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The effect of surface management method on the pedological properties of soil using geospatial applications for some football fields in Iraq

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Abstract

A field study was carried out to study the variations in some of the biological characteristics of the green areas within two football fields (Al-Karkh stadiums in Baghdad Governorate and Najaf Stadium in Najaf Governorate). Due to the heterogeneity of the management methods used, so dirt samples were obtained from the depth of 0-30 cm after determining geographical locations 5 drill hole site examined at each stadium, and base maps were produced for the study areas using Google earth, with the aim of studying the impact of football stadium management style on some soil pedological characteristics. The results of the volumetric distribution of the soil separations of the surface samples of the playgrounds showed that the coarse texture is predominant in the two playgrounds, as the predominance in them is for the sand separated. The results also indicate a decrease in the bulk density values of all surface samples of the two playgrounds despite the predominance of the coarse separation in all surface samples, if Which was reflected in the values of porosity, as the results showed a disparity in the values of porosity in the stadiums. The results indicate a low salinity These results are consistent with the nature of the management method followed, and it was found that there is a variation in the values of organic carbon content, as the concentration of organic carbon in the soil is affected by soil management, and From the calculation of the readiness index of elements, it was found that the nitrogen readiness index was moderate in Karkh stadium, while Najaf stadium had a low nitrogen readiness index, while the phosphorus readiness index was high in Karkh and Najaf stadiums, while the potassium readiness index was low in Najaf stadium and medium in Karkh stadium.
Keywords: Green landscapes, Football fields, Characteristics of stadium soil, Management style, NPK readiness guide.

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Introduction:

The process of development that countries are undergoing is likely to enhance their status and propel them towards progress and advancement. Development encompasses many aspects that play a global, international, and local role. Perhaps the most important factor in attracting tourists is working on developing the attractions, including managing green spaces in optimal ways to gain approval and achieve the desired purpose. Green spaces are the cornerstone of urban planning due to their significant impact, and their presence serves to consider the planning, urban, and climatic requirements. They are an important element that must be present in every city and region due to their numerous benefits, including environmental, health, social, sports, and aesthetic benefits. The most important of these benefits is reducing soil erosion and increasing air humidity, which leads to moderating the temperature, especially in the summer. Creating a front view of trees, shrubs, and flowers also works to increase oxygen levels and reduce the percentage of gases emitted by industries and traffic, especially carbon dioxide, through a process called photosynthesis, where plants take in carbon dioxide and release oxygen, thereby purifying the air, softening the atmosphere, and reducing noise pollution through afforestation. They also act as cushions to reduce and alleviate injuries in sports fields, children's playgrounds, and race tracks, and are planted to stabilize slopes and incline (Kraemer & Kabisch, 2021; Anteneh *et al*.,2023).

The playgrounds are large flat areas of land covered with greenery, which are known as green rugs or lawns, and they need strenuous effort to work to bring them out in the most pompous way because they are considered a wonderful artistic cushion between the feet of the players and the playing ground, and the importance of their presence appears especially in football, polo, croquette, tennis, hockey, golf, equestrian fields... etc., whose floor must be flat and symmetrical because it affects the level of performance of the players and the control of the playing tool (ball-spear-pole-... etc.) And reduce the incidence of sports injuries Since hard and uneven floors cause muscle strain and exposure of the lower limb joints to sudden aches and injuries, in addition to obstructing playing tools and thus the results of the players are affected, so the process of creating green courts needs the necessary technical expertise so that the continuity of the green playing field can be maintained in good condition, whether during matches or training and after it throughout the year, because making any mistake during the construction process causes severe damage that may They are difficult to treat in the future, and even if we can fix them, the costs of this can be high(ÖZKAN, 2022).

Football fields are classified into two groups according to the characteristics of the land: natural grass fields and artificial turf fields. In recent years, the use of hybrid stadiums has also become widespread, with regard to football players and the game, natural grass fields are preferred to artificial turf pitches (Emmons and Rossi, 2015). The grass creates a visual aesthetic appearance and absorbs sunlight, reducing the effects of sunlight on the eyes. On the other hand, football pitches create a soft ground and area that can be moved more safely for players (Orchard, 2002; Chivers, 2008). The dimensions of the pitch can range from a minimum of 90 meters in length to a maximum of 120 meters and a minimum width of 45 meters and a maximum of 90 meters, while the standard dimensions of the turf court are x105 68 m (FIFA, 2011: UEFA, 2018). These dimensions are mandatory for final matches, for example the FIFA World Cup, Confederations Championships and European Champions.

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Football pitches are one of the most difficult areas to maintain among climate stadiums, excessive wear and pressure of grass due to playing many matches on the surface of natural grass (Puhalla *et al*., 2020). These difficulties are represented by conditions on the same land and high maintenance costs (Pessarakli, 2007).

Therefore, uneven or unstable ground can hinder the performance of players. These issues are minimized in football stadiums that are well constructed and managed with a proper infrastructure system and the correct grass types and varieties in line with standards (Emmons and Rossi, 2015). Sports fields with natural grass can be highly variable depending on use and management and the characteristics of the grass significantly affect the mechanical performance (Straw *et al*., 2020).

