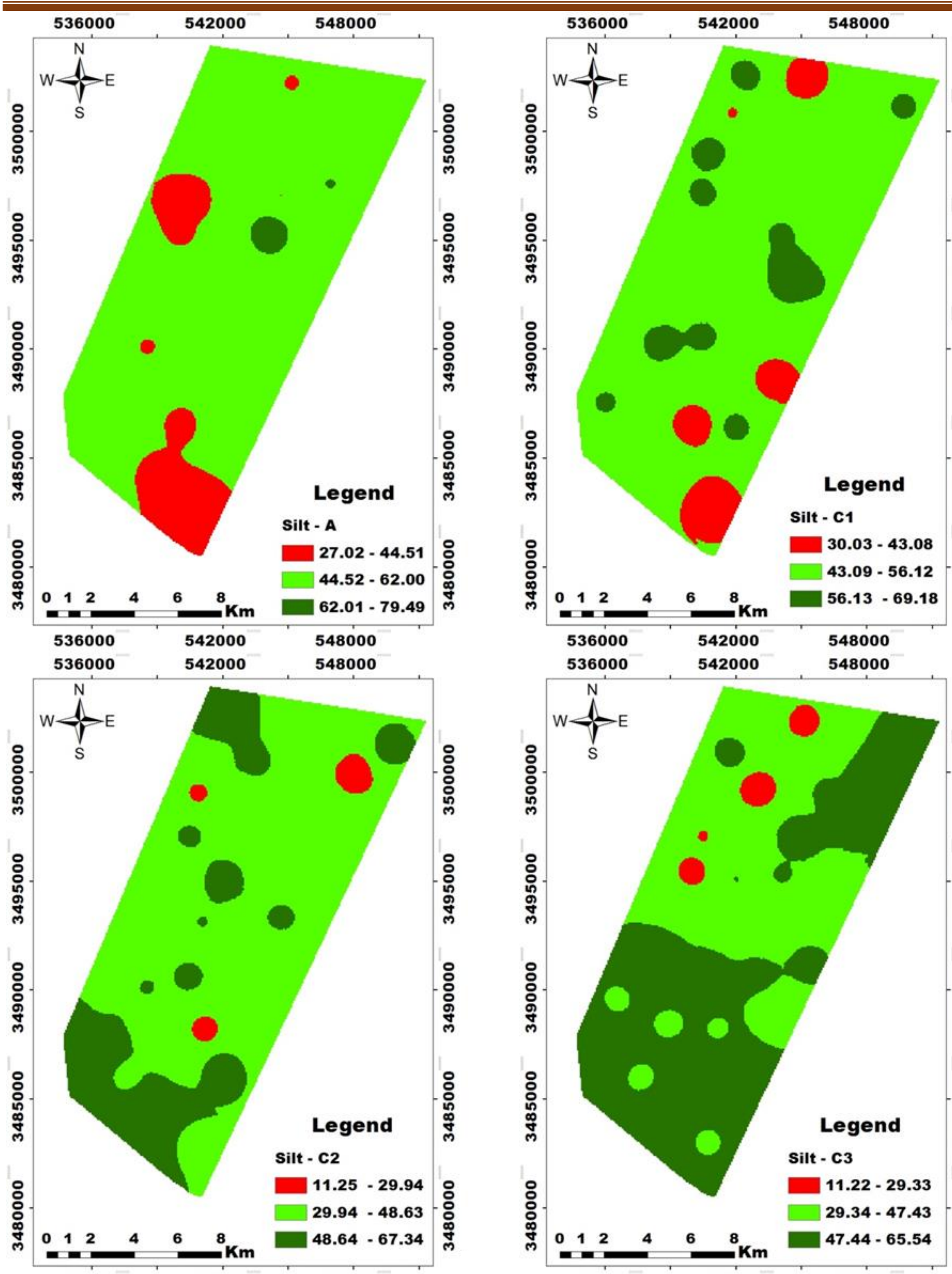

Figure 3: Spatial distribution of the Silt for the study area.

