Research Article

A Study of the Distribution of the Tigris River Sediments and the Variation of their Chemical, Physical and Mineral Properties and the Effect Caused by Kut Dam

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Abstract | A study was conducted for the sediments of the Tigris River in Wasit Governorate, Iraq, near the Kut Dam, to determine its chemical, physical and mineral properties. After the soil horizons of the study were determined , samples were taken from each horizon according to the specific depth of each horizon, and the laboratory examination was conducted for the physical and chemical properties. As for the mineral examination, it was conducted for only two depths (surface depth and subsurface depth). The results showed a variation in the chemical properties represented by the electrical conductivity values, pH of soil, organic matter, carbonate minerals, and the cationic exchange capacity of the soil between the front and rear of the Kut Dam. As for the physical properties, there was a variation in the particle size distribution in the soil (sand and clay), as well as the values of the particle's density and bulk density and total porosity of the soil between the front and rear of the Kut Dam. There was also a variation in the size distribution of some sand fraction. As for the sand minerals, a discrepancy was noted in some heavy and light sand minerals between the front and rear of the dam. It was found that both the difference in the mineral content of the sedimentary cycles and the effect of the Kut Dam on the velocity of the flow of the river load had a role in the variation in the distribution of soils in that region.

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Introduction

Kut Dam is one of the engineering institutions which was built on the Tigris River in Wasit Governorate, Iraq, for the purpose of regulating the distribution of the Tigris River water between its branches in that region. Its water carrying capacity is estimated at half a billion cubic meters. The length of the dam is 500 meters. It was established in 1918 (Al-Zarkani, 2016).

The hydrological engineering projects that are built in the canals affect the dynamics of the rivers, which is reflected in the morphological and geomorphological changes of the river channels (Abu-Saleem, 2009).

Dams have a clear impact on the shape of river channels and their river load, as they retain most of the sediment and reduce the sediment supply in a variety of ways (Salman *et al*., 2016). Dam construction in rivers reduces the speed of flow of water currents, causing increased sedimentation in the direction of the dam. Large dams produce important changes in the flow regime, sediment deposition and distribution in rivers. As the dam begins to store water, the surface area of the water increases, the flow rate decreases and sediment deposition increases, which may be rich in nutrients, industrial chemicals and minerals. It can affect the nature of the aquatic ecosystem (Turgut *et al*., 2015).

Sediments transported by river load are considered one of the most important influences on modern ecosystems and land features because of what they contain of primary or secondary minerals (Al-Khalidi and Al-Askari, 2015). When these sediments are affected by the engineering facility, especially when they reach the dams which are built on the rivers, the distribution of their sedimentation varies due to the impact of the different hydrological conditions caused by these dams (Manati, 2020). Studying river sediments and knowing their layers and mineral components gives us an important guide and indicator in evaluating what sediments contribute to add mineral elements, whether beneficial or polluting to the soil (Leeder, 2009).

Many studies indicate the importance of studying the physical properties of sediments such as particle size distribution and some other properties in addition to chemical properties such as the content of organic matter, reaction number, nature of chemical ions, mineral content and concentrations of pollutants in sediments (Suliman, 2014; Al-Shamare and Essa, 2020).

The study of sediments and the sequence of their layers is important in determining their texture and mineral content, as they give clues and indicators that help us understand and evaluate the contribution of these sediments to the supply of those soils with minerals and useful elements, which improve the composition and fertile content of the soil, or it may be harmful through its contribution to adding pollutants (Al-Ali, 2010).

The current study aims to know the variation in some physical, chemical and mineral properties of the sediments of the Tigris River at the Kut Dam, whether in the front or rear of the dam and the effect of the dam in the process of deposition and distribution of sediments, their properties and mineral content, which refers to the variation in sediments content in the river load at the front or the rear of the dam, which are deposited in the soil that irrigated by canals, whether they are the front or the rear of the dam, which is reflected on the chemical, mineral and fertility properties for that soils.

Materials and Methods

The research was started on 12/6/2020, as it identified the areas of sediment accumulation of the Tigris River in the front and rear of Kut Dam, as shown on the Figure 1. Four soil profiles were excavated, two at the front of the dam and the other at the rear of the dam, at two different levels from the bank of the canal, the first level from lowest level of water in the bank to a height of 1 meter, and the second level from a height of 1 meter to 2 meters, for both sites. The soil horizons of all the study sites were descripted and samples were taken from each horizon, for the purpose of conducting of the laboratory tests for the physical properties and chemical properties. As for the mineral studies, two horizons of each profile were examined from the surface horizon and the subsurface horizon, and the depth of each horizon is as shown in the tables.

The physical properties were measured, where particles size distribution was determined by the international pipette method (Pansu and Gautheyrou, 2006) and the bulk density of the soil were determined by using the Core Sampler method according to Black (1965). While the solid density was estimated by using the Pycnometer given in Black (1965). Porosity calculated from: porosity %= {1-bulk density ρb/solid density ρs} x 100.

The soil pH and electrical conductivity was determined by 1:1 soil extraction according to the method mentioned in Page *et al*. (1982), and soluble cations and anions were determined according to the method described by U.S. Salinity Laboratory Staff (1954). Organic matter was determined according to (Jackson, 1958). Total carbonate minerals were determined according to (Richards,1954) and Cation exchange capacity (CEC) was determined according to (Savant,1994).

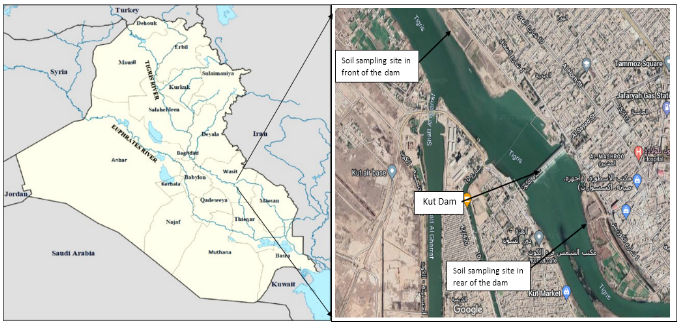

Figure 1: *The site of taking soil samples from the sediments of the Kut Dam.*

Mineralogical analysis, at the beginning the soil particles binding materials were removed, where the salts were disposed of according to the method followed by Kunze (1962). Then carbonate minerals were disposed of, as in the method followed by Rabenhorst and Wilding (1984). Then the organic substance was disposed of according to the method used by Anderson (1963) and finally, iron oxides were removed from the soil and as in the method adopted by Mehra and Jackson (1960).