Methodology:

Study area

The study was conducted for the two stadiums, Al-Karkh Stadium in Baghdad Governorate, which has an area of (7140) m2, where it is located on a longitude of (33º19'80') and latitudes (44º21'54') in the center of Baghdad on the Karkh side, surrounded on the northern side by the Arm neighborhood, on the east by Al-Zawraa Park, on the south by the Baghdad International Fair and on the western side by the Alhelal Hospital. The study also included the province of Najaf, which included Najaf International Stadium, which has an area of (10625) m2, where it is located on a longitude (32º03'58') and latitude circles (44º19'01'), surrounded on the northern side by Al-Kafeel University Street, on the east by Karbala-Najaf Road and Al-Mukarramah neighborhood, on the south by Al-Nidaa neighborhood, and on the western side by Al-Askari neighborhood (Figure 1).

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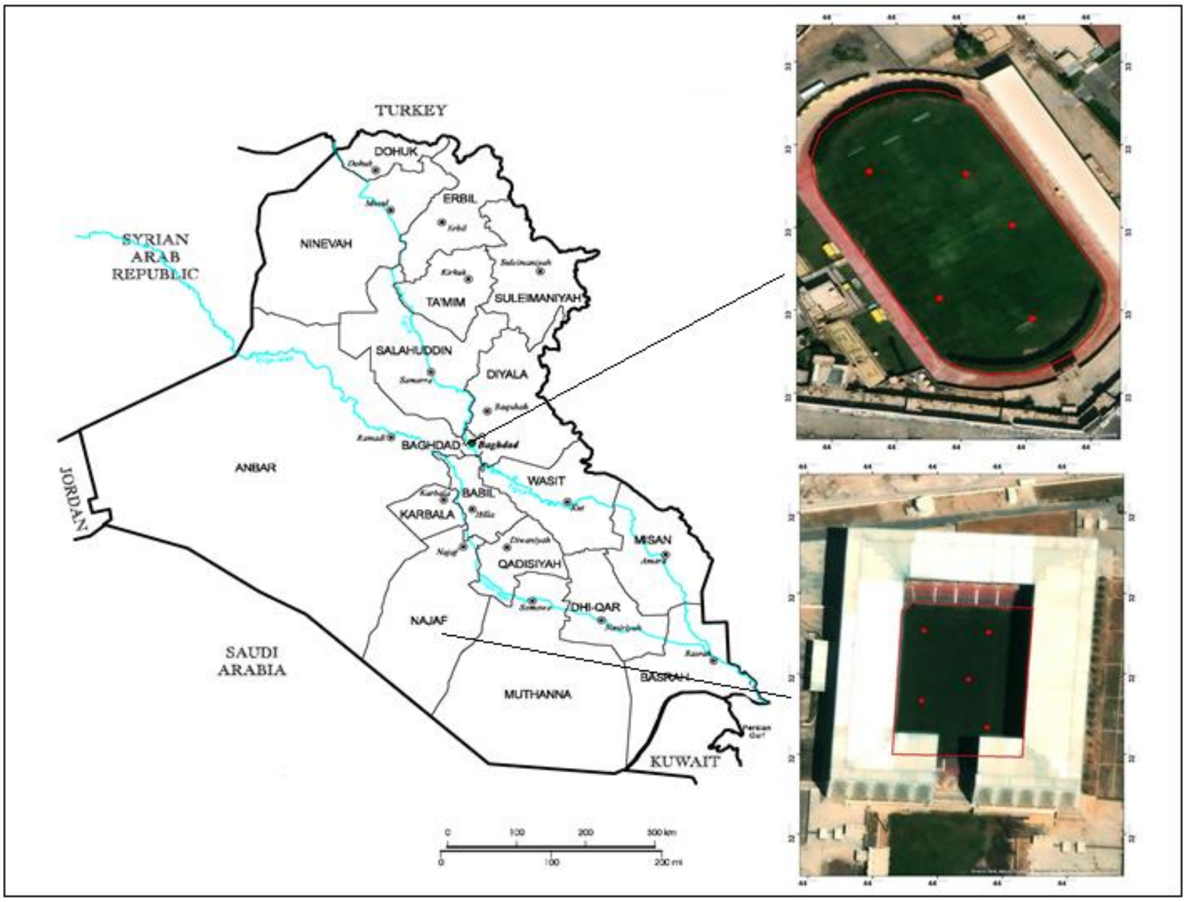

Figure 1. Aerial photos of Alkarkh and Najaf stadiums.

Field procedures:

Several visits were made to the specified areas mentioned earlier, and samples were collected during the period from 8th November, 2022, to 27th January, 2023. During this time, 6 drill hole sites were identified for each field, considering each site as representing the ground perspective of the green spaces. At each site, soil samples were obtained from depths of 0-30 cm (the root zone and the habitat for green plants), packed in polyethylene bags, numbered, and transported to the laboratory for various physical, chemical, and fertility analyses.