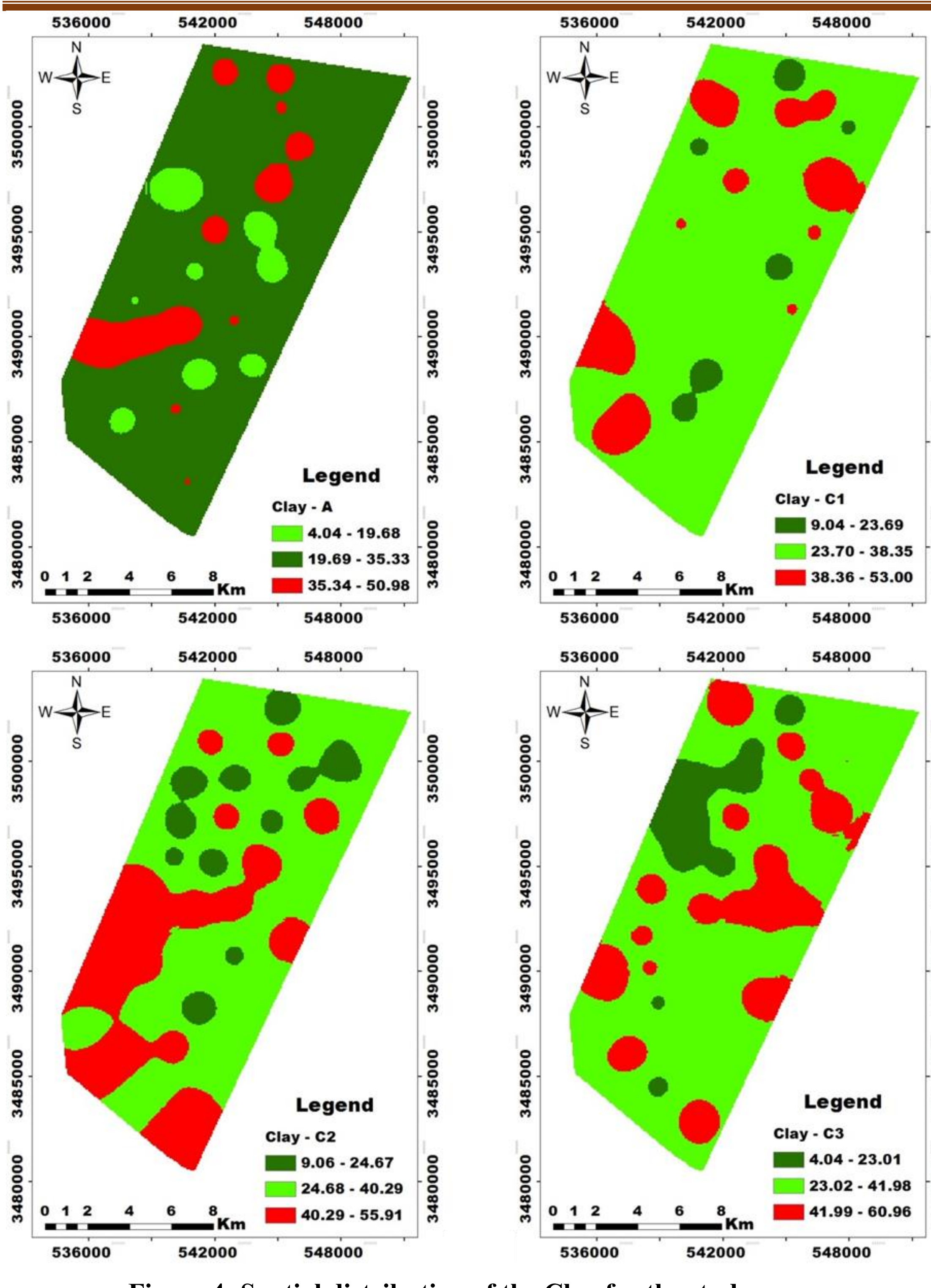

Figure 4: Spatial distribution of the Clay for the study area.

Conclusions

It is concluded that the predominance of fine and medium-fine textures compared to coarse textures in most of the soils of the study area is a result of the high content of silt and clay separators at the expense of the sand separators, while an increase in sand separators was observed in some locations as a result of their proximity to the source of deposition.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

Author 1; methodology, writing original draft preparation, Author 2 and Author writing 3 review and editing. All authors have read and agreed to the published version of the manuscript.

Funding:

This research received no external funding.

Institutional Review Board Statement:

The study was conducted in according to the department of soil sciences and water resources at the college of Agriculture – Al Qasim Green University.

Informed Consent Statement:

No Informed Consent Statement.

Data Availability Statement:

No Data Availability Statement.

Conflicts of Interest:

The authors declare no conflict of interest.

Acknowledgments:

The authors are thankful for the help of the Deanship of the college of Agriculture and the head of the department of soil sciences and water resources at Al – Qasim Green University, Iraq. For their assistance in completing this research.

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