After removal of the soil particles binders, the process of separation and fractionation began. The sand particles were separated by sieving (Wet) method by using a sieve with diameter of 50 µm. Then the samples were dried and divided into two parts. The first section of the sample was carried out by wet sieving in order to determine the proportions of the sand fractions by using a set of sieves of different diameters 100, 250, 500, 1000 micrometers, in order to separate each of the very coarse sand, coarse sand, medium sand, fine sand and very fine sand. The second section of the sample, the heavy sand minerals were separated from the light sand minerals according to the method approved by Milner (1962). The examination was carried out by using polarized light microscopy according to the method described by Brewer (1976) and followed by Kerr (1977) and Nesse (2000). The proportions of minerals were calculated by using a dot-counting device for 250-300 grains of sand as in the mentioned method in Black (1965). The mineral estimates are semi-quantitative, so they are not subjected to statistical analysis.

Results and Discussion

The results of the electrical conductivity values in Table 1 showed that their values were in the range of 0.82-7.11 $dS.m^{-1}$ in all of soils horizons. It was observed that the values of electrical conductivity in the soil profiles at the front of the dam were higher compared with the soils at the rear of the dam at a level of 1m from the bank. This may be due to the effect of each of the soil texture and the content of organic matter and the content of carbonate minerals (Al-Azawi, 2012; Al-Obeidi and Al-Azzawi, 2017) because the soil texture was fine particles in the soil of the front compared with the soil at the rear of the dam, in addition to an increase in the values of organic matter and carbonate minerals in the soil of the front of the dam compared to the soil of the rear of the dam at the level of 1 meter. The values of electrical conductivity in the soil profiles at the rear of the dam were higher compared with the soils at the front of the dam at a level of 2m from the bank. The reason may be due to the difference in the length of time for the water fluctuation between the front and rear of the dam, as the immersion period is greater in the soils of the front of the dam within the level 2 meters from the bank, which allows a period to leaching the salts from those soils, as the immersion period of water at the rear of the dam is short, it allows the rise of salts by capillary action and gives more time for the movement of salts by lateral infiltration than the neighboring soils. Also, the soil of the rear of the dam was coarser particles compared with the soil of the front of the dam as the speed of rising of the salts by capillary action and their lateral movement is greater in the coarse textures compared to the soft textures (Singh *et al*., 2015) which contributed to the increase in the electrical conductivity in the soils of the rear of the dam at a level of 2 meters.

Table 1 indicates that the values of soil pH were in the range of 7.0 - 8.2 in the study soil and it was within alkaline range because most of the Iraqi soils are alkali soils, due to the increase in carbonate minerals in soil which made soil have high buffer (Taqqa and Hussein, 1991). An increase in the values of soil pH was observed in the soils of the front of the dam compared to the soils of the rear of the dam at the level of 2 m due to the increase of carbonate minerals and the decrease in the electrical conductivity in the soils of the front compared to soils of the rear of the dam at the level of 2 m. A decrease in the values of soil pH was observed in the soils of the front of the dam at a level of 1 m compared to the soils of the rear of the dam at the level 1 m from the bank because of the inverse relationship between the content of the organic matter and the electrical conductivity on the one hand and values of soil pH, on the other hand, which affected the degree of soil pH (Sposito, 2008).

Table 1 indicates the values of soluble cations and anions in the soil, where the values of calcium were in the range of 1.25-13.12 mmol l^{-1}, and magnesium were 1.81-15.10 mmol l^{-1}. It shows that the magnesium values were higher than the calcium values in most of the study sites, this may be due to the nature of the mineral composition of the study soils (Fadel, 2015). Potassium values were in the range of 0.08-0.50 mmol l^{-1}, while sodium was in the range of 2.65-15.80 mmol l^{-1}. It also shows that there is a direct relationship between the increase in its concentration with the increase in electrical conductivity and this agrees with Abood and Salman (2014), where they found a direct relationship between the electrical conductivity and the concentration of sodium. As for the anions, it was found that the chloride ion values were 5.18-26.74 mmol l^{-1}, and it appeared that chloride concentration also increases directly with the increase in the electrical conductivity of the soil and this is consistent with Li *et al.* (2014), as they showed a direct relationship between electrical conductivity and the values of chloride in the soil, while the bicarbonate ion values were in the range of 1.02-6.80 mmol l^{-1}. There were no values of carbonates in the soil, because this situation is common in Iraqi soils, it may be due to the carbonate ion is need to the high soil pH conditions or because of the common conditions in Iraqi soils which converted the carbonates to the bicarbonate, in addition to the lack of solubility of carbonates salts (Abaas, 2007). The sulfate ion values were in the range of 1.08-18.18 mmol l^{-1}. It is clear that the value of chloride ion is greater than the value of sulfate ion in most of the study soils, this may be due to the nature of the salts structure and mineral composition of those soils. No significant difference was observed in the values of soluble cations and anions with respect to their position on the dam or their sedimentation level except the sodium and chloride ions because their distribution is identical to the electrical conductivity distribution for the soil of dam.