Preparation of soil samples for laboratory analysis and measurements: The obtained soil from each diagnostic horizon was air-dried, ground, and then sieved through a 2mm sieve diameter, then stored in plastic containers until laboratory analysis and measurements were carried out. Some aggregates were isolated and kept without separation for the purpose of measuring apparent density. Run the mechanical analysis of soil samples using the Hydrometer method according to Day (1965) and described in Black (1965). Estimate the apparent density of the soil by wax-coating the container, and according to the method provided by Black *et al*. (1965a). Estimate the electrical conductivity of the 1:1 extract according to the method provided in Black (1965b). The soil's calcium carbonate equivalent content was estimated by titration with 1N sodium hydroxide after

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the addition of 1N hydrochloric acid, using phenolphthalein as described in Jackson (1958). Gypsum was determined by the acetone deposition method and then measuring the electrical conductivity of the formed precipitate according to Richards (1954). The wet oxidation method, as described in Jackson (1958), was used to estimate the soil's organic matter content, by oxidizing it with potassium dichromate and adding concentrated sulfuric acid as a heat source, followed by titration with ferrous ammonium sulfate using the ferrion indicator.

The ready nitrogen (NO_3 + NH_4) in the soil was estimated using the KCL extraction and distillation method with Semi-Micro-Kieldahl, according to Bremner and Mulvaney (1982). The ready phosphorus (P) extracted from the soil using 0.5 M $NaHCO_3$ at pH 8.5, and determined using the ammonium molybdate indicator and ascorbic acid, then phosphorus was estimated using a spectrophotometer at a wavelength of 882 nanometers according to Cole *et al*., (1954). For neutral and alkaline soils (pH > 6.5), the available potassium (K) in the soil was extracted using 0.5 M $CaCl_2.2H_2O$, and then potassium was measured using a flame photometer according to Martin and Sparks (1983).

A. Nutrient availability index:

Soil fertility indicators were classified according to (Sharma *et al*., 2004), and the nutrient availability index was calculated based on a chart of soil fertility ranges and using an index that was proposed by (Parker *et al*., 1951) and modified by (Amara *et al*., 2017). To compare soil fertility levels at each field.

$$\textbf{Nutrient index} = \{(\mathbf{1xA}) + (\mathbf{2xB}) + (\mathbf{3xC})\} / \mathbf{NS} \qquad (\mathbf{1})$$

Where: -

- A = Number of samples in the low category.
- B = Number of samples in the medium category.
- C = Number of samples in high category.
- NS = Total number of samples.

The nutrient index value (NIV) of 1.67 to 2.33 is a medium. The NIV less than 1.67 is considered as low, and greater than 2.33 is as High.

Table 1 A chart of the ranges of soil fertility characteristics and their nutrient indicators

The testing Soil parameters	Rating				
Available N(mg/kg)	Very low	Low	Medium	High	
	deficient	I	II	III	
	<10	11- 20	21- 40	>41	
Available phosphorus(mg/kg)	Low		Medium	Adequate	High
	deficient		I	II	III
	<12.5		12.5-22.5	22.5-45.0	>45.0
Available potassium(mg/kg)	Low		Medium		High
	deficient		I		II
	<135		135-335		>335

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3- Office work:

i. Creating basemaps for study areas using Google earth, as shape files for study areas were projected, which were prepared in advance by using GIS Arc Map version 10.8. The study points and shape files of the study sites in each playground were dropped on a Google earth program that was exported as a Kml file to be imported into the GIS environment Arc GIS 10.8 and then converted to a shape file to then be able to draw the spatial distribution of soil characteristics.(Mahal et al.,2022).

ii. GIS Environment Shapefiles were imported from Shape File into GIS Environment for spatial distribution mapping of soil characteristics following the Distance Weight Inverse (IDW) method used as an imperative method in spatial distribution mapping, if The potential for using GIS in urban research is significant also regarding green space analysis .if With the latest technologies, researchers can analyse anthropogenic areas and the benefits of UGS .reliably represent the current state of urban green space use. Their proximity is the traditional metric of greenness exposure, which today is measured precisely and comprehensively with GIS solutions (Al-Arazah *et al*.,2021; Abdullatiff & Wheib, 2019).

iii. Statistical analysis: Description of the surface sample data was performed using EXCEL, the integrated package for office programs from Microsoft Excel, Office. The coefficient of covariance was measured to detect the nature of the heterogeneity of the traits as well as the analysis of geological statistics in the mapping of the spatial distribution, and the same program (EXCEL) was used in drawing the vertical distribution of soil characteristics.

Results

1-Climate of the study area

The climate of Baghdad province is generally arid, hot dry in summer and cold with little rain in winter, and in light of this, the growth of grass in Karkh Stadium will be determined by hot weather conditions in the relatively long summer and cold in the relatively short winter. The lowest winter temperatures in Baghdad were 4.2°C recorded in January, and the highest summer temperatures in Baghdad were about 43.4°C recorded in July (Table 1), while the total rainfall reached 88.4 mm annually, as rainfall begins in late October and ends in May.

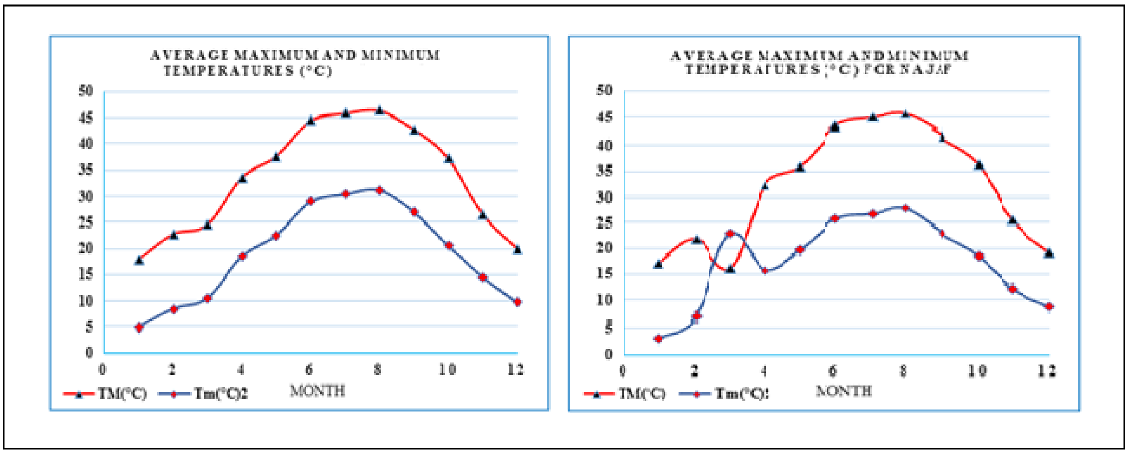

Figure 2. Average maximum and minimum temperatures for 2022.

The dry seasons last from May and end at the end of October, as these seasons are accompanied by a rise in evaporation rates with a clear decrease in relative humidity. The average wind speed is 3.4 m/s, with the highest wind speed recorded at 4.5 m/s in June and the lowest wind speed of 2.5 m/s in November. Based on the principles of the US Soil Survey Staff (1996) and according to the climate data given in (Table 2), the soil temperature regime was of the Hyper thermic type.

Table 2 Average climate data for the weather station in Baghdad for 2003-2022

rate Relative humidity %	Average wind speed m/s	Falling rate Mm	Average minimum temperature ° C	Average maximum temperature ° C	Average monthly temperature °C	Months of the year
71	2.6	14.5	4.2	15.9	9.9	January
61	3.4	14.8	5.7	18.5	12.2	February
53	3.6	18.5	9.2	22.2	15.8	March
43	3.5	10.5	14.6	29.0	22.2	April
30	3.6	3.1	19.6	35.8	28.4	Mays
21	4.2	-	23.3	40.9	32.0	June
22	4.5	-	25.3	43.4	34.8	July
22	4.0	-	24.7	43.5	34.5	dad
26	3.4	-	23	39.6	30.7	September
34	2.9	-	16.2	33.6	24.7	October
54	2.5	11.5	10.6	24.5	17.2	November
71	2.6	15.5	5.2	17.7	11.2	December
38	3.4		15.0	30.4	22.9	annual rate
		88.4				Annual total

As for the climate that dominates the Najaf stadium area, the climate of the Najaf region in Iraq is characterized as a desert climate, hot and dry during the summer months, mild during the spring and autumn, and relatively cold and humid during the winter. Summer temperatures range from 40-50 ° C, with a decrease at night, while winter temperatures range between 5-20 ° C, with high humidity and rainfall in general in the region during autumn and winter, and the amount of rainfall ranges from 50-100 mm per year.

1. **Physical qualities**

a)Volumetric distribution of soil separations

Table (3) shows the results of the volumetric distribution of soil separations, where the sand separated ranged between 890-290 g kg^{-1}, followed by silt, which ranged between 16.8-591 g kg^{-1}, while the clay content ranged between 60-430 g kg^{-1}, and It is concluded from the results of the surface samples of the volumetric distribution of the soil separations of the surface samples of the two playgrounds that the coarse tissue is predominant, which keeps pace with the modern trend in the use of salt-free sandy soils for green spaces after Improving it by adding organic materials (Kowalewski *et al*., 2015; Hameed 2023), Where the results of the values of the coefficient of difference of the surface samples of the soil of the stadiums showed that the separated sand gave the lowest values, as the coefficient of variation for the sand separation in Najaf stadium was 1.97%, and it is more homogeneous in Najaf stadium compared to the sand content of Karkh stadium, where the coefficient of difference was 23.53%.