Table 1: *Some chemical properties of the study soils.*

CEC cm-mol_c kg^{-1}	Total $CaCO_3$ $g.kg^{-1}$	OM $g.kg^{-1}$	Soluble cations and anions in the soil (mmol l^{-1})								Ec dSm^{-1}	PH	Depth cm	Location	
			SO_4	CO_3	HCO_3	Cl	K	Na	Mg	Ca					
24.73	310.40	8.63	5.91	NIL	5.11	15.33	0.18	8.97	7.16	4.15	3.19	7.4	0-17	A	front of dam at a level 1 m
24.64	289.80	8.37	5.83	NIL	4.75	15.02	0.14	8.64	7.13	4.18	3.11	7.4	17-34	C1	
25.74	306.30	9.83	4.75	NIL	4.62	13.88	0.11	7.84	6.32	3.66	2.78	7.6	43-65	C2	
23.46	281.90	6.84	3.31	NIL	3.60	11.65	0.07	6.11	5.13	3.16	2.18	7.7	65-77	C3	
23.98	296.50	7.92	2.21	NIL	3.14	10.03	0.23	5.54	3.01	2.89	1.74	7.9	77-89	C4	
22.84	302.60	6.56	1.56	NIL	2.16	8.11	0.11	4.52	2.56	2.06	1.31	8.0	+89	C5	
25.65	275.40	7.85	4.95	NIL	3.38	13.98	0.30	8.00	6.13	4.41	2.86	7.6	0-23	A	front of dam at a level 2 m
25.85	268.60	8.21	6.26	NIL	3.45	15.14	0.50	8.53	7.06	4.11	3.10	7.4	23-36	C1	
24.45	304.50	7.12	6.13	NIL	3.41	15.13	0.31	8.43	6.90	4.56	3.07	7.4	36-57	C2	
24.79	285.70	6.89	7.88	NIL	5.16	16.84	0.19	9.26	7.91	6.12	3.87	7.3	57-74	C3	
24.06	269.80	4.48	11.92	NIL	3.86	21.15	0.15	12.53	10.10	8.12	4.82	7.3	74-87	C4	
24.79	289.97	5.64	12.10	NIL	3.61	20.41	0.20	12.20	10.04	8.10	4.81	7.2	+87	C5	
18.65	242.60	6.54	4.02	NIL	3.51	11.86	0.08	5.76	5.31	2.76	2.26	7.6	0 - 21	A	rear of dam at a level 1 m
15.78	237.50	5.01	3.34	NIL	3.64	11.36	0.08	5.67	4.57	3.21	2.09	7.7	21 -37	C1	
18.12	250.30	4.91	3.41	NIL	4.01	11.42	0.07	5.85	4.75	2.91	2.11	7.7	37-52	C2	
16.83	245.60	5.62	3.14	NIL	3.22	10.11	0.05	4.87	3.41	3.44	1.97	7.8	52 -68	C3	
18.56	249.80	3.67	1.56	NIL	2.24	9.84	0.25	4.08	2.91	2.36	1.51	8.0	68 -81	C4	
17.84	240.40	4.42	1.18	NIL	1.50	7.04	0.15	3.52	2.08	1.52	1.08	8.1	81 -96	C5	
18.52	248.10	3.58	1.08	NIL	1.02	5.18	0.10	2.65	1.81	1.25	0.82	8.2	+ 96	C6	
18.89	250.60	7.16	18.18	NIL	6.80	26.74	0.37	15.80	15.10	13.12	7.11	7.0	0-26	A	rear of dam at a level 2 m
18.69	253.90	5.29	12.56	NIL	5.12	23.12	0.35	12.69	10. 33	10.04	5.34	7.2	26-40	C1	
16.87	238.60	6.67	12.44	NIL	5.13	23.21	0.42	12.21	11.06	9.51	5.33	7.2	40 –58	C2	
16.09	234.40	4.77	12.55	NIL	5.14	23.31	0.03	12.27	11..01	9.57	5.36	7.2	58 –71	C3	
15.06	231.80	2.87	9.27	NIL	4.64	19.33	0.21	12.65	8.69	6.12	4.21	7.3	71-86	C4	
15.79	238.50	3.82	8.30	NIL	4.63	18.13	0.18	11.71	7.40	7.12	4.01	7.3	+86	C5	

Links Researchers

Table 1 indicates that the value of organic matter is in the range of 2.87-9.83 $g.kg^{-1}$, which is low in most of the Iraqi soils due to the decrease in the rate of rain, the increase in temperatures and evaporation intensity. As a result, this affected the decrease in the organic matter in Iraqi soils (Wheib and Ibrahim, 2012). The values of organic matter were higher in the upper soil horizons compared to the lower soil horizons of the same location in most cases. It was also observed that the organic matter increased in the soils of the front of the dam compared to the soils of the rear of the dam in most of the sites, this is consistent with what was found by Stanley and Wingerath (1996). It has been shown by Fonseca *et al*. (2003) that most of the dams have an important role in the retention of organic materials and fertilizers in the front of the dam. An increase in organic matter was observed in most of the horizons of the soil profiles in the front of the dam at the level of 1 meter compared to the level of 2 meter, while there was no variation for the soil of the rear of the dam.

Table 1 indicates that the carbonate minerals values in the soil were 231.80 - 310.40 $g.kg^{-1}$, and their values indicate that the study soil was calcareous, as most of the Iraqi soils are classified as calcareous soils (Al-Janabi, 2016). It Indicates that its values have increased in the soil of the front of the dam compared to the rear of the dam. The reason for this may be due to the impact of the dam on the river load by reservation some sediment, including carbonate minerals, in larger quantities in the front of the dam, especially the fine particles, which have size of partials as clay and silt, and their size indicates that the source of carbonate minerals is not inherited from the origin material, which is expected to come with the load of river sediments or they were transported to long distances, which exposed them to crushing due to water transport, then turned into sizes as much as the size of the silt and clay particles (Deliver, 1962). An increase in carbonate minerals was observed in most of the horizons of the soil profiles at the level of 1 meter compared to the level of 2 meters, and this may be due to the difference of their sizes of their particles and their influence in the different sedimentation conditions between two sites. There was no variance with respect to the soil of the rear of the dam.

Table 1 indicates that the value of the cationic exchange capacity of the soil ranged between 15.06-25.85 cmol kg^{-1}. The values increased in the soils of the front of the dam compared to the rear of the dam in most of the soils of the study, the reason for this may be due to the effect of the increase in the proportion of clay and the organic matter in the soils of the front of the dam compared to the rear of the dam (Fattah and Karim, 2021), which increased the cation exchange capacity in the soils of the front of the dam compared to the rear of the dam. An increase in the cation exchange capacity was observed in most of soil horizons of the dam at the level of 2 meter compared to the level of 1 meter, while there was no variation in the cationic exchange capacity value for both levels of soil profiles at the rear of dam, the overall effects causing this situation may be due to a variation in the distribution of organic matter and carbonates and distribution of soil particles, especially the fine particle, and their difference among the study sites, due to the effect of the dam and the content of the river load during the sedimentation cycles.

Table 2 indicates some physical properties of the study soils, that the values of the particle size distribution were dominated by fine particles in the soils of the front of the dam and for both levels, where the values of the clay separated ranged from 414.42-505.41 g.kg-1. In addition, the values of the clay particles in the soils of the rear of the dam were declining for both levels, where they were in the range of 94.83-222.74 g.kg-1, and this is consistent with Al-Mansoori and Abdullah (2008), he was shown that the engineering facility which built on rivers has important role in retention suspended sediments, and limiting the amount of those sediments passing through the dam. The values of soil particle size distribution show increase sand particles values in the soils of the rear of the dam compared to the soils of the front of the dam. The values of sand particles in the soil of the rear of the dam were in the range of 300.40-664.82 g.kg-1, while the values of sand particles in the soil of the front of the dam were in the range of 128.65-257.20 g.kg-1. The reason for this may be due to the effect of the dam by controlling the flow of the transient water currents and the speed of their flow, which affects the resuspension of the bed load particles (rolling, saltation, sliding) Al-Taiee and Al-Hamdani (2007), and then the sedimentation process begins with the time and distance determined by the speed of the flow. As the coarse particles are deposited first, then the medium and finally the fine particles, the further away it is from the rear of the dam, as a result of a decrease in the velocity of the flow of water currents Zhao *et al*. (2011).