Table 3. Physical properties of surface samples of playgrounds

Clay	Silt	Sand	Texture	Porosity %	P_p (Mg m^{-3})	Simple
gm kg^{-1}						
Alkarkh Sport Club						
336	248	416	clay loam	46.12	1.32	1
399	591	542	sandy clay	45.06	1.28	2
252	143	605	sandy clay loam	45.56	1.35	3
430	280	290	Clay	46.93	1.21	4
231	227	542	sandy clay loam	47.41	1.32	5
%26.57	%57.61	%26.30	------------------------	%2.08	%4.18	**C.V**
Al-Naiaf International Stadium						
100	90	810	loamy sand	45.98	1.41	1
121	52	827	loamy sand	49.06	1.35	2
143	72	785	sandy loam	48.02	1.31	3
119	92	795	sandy loam	48.19	1.29	4
133	93	804	sandy loam	47.84	1.33	5
%13.14	%22.25	%1.97	------------------------	%2.36	%3.44	**C.V**

b) Bulk density:

The results of Table (3) indicate a decrease in the bulk density values of for surface samples of the two stadiums, which ranged between 1.21-1.41 mcg M^{-3}, despite the predominance of the coarse separation due to the service operations followed in those lands, which include the addition of organic matter (humus) because all playgrounds cover the surface layer of them with organic matter from various mixtures with a depth of 15-20 cm, which reflected positively on the values of the bulk density of the surface samples and led to a decrease in their values. This is what he pointed out (chaudhari *et al*.,2013; stolf *et al*.,2011).

c) Porosity%:

It is clear from Table (3) that there is a discrepancy in the porosity values for surface samples of the two stadiums, which ranged between 45.06-49.06%, and that the reason for this disparity is due to the variation in the levels of organic matter, which is associated with a direct relationship with porosity, and that porosity is associated with an inverse relationship with bulk density, as the increase in coarse separation leads to a decrease in porosity, and conversely, when the content of the fine separator rises, it leads to a rise in porosity values (Mola-Abasi *et al*., 2018;Kenigsberg *et al*., 2020).

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2.Chemical qualities

a) Soil Reaction (pH)

Table (4) indicates a convergence in the results of the values of the degree of interaction for surface samples of the two stadiums, which ranged from 7.21-7.68, and therefore there is a convergence in the values of the coefficient of difference, where Najaf Stadium recorded the lowest values, as it amounted to 1.62%, followed by Al-Karkh Stadium with a coefficient of difference of 1.82%, as it is located within the moderate to light base soils according to Soil Survey Staff (2014). As the degree of soil interaction is affected by the content of sand, which may contribute to reducing the degree of interaction, in addition to containing the surface layer of playground soils on mixtures of organic materials (humus), as well as repeated fertilization operations with NPK fertilizer for playground soils as they are subject to an administrative program, which led to a relative reduction in their values. (Zhang *et al*.,2016).

Table 4. Chemical qualities of surface samples of playgrounds

pH	EC (dS m^{-1})	O.C	Simple	Statistical Standards
		(Cmolc kg^{-1} Soil)		
Alkarkh Sport Club				
7.39	1.26	1.08	1	
7.56	1.41	1.06	2	
7.61	4.51	1.2	3	
7.37	3.76	1.06	4	
7.29	2.11	0.86	5	
%1.82	%55.67	%11.61	Coefficient of Variation	
Al-Naiaf International Stadium				
7.29	3.43	1.32	1	
7.48	3.47	1.27	2	
7.33	3.34	1.61	3	
7.44	3.03	1.31	4	
7.59	3.01	1.7	5	
%1.62	%6.78	%13.72	Coefficient of Variation	

b) Soil Salinity (EC)

Table (4) shows the low salinity of the two study sites, which ranged between 0.42-4.78 dS M^{-1}, and that these results are consistent with the nature of the management method followed, as a result of repeated irrigation as an administrative procedure to preserve the greenery of these areas, in addition to the presence of trocars and this is consistent with what he mentioned (Miyamoto *et al*.,2008: Schaan. *et a*l.,2003) because repeated irrigation works to wash the sodium and chlorine ions during irrigation operations away from the root area and thus reduce soil salinity. It is under the influence of an intensive management method, and it gave the lowest value of the coefficient of variation for surface samples at Najaf Stadium, which amounted to 6.78%, while the coefficient of variation was 55.67% for Alkarkh Stadium.

c) Organic carbon

Table and Figure (3) shows the values of organic carbon content for surface samples, which ranged between 0.86-1.7 g kg^{-1} for the two stadiums, it is clear from the map of the spatial distribution of organic carbon content that the most prevalent area of organic carbon content in Karkh stadium is in a range of 1-1.2, while the low content is distributed in the northeastern part of Karkh stadium, while the prevailing content in Najaf stadium is distributed in a range of 1.5-1.7, which is distributed in the northern part and the southeastern part of the stadium, as the concentration of organic carbon is affected in Soil management as irrigation and fertilizer applications enhance mineral weathering, which leads to an increase in clay content, and increase the production of biomass under irrigated and fertilized soil leads to an increase in organic carbon content., and the organic carbon content changes faster in sandy soils compared to soft weaving soils, and the high carbon content is noted in the soils of surface samples, as this is due to the addition of mixtures of organic materials with a depth of 15 cm of the layer The surface of the playground lands, as well as the fact that the surface samples of the playgrounds are subject to an administrative method of applying fertilization and irrigation, Organic carbon increases cation exchange capacity and reduces bulk density (Yost and HartemnK, 2019, Jasim & Alfatlawi, 2023).