Table 2: *Some physical characteristics of the study soil.*

g.kg^{-1}			Porosity %	Bulk Density g.cm^{-3}	Particle Density g.cm^{-3}	Depth cm	Location	
Clay	Silt	Sand						
478.39	345.76	175.85	49.43	1.32	2.61	0-17	A	Front of dam at a level 1 m
475.42	279.39	245.19	50.19	1.30	2.61	17-34	C1	
442.59	428.76	128.65	48.66	1.34	2.61	43-65	C2	
439.09	322.61	238.30	47.71	1.37	2.62	65-77	C3	
461.79	303.40	234.81	46.56	1.40	2.62	77-89	C4	
414.42	361.63	223.95	46.77	1.40	2.63	+89	C5	
505.41	273.31	221.28	49.23	1.32	2.60	0-23	A	Front of dam at a level 2 m
479.37	304.31	216.32	48.85	1.34	2.62	23-36	C1	
466.12	319.53	214.35	48.11	1.37	2.64	36-57	C2	
468.14	320.65	211.21	47.15	1.39	2.63	57-74	C3	
432.25	310.55	257.20	46.39	1.41	2.63	74-87	C4	
469.41	322.57	208.02	46.01	1.42	2.63	+87	C5	
189.16	196.11	614.73	45.72	1.46	2.69	0 - 21	A	Rear of dam at a level 1 m
94.83	240.35	664.82	45.35	1.47	2.69	21 -37	C1	
215.71	399.65	384.64	45.32	1.46	2.67	37-52	C2	
178.98	416.15	404.87	44.19	1.49	2.67	52 -68	C3	
201.39	498.21	300.40	43.02	1.51	2.65	68 - 81	C4	
211.23	370.16	418.61	42.48	1.53	2.66	81 -96	C5	
210.85	454.32	334.83	41.51	1.55	2.65	+ 96	C6	
212.41	407.69	379.90	43.98	1.49	2.66	0-26	A	Rear of dam at a level 2m
222.74	350.20	427.06	44.57	1.48	2.67	26-40	C1	
131.27	429.88	438.85	43.82	1.50	2.67	40 –58	C2	
162.43	313.74	523.83	43.87	1.51	2.69	58 –71	C3	
108.16	355.53	536.31	43.91	1.52	2.71	71-86	C4	
157.17	308.07	534.77	42.59	1.55	2.70	+86	C5	

As for the values of the particle size distribution according to the level from the river bank, there was a variation in clay particle values of soil of the front of the dam, while there was no variation in the soil of the rear of the dam according to the samples level from the bank river. As for the sand and silt particles, there was no variation in their values between the front and rear of the dam according to the samples level from the bank river.

Table 2 indicates that the values of particle density of the soils of the rear of the dam were high compared to the soils of the front of the dam for both levels, where its values in the soils of the rear of the dam were in the range of 2.65 - 2.71 g.cm^{-3}, while its values in the soils of the front of the dam were in the range of 2.60 - 2.64 g.cm^{-3}. The reason for this may be due to the increase in organic matter in the soils of the front of the dam (Kadhim, 2015). In addition to that, the sand particles increased on the clay particles in the rear of the dam which causes to increase particles density at the rear of the dam (Doran and Jones, 1996).

Table 2 shows that the bulk density values of the soils of the rear of the dam were higher than that of the front dam soils in most of the sites, and their values in the soils of the rear of the dam were in the range of 1.46-1.55 g.cm^{-3}, while their values at the front of the dam were in the range of 1.30-1.42 g.cm^{-3}. This is because the value of sand increases in the soil of the rear of the dam compared to the soil of the front of the dam, and that the increase in the sand particles at the expense of the clay particles leads to an increase in the bulk density of the soil (Al-Mousawi *et al*., 2019). Also, the values of bulk density were increasing with increasing soil depth in all study sites. This was due to the effect of the weight of a soil mass, which was stacked on top of each other, which increased the compaction of the layers with increasing depth. As for the porosity of the soil, its ratio was increased in the soils of the front of the dam compared to the soils of the rear of the dam, and in most of the study sites. Where their ratios in the soils of the front of the dam were 46.01 - 50.19%, while in the soils of the rear of the dam they were 41.51 - 45.72%. This may be due to the lower values of bulk density in the soils of the rear of the dam compared to the front of the dam which increased the porosity of the soil in the front of the dam due to the difference in the content of clay particles, sand particles and the content of organic matter between the two sites, which reflected in the variation in the porosity (Kadhim, 2015).There was not any significant variation in the particle density, bulk density and total porosity of the soil with the difference in the level of the samples from the river bank.

Table 3: *volume distribution of sand fraction for the study soil.*

Sand fractions %					Depth cm	Location	
Very coarse	Coarse	Medium	Fine	Very fine			
------	0.02	2.49	7.63	89.86	0-17	A	Front of the dam at a level of 1 m
------	0.07	2.51	8.84	88.58	17-34	C1	
------	0.03	0.66	7.64	91.67	43-65	C 2	
------	0.02	0.43	7.13	92.42	65-77	C3	
------	0.04	1.25	6.54	92.17	77-89	C4	
------	0.03	2.00	8.54	89.43	+89	C5	
------	0.05	2.58	9.23	88.14	0-23	A	Front of the dam at a level of 2 m
------	0.03	1.90	9.23	88.84	23-36	C1	
------	0.03	2.01	7.54	90.42	36-57	C2	
------	0.08	1.68	9.23	89.01	57-74	C3	
------	0.05	0.88	6.86	92.21	74-87	C4	
------	0.05	2.03	8.61	89.31	+87	C5	
------	0.16	2.43	16.33	81.08	0 - 21	A	Rear of the dam at a level of 1 m
------	0.11	2.46	16.01	81.42	21 -37	C1	
------	0.56	2.80	13.52	83.12	37-52	C2	
------	0.14	2.97	15.96	80.93	52 -68	C3	
------	0.23	2.94	15.95	80.88	68 - 81	C4	
------	0.62	2.59	14.88	81.91	81 -96	C5	
------	0.36	2.38	15.53	81.73	+ 96	C6	
------	0.87	2.83	13.21	83.09	0-26	A	Rear of the dam at a level of 2 m
------	0.33	2.82	13.43	83.42	26-40	C1	
------	0.55	2.63	15.48	81.34	40-58	C2	
------	0.99	2.83	13.82	82.36	58–71	C3	
------	0.44	2.83	13.83	82.90	71-86	C4	
------	0.62	2.59	14.88	81.91	+86	C5	

Table 3 shows the percentages of the sand fractions, where it was clear from the results that the dominance was largely for the sand size particle of very fine compared to the other of the sand fractions, this may be due to high content of the particle size of sand (very fine) in the river load, that may indicate to the long distance traveled by sediments from the source to the place of deposition, which indicates the occurrence of erosion of sand particles due to the process of abrasion, which reduced the sizes of sand particles according to its intensity of their resistance to erosion, which is due to the nature of their mineral composition, which caused an increase in the percentage of very fine sand fraction. In addition, some of the sand fraction, which was classified as larger size than fine sand particles, was deposited before reaching the study site. This is also an indication of the nature and intensity of the water currents (Al-Shammari, 2020).