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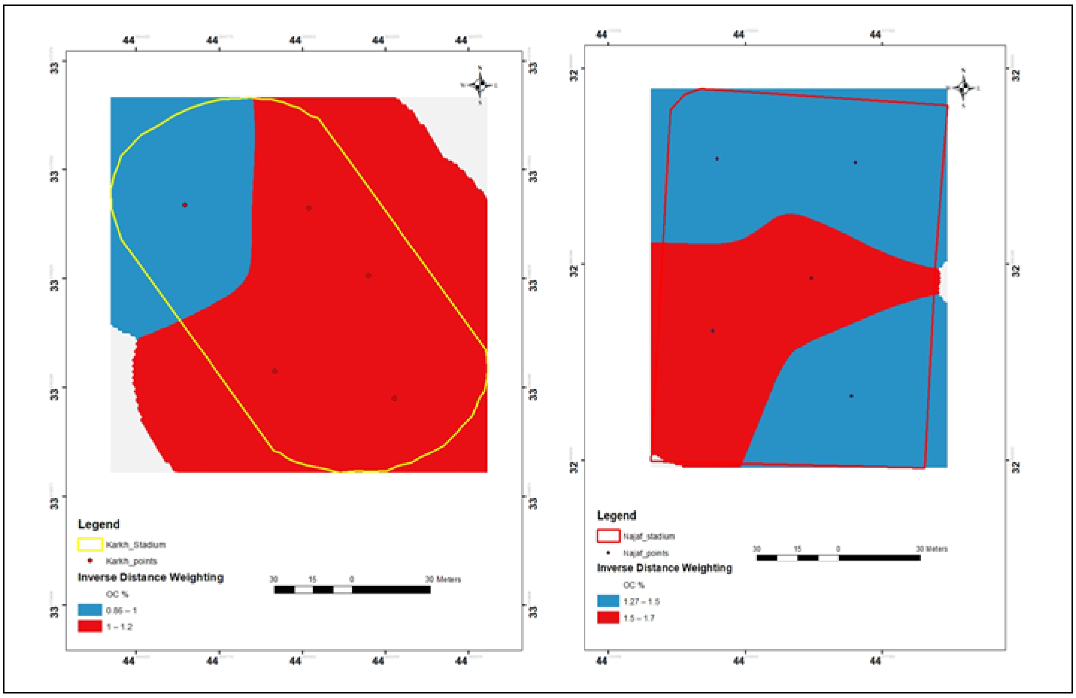

Figure 3. Spatial distribution of organic carbon content.

Available elements for surface samples of stadiums:

The results in Table (5) indicate that the soil content of available nitrogen in Al-Karkh stadium ranged between 21-31.50 mg kg^{-1} with a coefficient of difference of 20.33%, as shown in Figure (4) maps of the spatial distribution of available nitrogen content in the surface samples of the stadiums, which indicates the predominance of the moderate content of available nitrogen was in a range of 21-22.5 mg kg^{-1} for Karkh stadium, while the soil content of available nitrogen in Najaf stadium ranged between 16-22 mg kg^{-1} with a coefficient of variation of 12.43%, When using the special formula to determine the nutrient availability index proposed by (Amara *et al*., 2017) shown in Table (5), which shows that the nitrogen readiness index was moderate in Al-Karkh Stadium, while in Najaf Stadium, the nitrogen readiness index was weak, so Najaf Stadium needs an integrated nitrogen fertilization program, as nitrogen significantly affects grass growth, color and density, and is one of the basic components of chlorophyll, amino acids and enzymes, and therefore the color and quality of grass is related to the level of nitrogenous nutrition and accordingly nitrogen is usually applied in larger quantities of other nutrients (Beard, 1973; Hummel,1992) as well as the irrigation process followed in the stadium, as the inappropriate irrigation method leads to an increase in the loss of nitrogen (Sieczko *et al*.,2023).

Table 5. Available elements for surface samples of stadiums

	K	P	N	Statistical Standards
	gm kg^{-1} soil			
Alkarkh Sport Club	231.50	37.30	21.00	1
	263.10	33.10	31.50	2
	218.40	27.20	21.00	3
	365.70	28.40	21.00	4
	326.30	38.00	21.00	5
	%22.45	%15.10	%20.33	Coefficient of Variation
Al-Naiaf International Stadium	122.50	40.50	16.00	1
	151.00	47.70	19.00	2
	130.00	43.10	21.00	3
	187.20	45.10	22.00	4
	178.00	41.10	18.00	5
	%18.56	%6.81	%12.43	Coefficient of Variation

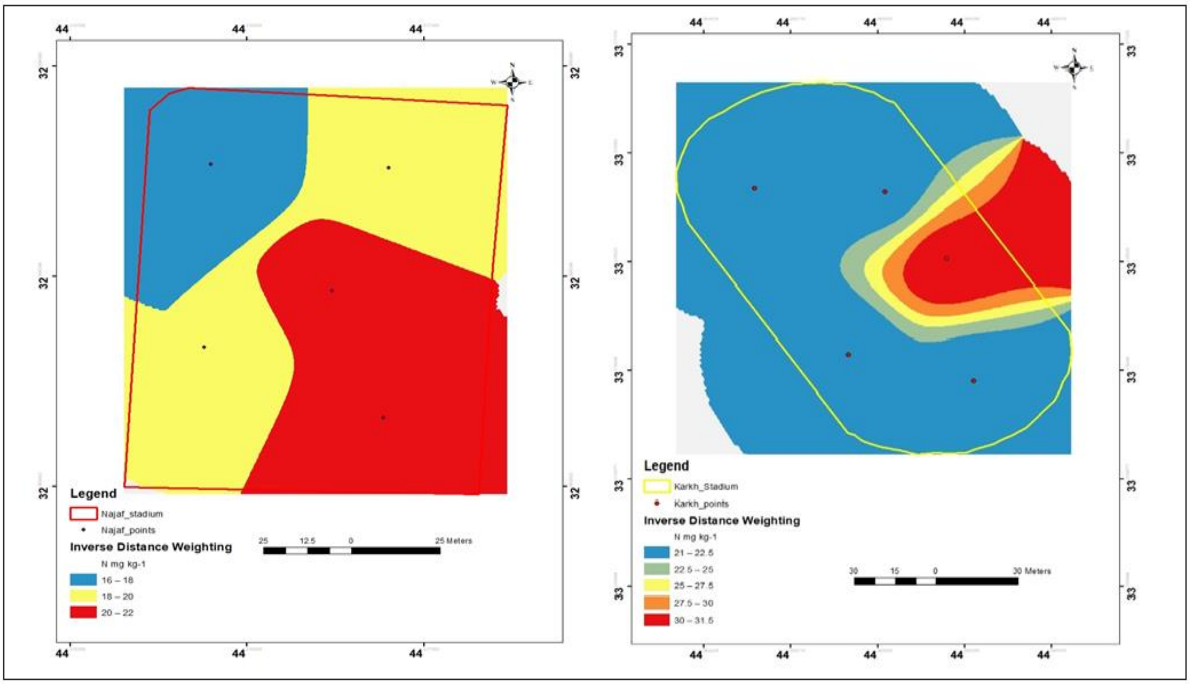

Figure 4. Spatial distribution of nitrogen content.

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Table 6. NPK nutrient guide in stadiums according to the equation proposed by Amara et al, (2017)

Available index potassium (mg kg^{-1})	Available index phosphorus (mg kg^{-1})	Available index Nitrogen (mg kg^{-1})	Stadiums
2.2	3	2	Alkarkh Sport Club
1.6	3	0.02	Al-Naiaf International Stadium

Table (5) indicates the soil content of available phosphorus in Karkh stadium, which ranged between 27.20-38.00 mg kg^{-1} with a coefficient of variation of 15.10%, and it is clear from the spatial distribution map that the high content of phosphorus was more dominant in Karkh stadium and distributed in the northern half of the stadium, while moderate phosphorus content was distributed in the southern half of it with a range of 27.2-30 mg kg^{-1}, while the soil content of available phosphorus in Najaf stadium ranged from 40.50-47.70 mg kg^{-1} with a coefficient of difference of 6.81%. Figure (5) shows that there is a variation in the distribution of available phosphorus content in Najaf stadium, as the dominance of the range was 40.5-42 mg kg^{-1} in the western half of the stadium, the increase in the phosphorus readiness index in the stadiums is attributed to the fertilization plan followed in those stadiums, as it has an important impact in the establishment phase of a strong root system, which improves the grass's tolerance to heat, cold and drought, improves water use efficiency, as well as suppresses some grass diseases (Carrowet *et al*.,2001; Hashim & Hassan, 2023).

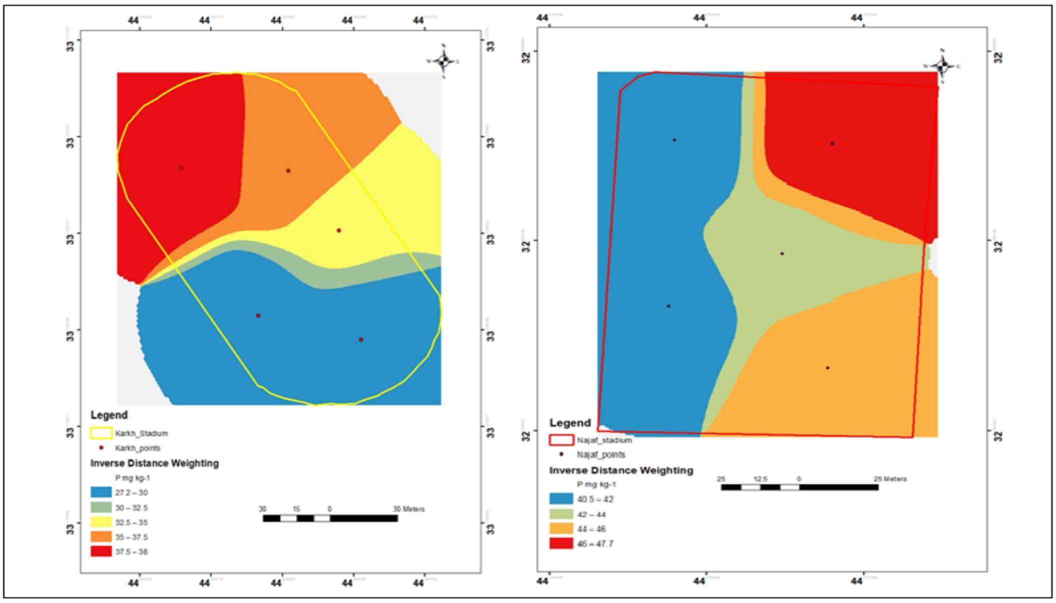

Figure 5. Spatial distribution of available phosphorus content.