Table 3 shows that the ratio of very fine sand was higher in the soils of the front of the dam compared to the soils of the rear of the dam, where their ratio in the soils of the front and rear of the dam was in the range of 88.14-92.24% and 80.88-83.42%, respectively. The reason may be due to its deposition more in the soil of the front of the dam to its deposition with the fine particles at the front of the dam, because the effect of the decrease in the water currents carrying it at front of the dam (Sahar, 2010). As for the fine sand particles, its ratio was greater in the soils of the rear of the dam compared to front of the dam, with a range of 6.54 - 9.23% and 13.21-16.33% in the soils of the front and rear of dam respectively. The same status applied to the particles medium sand. It was noted that its ratio was greater in most of the soils of the rear of the dam compared to the soils of the front of dam, where the ratio 0.43 - 2.58% and 2.38 - 2.97% for the soils of the front and rear of the dam respectively. The same status applied to coarse sand fraction where the ratio was higher in the soils of the rear of the dam compared to the front, where the ratio in the soils of the front and rear of the dam was in the range of 0.02 - 0.08% and 0.11 - 0.99%, respectively. The reason for the increase in fine, medium and coarse sand fractions in the soils of the rear of the dam may be due to the effect of narrowing the cross-section of the channel due to the dam's gates, which increases the flow velocity of the water passing through the dam, as it leads to disturbances and vertical eddies that re-suspend most of the sediments, especially the bottom sediments in bed river load. Then the sedimentation process begins with the time and distance determined by the velocity of the flow, so the particles are deposited according to their size and the shape and their specific weight, according to the speed and distance after crossing it from the rear of the dam (Al-Shahmani, 2020). As for the coarse sand fraction, they did not have no percentage within the sand fractions. This may be due to the sedimentation of most of them in areas far from the dam and close to the source, as the water currents and the intensity of their flow cannot carry coarse sand fraction along distances with them and it deposited before reaching the dam, because its particles are large sizes and big weights.

As for the distribution of the sand fractions, according to the level of their location in the river bank, no significant effect was observed in the variance with respect to the level of the soil samples from the river bank.

The composition of sand minerals in the soil

Table 4 shows that the light sand minerals includes both type of quartz minerals, monocrystalline quartz with an average of 16.5% and polycrystalline quartz with an average of 3.4%. Table 4 shows that feldspar minerals included alkali feldspar orthoclase with an average of 2.7%, alkali feldspar microcline with an average of 2.4%, and plagioclase feldspar with an average of 3.6%. As for carbonate rock fragments, which included aragonite shell with an average of 4.6%, limestone with an average of 30.7%, and fossil grains with an average of 4.5%. the other light sand minerals included chert rock fragments with an average of 9.1%, igneous rock fragments with an average of 3.6, metamorphic rock fragments with an average of 4.5%, mudstone rock with an average of 4.7%, evaporites with an average of 3.5, coated grain by clay with an average of 3.8%, and finally other minerals with an average of 2.6%.

An increase in the ratio of quartz minerals was observed for both types of monocrystalline quartz and polycrystalline quartz in the rear of the dam compared to the soils of the front of the dam. The average value in the rear of the dam was 17.7% and 3.8% for monocrystalline quartz and polycrystalline quartz respectively. The averages at the front of the dam were 15.3% and 2.9%, respectively. This is due to its sedimentation with the coarse particles in a greater percentage in the soils of the rear of the dam, because this mineral is considered one of the minerals resistant to weathering, in addition to what was found by Mousa (2006) and Khalaf and Shallal (2016), where they found that the ratio of quartz minerals increases with the increase in the sizes of soil particles, in the form of particles have large size, which deposited in the soil of the rear of the dam with a greater percentage. The same is the case with chert rock fragments, where the percentage increased in the soils of the rear of the dam, as the percentage in the soils of the front of the dam and the rear of the dam was 8.4% and 9.9% respectively. The reason for this may be due to its deposition in the soils of the rear of the dam as fine and medium sand fractions, because its sizes were expecting among those sizes, because it is a highly weathering resistant mineral (Serwan *et al*., 2015). As for carbonate rock fragments, their percentages were greater in the soils of the front of the dam compared to the soils of the rear of the dam in all the study sites. Where the percentage of each of the minerals aragonite shell, limestone and fossil grains were 4.8%, 32.3%, 4.7% respectively in the soils of the front of the dam. While in the soils of the rear of the dam 4.5%, 29.1%, 4.3% respectively. The reason for this may be due to the dominant of its fine volumes, which may be deposited in the soil of the front of the dam in a greater proportion. As Rahal (2009) referenced to the fine particles are deposited in quiet water environments. In addition to what was found by Deliver (1962) about the most of carbonate minerals were transported with the waters of the Tigris and Euphrates rivers and their tributaries in the form of very fine and fine particles from the upper north and were deposited with soil particles in the alluvial plain area in Iraq. No contrast was observed for the rest of the light sand minerals.

Table 5 shows the percentages of heavy sand minerals which included opaques with an average of 40.2%, and chlorites with an average of 8.4%. As for the pyroxene group minerals, they included orthopyroxene with an average of 2.5% and clinopyroxene with an average of 4.5%. The amphibole group minerals included hornblende with an average of 5.1% and actinolite with an average of 2.5%. As for the mica group minerals, they included muscovite with an average of 5.0% and biotite with an average of 4.6%. As for the other of the heavy sand minerals, they included zircon with an average of 5.9%, garnet with an average of 4.3%, epidote with an average of 6.6%, tourmaline with an average of 3.7%, kyanite with an average of 2.5%, rutile with an average of 1.8%, and finally staurolite with an average of 2.4%.

Table 4: *Proportions of light sand minerals.*

Light components %		Samples number										
		Front dam					Rear dam					
		Level 1m		Level 2m		mean	Level 1m		Level 2m		mean	Total mean
		A	C4	A	C3		A	C3	A	C2		
Monocrystalline quartz		17.5	15.3	13.9	14.3	15.3	17.5	19.2	14.8	19.4	17.7	16.5
Polycrystalline quartz		3.1	2.3	3.3	3.0	2.9	3.9	3.8	3.9	3.7	3.8	3.4
Alkali feldspar orthoclase		2.3	3.2	2.3	2.2	2.5	3.4	2.7	2.4	2.7	2.8	2.7
Alkali feldspar microcline		2.8	2.4	2.1	2.7	2.5	2.4	2.5	2.3	2.1	2.3	2.4
Plagioclase feldspar		3.9	3.5	3.9	3.8	3.8	3.5	3.3	3.5	3.1	3.4	3.6
Carbonate rock fragments	Aragonite shell	4.7	4.9	4.7	4.8	4.8	4.2	4.4	4.7	4.5	4.5	4.6
	Limestone	28.3	33.9	34.0	32.9	32.3	27.6	28.4	31.4	29.1	29.1	30.7
	Fossil grains	4.9	4.8	4.5	4.6	4.7	4.0	4.5	4.4	4.2	4.3	4.5
Chert rock fragments		10.0	7.3	8.1	8.1	8.4	10.9	9.2	10.2	9.3	9.9	9.1
Igneous rock fragments		3.2	3.5	4.1	4.0	3.7	3.8	3.3	3.7	3.1	3.5	3.6
Metamorphic rock fragments		4.6	4.3	4.9	4.4	4.6	4.5	4.6	4.1	4.6	4.5	4.5
Mudstone rock fragments		4.8	4.6	4.7	4.8	4.7	4.4	4.6	4.7	4.6	4.6	4.7
Evaporites		3.6	3.6	3.4	3.9	3.6	3.4	3.4	3.4	3.4	3.4	3.5
Coated grain by clay		3.5	4.7	3.5	3.6	3.8	3.6	3.8	3.8	3.5	3.7	3.8
Others		2.8	1.7	2.6	2.9	2.5	2.9	2.3	2.7	2.7	2.7	2.6

Table 5: *Percentages of heavy sand minerals.*

Total mean	Samples number										Heavy components %	
	Mean	Rear dam				Mean	Front dam					
		Level 2 m		Level 1 m			Level 2m		Level 1m			
		C4	A	C4	A		C4	A	C4	A		
40.2	41.1	40.8	41.2	41.9	40.5	39.4	38.4	39.3	39.2	40.5	Opaques (Iron Oxides)	
8.4	7.7	8.0	7.7	7.0	8.1	9.0	9.5	9.4	8.7	8.5	Chlorites	
2.5	2.8	2.6	2.8	2.4	3.3	2.2	2.2	2.6	1.8	2.3	Orthopyroxene	Pyroxene Group
4.5	4.8	4.6	4.6	4.7	5.4	4.3	4.8	4.8	3.2	4.2	Clinopyroxee	
5.1	5.1	5.8	4.6	5.6	4.4	5.0	5.4	4.2	4.3	6.1	Hornblende	Amphibole Group
2.5	2.7	2.4	2.5	2.4	3.3	2.4	2.7	2.7	2.2	2.1	Actinolite	
5.0	4.7	4.0	4.9	5.3	4.5	5.4	5.9	5.6	4.4	5.5	Muscovite	Mica Group
4.6	4.0	4.6	4.1	3.3	4.0	5.3	5.3	4.1	6.5	5.2	Biotite	
5.9	5.9	5.8	6.2	5.1	6.5	5.8	4.7	6.8	6.4	5.3	Zircon	
4.3	4.0	4.3	3.8	4.6	3.4	4.5	5.4	3.5	4.5	4.7	Garnet	
6.6	6.6	6.7	6.6	6.6	6.6	6.5	5.7	6.8	7.1	6.5	Epidote	
3.7	3.8	3.7	3.7	4.2	3.5	3.7	2.7	3.7	4.7	3.6	Tourmaline	
2.5	2.7	2.5	2.8	2.7	2.6	2.4	2.9	2.9	1.6	2.1	Kyanite	
1.8	1.5	1.4	1.7	1.8	1.1	2.2	2.4	1.6	2.7	1.9	Rutile	
2.4	2.7	2.8	2.8	2.4	2.8	2.1	2.0	2.0	2.7	1.5	Staurolite	

Table 5 shows that there is a variation in the distribution ratios of heavy sand minerals between the front and rear of the dam, where it was observed that the percentages of opaques mineral increased in the soils of the rear of the dam compared to the front of the dam, where the ratio were 39.4%, 41.1% in the front and rear of the dam respectively, as this indicates to their deposition with the size of fine and medium sand fraction greater than of very fine fraction. Where Al-Bassam and Al-Mukhtar (2008) found the opaque mineral decreases with the distance and its percentage increases in the northern regions and decreases with the direction of the river's load towards the south, and this indicates that it needs strong water currents to carry it due to its specific weight, which increased its sedimentation at the rear of the dam.

The reason may also be due to the source rocks of the opaque mineral may not be very far, as studies have shown that the opaque mineral sources in the Tigris River come from its eastern tributaries, which are not far from the study sites. The increase of chlorites was observed in the soils of the front of the dam compared to the rear of the dam, where the ratios were 9.0%, 7.7% in the front and rear of the dam respectively. It may be due to the dam retains the very fine sand fraction in the front of the dam. In addition to that, some studies have found a relationship between an increase in the fine particles of sand and an increase in chlorite, such as Al-Hussaini (2010) and Al-Bayati *et al*. (2017), they have found the reason for the increase of chlorite mineral due to the increase of very fine sand fraction. An increase of mica group minerals was observed in most of the soils of the front of the dam compared to the rear of the dam, where the averages of muscovite and biotite reached 5.4%, 5.3% in the soils of the front of the dam while they were 4.67%, 4.00% in the soils of the rear of the dam, and this is consistent with Al-Hazaa (2009) where he showed that the construction of dams has a significant impact on the ratio of minerals of chlorite and mica. In addition to that, mica minerals (muscovite and biotite) float with the river load, where they are transported to long distances and are deposited after colliding with the surface of the soil due to the infiltration of water or the decrease of the water currents carrying it, because of its characteristics such as its low density and its non-spherical laminar shapes (Abbas, 2010). Therefore, it was deposited in the front of the dam when the speed of the water currents decreased. An increase in the ratio of rutile mineral was observed in the soils of the front of the dam compared to the rear of the dam, where its ratios were 2.2% and 1.5% in the front and rear of the dam respectively, due to its size and specific weight and the shape of its partials (Al-Juboury, 2006). In addition to that, Khorsheed and Ali (2015) have found that dams have an effect on sorting and sequestering sand heavy minerals.

Conclusion and Recommendations

The Kut Dam affects the river load of the Tigris River, which leads to a variance in some of the chemical and physical properties and the mineral content of the sediments carried in the Tigris River and the difference in their distribution between the front or the rear of the Kut Dam, which is located near the city of Kut in Wasit Governorate - Iraq. There was a variation in some of the chemical properties such as: electrical conductivity, pH, sodium and chlorine content, organic matter, carbonate minerals, and cationic exchange capacity. As for the variance in some physical properties of the soil of the sediment of the Tigris River in the front and rear of the Kut Dam, it includes: particle size distribution, particle density, bulk density, the total porosity and percentages of the sand fractions. The physical and chemical properties of the sediments of the Tigris River vary according to their location from the dam (front or rear of the dam) as well as the distance of their deposition from the bank of the Tigris River channel.