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Table (5) shows that the soil content of available potassium was different throughout the Karkh stadium, as the high values of available potassium content were prevalent in the western half of the field with a range of 290-365.7 mg kg-1, while the low ranges were distributed in the eastern half of the field with a range of 218.4-290 mg kg-1. The values of the content of available potassium in the whole of the Karkh stadium ranged between 218.40-365.70 mg kg-1 and a coefficient of difference of 22.45%, while for the Najaf stadium, the soil content of available potassium ranged between 122.50-187.20 mg kg-1 with a difference factor of 18.56% and the spatial distribution map shows that the moderate potassium content was prevalent in the southern half of the stadium and a range of 160-187.2 mg kg-1, (Mahmood & Kadhim, 2023)

while the low content of available potassium was distributed in the northern half of the stadium and the range of 122.5-160 mg kg-1. It is also clear from Table (6) that the potassium readiness index decreased in Najaf stadium, while the potassium readiness index was average in Al-Karkh stadium, and that the variation in the potassium readiness index is due to the fertilization plan followed and the organic matter in each stadium, (Mousa & Kadhim, 2023)

as well as the moisture content, which plays a major role in the plant's response to potash fertilization because potassium moves to the roots in a way of propagation and mass flow. Potassium is the backbone of any fertilization program and a key nutrient in plant cells. This element activates many enzymes and is important in many metabolic processes. The lack of K leads to a significant decrease in the growth and productivity of weeds used in the cultivation of Bermuda in green spaces (Ihtisham et al.,2020; Mc Carty Miller,2002).

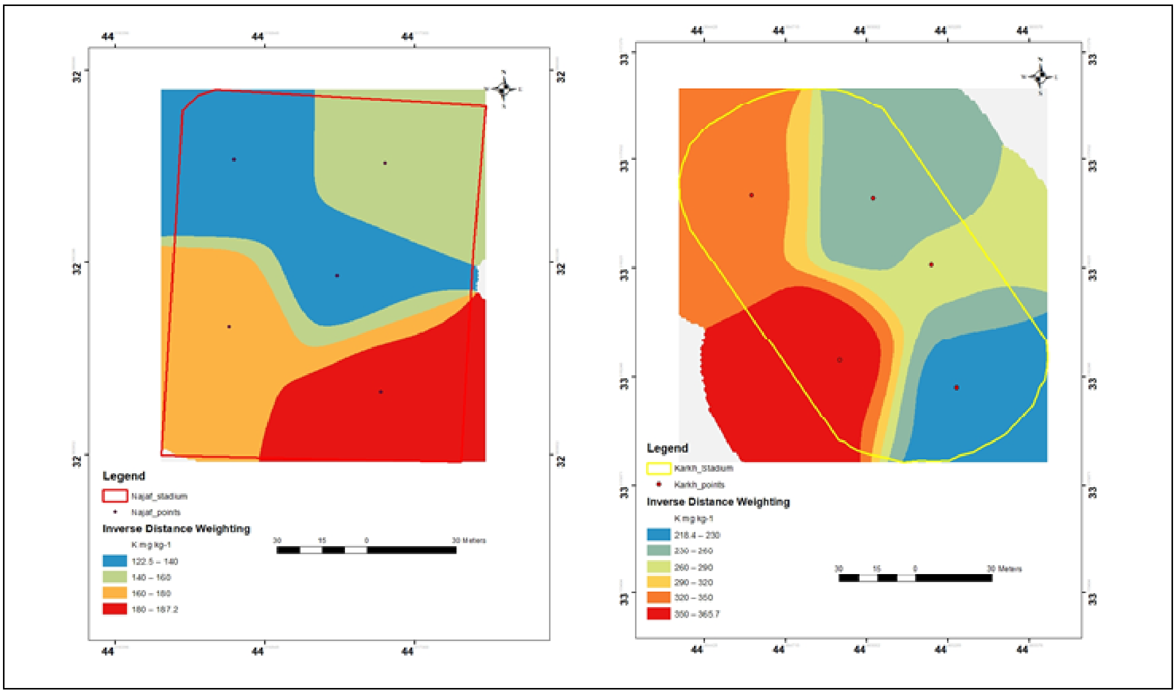

Figure 6. shows the spatial distribution of potassium content in surface samples

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Conclusion

Najaf International Stadium recorded the lowest values of spatial heterogeneity for most of the studied soil characteristics in terms of the coefficient of variation compared to the rest of the study areas, and that the standard textures of the stadium soils are coarse (sandy, sandy mixed, and sandy mixed), while some soft and moderately soft tissues appeared in Al-Karkh Stadium, it was also found that the stadium soil lacks nitrogen due to its easy loss. The quality of the grass and its suitability for play depend on proper management.

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