Mineral studies of light sand minerals of the soil of the Tigris River sediments in Wasit Governorate showed the presence of minerals that included: quartz, feldspar, carbonate rock fragments, chert rock fragments, igneous rock fragments, metamorphic rock fragments, mudstone rock, evaporites and grain coated by clay. The effect of the Kut Dam on the variation in the distribution of some light sand minerals front and rear of the dam for minerals such as: carbonate rock fragments, quartz and chert. Mineral studies of heavy sand minerals in the sediments of the Tigris River showed that they include: opaques, chlorites, pyroxene group, amphibole group, mica group, zircon, garnet, epidote, tourmaline, kyanite, rutile and staurolite. The effect of the Kut Dam on the variation in the distribution of some heavy sand minerals front and rear of the dam for minerals such as: opaque, chlorites, mica and rutile.

The effect of the Kut Dam on the content of the river load of the Tigris River is reflected on the nature of the variation in the chemical and physical properties and mineral content of soils of the sediments of the Tigris River, whether it is the front or the rear of the Kut Dam, which may lead with over time to a variance in some properties of the soils of the agricultural lands that are irrigated from the sub-channels of the Tigris River as according to the location of the channels from the Kut Dam, whether they are located in the front or rear of the dam.

Novelty Statement

The study showed a variation in the chemical properties represented by the electrical conductivity values, pH of soil, organic matter, carbonate minerals, and the cationic exchange capacity of the soil between the front and rear of the Kut Dam. It was a new data provide for Kut Dam.

Conflict of interest
The authors have declared no conflict of interest.

References

Abaas, F.H., 2007. Determination of origin; water type of Euphrates river and hydrodynamic effects in accumulation hydrocarbons by usage Hudrochemical Function. Anbar. J. Agric. Sci., 5(2): 15-31.

Abbas, I.H., 2010. Characterization and classification of soil units of the North Kut project and prediction of some physical characteristics using geographic information system and remote sensing. PhD thesis. College of Agriculture, University of Baghdad.

Abood, M.A. and L.S. Salman. 2014. Leaching of saline soil (Sabakh) by using different qualities of water and its impact on some chemical and physical properties of the soil. Euph. J. Agric. Sci., 6(4): 214-232.

Abu-Saleem, A.H., 2009. The geomorphological analyses of the natural causes limiting river floods in Wadi Al-Jurthan Joud. J. Soc. Sci., 2(1): 137-168.

Al-Ali, S.H., 2010. Geochemical and mineralogical study of the fluvial deposits at Abul Khasib area, south east of Iraq. Meso. J. Mar. Sci., 25(2): 154-165.

Al-Azawi, K.M., 2012. Effect of kind and concentration of salts and organic matter on electrical conductivity and soil reaction under leaching conditions. Iraq J. Agri. Sci., 43(3): 42-51.

Al-Bassam, K.S., and L.A. Al-Mukhtar. 2008. (Arabic) Heavy minerals in the sediments of the Euphrates River, in Iraq. Iraq Bull. Geo. Min., 4(1): 29-41.

Al-Bayati, A.H., Muhaimeed, A.S., and S.A.S. Al-Jaberi. 2017. Soil Mineralogical Identification in Pripj Region as A Sample for Iraqi Southern Desert. Iraq J. Des. Stud., 7(1).

Al-Hazaa, S.H., 2009. Sediment logical and mineralogical study of the flaky minerals in the Recent sediments of the Tigris River (from the Lesser Zab in the north to the Kut city in the south of Iraq). Tikrit. J. Pur. Sci., 14(2).

Al-Hussaini, I.K.A., 2010. Inheritance and evolution of earning layers for some soils in northern Iraq, PhD thesis. College of Agriculture, University of Baghdad.

Al-Janabi, H.Y.A., 2016. Applied Land Reclamation, Ministry of Higher Education and Scientific Research, Al-Qasim Green University, College of Agriculture.

Al-Juboury, A., 2006. Some aspects on heavy minerals enrichment from recent fluvial sediments, Northern Iraq, 5th European Congress on Regional Geoscientific Cartography and Information (Earth and Water) Proceedings, I: 250 – 252.

Al-Khalidi, M.A.T., and J.H.A. Uws.2015. Analysis of the natural characteristics of river sediments in the central Diyala Basin, a study in applied geomorphology. J. Res. Diyala. Hum. (66).

Al-Mansoori, F.Y. Abdullah. 2008. Estimates of the future to restore the marshes of southern Iraq. PhD thesis. College of Agriculture, University of Basra.

Al-Moussawi, and N. Adel-Ibrahim. 2019. The effect of physiographic location on some characteristics of sedimentary soils in the Latifiya Project, Master thesis, College of Agricultural Engineering Sciences, University of Baghdad.

Al-Obeidi, A.G., and K.M. Al-Azzawi. 2017. The relationship between the values of electrical conductivity of different suspensions and saturated paste for different textured soil. Diyala Agric. Sci. J., 9(1): 287-300.

Al-Shamare, A.H., and S.K. Essa.2020. The effect of sedimentation sources on the exchange properties of the clay particles of some soils in Wasit and Maysan governorates. Plant Arch., 20(2): 566-573.

Al-Shammari, A.H.D., and Essa, 2020. The effect of sedimentation source on the content and distribution of separated clay particles and the exchange properties of some Wasit and Maysan soils. PhD thesis. College of Agricultural Engineering Sciences, University of Baghdad.

Al-Shihmani, L.S.S., 2020. Spatial variation of content and distribution of Sediments minerals of Al-Gharraf River in Wasit and Thi-Qar governorates. PhD thesis. College of Agricultural Engineering Sciences, University

of Baghdad.
Al-Taiee, T., and A. Al-Hamdani. 2007. Morphological variations of a certain Tigris river reach for different periods in Iraq. Tikrit. J. Eng. Sci., 14(4).
Al-Zarkani, A.A.S., 2016. Determination of the coefficient of homogeneity of the origin materials for soils adjacent to the Tigris River below and above the Kut Dam. J. Uni. Bab., 24(2).
Anderson, J.U., 1963. An improved pretreatment for mineralogical analysis of samples containing organic matter. Clays Clay Min., 10: 380 –388. https://doi.org/10.1346/CCMN.1961.0100134
Black, C.A., 1965. Methods of soil analysis. Part I and II, Amer. Soc. Agron. Inc. Publisher, Medison, Wisconsin, USA.
Brewer, R., 1976. Fabric and mineral analysis of soils. John Wiley and Sons, Inc., New York. pp. 75-84.
Deliver, P., 1962. Properties of saline soil in Iraq. Neth. J. Agric. Sci., pp. 191-210. https://doi.org/10.18174/njas.v10i3.17590
Doran, J.W., and A.J. Jones. 1996. Methods for assessing soil quality. Soil Sci. Soc. Am., 49: 123 -142. https://doi.org/10.2136/sssaspecpub49
Fadel, O.S.R., 2015. Characterization and inheritance of some soils cultivated with rice in the Governorates of Najaf and Al-Diwaniyah, Master's thesis, College of Agriculture, University of Al-Muthanna.
Fattah, M.A., and K.H. Karim. 2021. Performance of linear models in predicting cation exchange capacity of calcareous soils. Iraq. J. Agric. Sci., 52(6): 1489-1497. https://doi.org/10.36103/ijas.v52i6.1490
Fonseca, R., F.J.A.S. Barriga and W.S. Fyfe. 2003. Dam reservoir sediments as fertilizers and artificial soils. Case studies from Portugal and Brazil. In: Proceedings of International Symposium of the Kanazawa University, Japan
Jackson, M.L., 1958. Soil chemical analysis. Printice Hall, Inc., Engloweed Cliffs, N.J.,
Kadhim, R.J.M., 2015. Statistical relationships of some soil physical properties and organic matter content. Kufa J. Agric. Sci., 7(1).
Kerr, P.F., 1977. Optical mineralogy. McGraw-Hill Book Co. Inc. New York, U.S.A.
Khalaf, A.A. and K.S. Jasim. 2016. The characteristics and components some of dust storms and their effects in environmental pollution and degradation. Iraq. J. Des. Stu., 6(1): 1-11.
Khorsheed, D.H., and A.R. Ali. 2015. Heavy minerals distribution in the recent stream sediments of Diyala River Basin/ Northeastern Iraq. Kirkuk. Univ. J. Sci. Stu., 10(4). https://doi.org/10.32894/kujss.2015.124099
Kunze, G.W., 1962. Pretreatment for mineralogical analysis. Reprint of Section prepared for methods monograph published by the soil.
Leeder, M.R., 2009. Sedimentology and sedimentary basins from turbulence to tectonics. John Wiley and Sons.
Li, Y.F., J.S. Li, and H. Zhang. 2014. Effects of chlorination on soil chemical properties and nitrogen uptake for tomato drip irrigated with secondary sewage effluent. J. Int. Agric., 13(9): 2049-2060. https://doi.org/10.1016/S2095-3119(13)60692-9
Manati, A.N., 2020. A study of some physical and chemical properties of the accumulated sediments of the Tigris River in front of the Kut Dam and their impact on engineering parameters. For the section of the river and the performance of the origin of the dam. Master's Thesis, College of Agriculture, Wasit University.
Mehra, O.P. and M.L. Jackson. 1960. Iron oxide removal from soil and clays by a dithionite-citrate system buffered with sodium bicarbonate. Clay Clay Miner., 7(1): 317-327. https://doi.org/10.1346/CCMN.1958.0070122
Milner, H.B., 1962. Sedimentary petrography. 4th Ed. Murby and Co. London.
Mousa, G., 2006. Evaluation and beneficiation of feldspar from arkosic sand stone in south Jordan for application in the ceramic industry.
Nesse, W.D., 2000. Introduction to mineralogy, Oxford University press, New York, pp. 442.
Odeh, B.A., 2016. Geographical evaluation of the irrigation network in Wasit Governorate. J. Coll. Educ. Grils Hum. Sci., 4.
Page, A.L., R.H. Miller, and D.R. Kenney. 1982. Methods of soil analysis part 2. Chemical and microbiolgical properties 2nd ed. Agronomy 9 Am. Soc. Agron. Madison, Wisconsin.
Pansu, M. and J. Gautheyrou. 2006. Handbook of soil analysis. Mineralogical, organic and inorganic methods. Text book, Library of Congress, Springer Berlin Heidelberg New York.
Rabenhorst, M.C. and L.P. Wilding. 1984. Method

to obtain carbonate free residues from lime stone and petrocalcic materials. Soil Sci. Soc. Am. J., 84: 216-219. https://doi.org/10.2136/sssaj1984.03615995004800010039x

Rahal, N.S., 2009. Differentiation sedimentological environments of soil series materials within irrigation and river basins from middle-mesopotamian. J. Wasit. Sci. Med., 2(2): 94-117.

Richards, L.A., 1954. Diagnosis and improvement of saline and alkaline soil. https://doi.org/10.1097/00010694-195408000-00012

Sahar, A.A., 2010. Study of the mineral composition of the accumulated sediments at the front and back of the Kut Dam, the Fourth Scientific Conference, Wasit University.

Salman, A.H., H.H. Zainab and A.R. Ibtisam. 2016. Environmental effects of water dams in Iraq. J. Geo. Res., 20.

Savant, N.K., 1994. Simplified methylene blue method for rapid determination of cation exchange capacity of mineral soils. Soil Sci. Plant Anal., 25(19–20): 3357–3364. https://doi.org/10.1080/00103629409369269

Serwan, A.S., A.R. Jober and R.A. Shakir. 2015. The use of geological statistics to prepare map to the sand Minerals in some of the Middle Euphratesareas. Euph. J. Agric. Sci., 7(3).

Singh, R.S., J.T. Reager, N.L. Miller and J.S. Famiglietti. 2015. Toward hyper-resolution land-surface modeling: The effects of fine-scale topography and soil texture on CLM 4.0 simulations over the Southwestern US. Water Res. Res., 51(4): 2648-2667. https://doi.org/10.1002/2014WR015686

Sposito, G., 2008. The chemistry of soils. Oxford university press.

Stanley, D.J. and J.G. Wingerath. 1996. Nile sediment dispersal altered by the Aswan High Dam: The kaolinite trace. Mar. Geol., 133: 1–9. https://doi.org/10.1016/0025-3227(96)00019-9

Suliman, A.A., 2014. Spatial variability of some soil physical and chemical properties for alluvial soils between euphrates and tigris using time series analysis. Diyala Agric. Sci. J., 6(1): 159-171.

Taqqa, K.J., and Q.H. Adnan. 1991. Soil chemistry, Ministry of Higher Education and Scientific Research, Technical Institutes Authority. Dar Al-Hikma for printing and publishing.

Turgut, B., M. Özalp and B. Köse. 2015. Physical and chemical properties of recently deposited sediments in the reservoir of the Borcka Dam in Artvin, Turkey. Turk. J. Agric. For., 39(5): 663-678. https://doi.org/10.3906/tar-1404-60

U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Agric. Hand book. 60. U.S. Gov. Print. Office, Washington, DC.

Wheib, K.A., and O.N. Ibrahim. 2012. Study of morphological and micromorphological properties of some salt affected soil in the middle of Iraq. Iraqi J. Agric. Sci., 43: 106-118.

Zhao, P., M.A. Shao and R. Horton. 2011. Performance of soil particle-size distribution models for describing deposited soils adjacent to constructed dams in the China Loess Plateau. Acta Geo., 59(1): 124-138. https://doi.org/10.2478/s11600-010-0037-2