QUANTITATIVE ANALYSES OF SURFACE WATER AND GROUNDWATER RESOURCES AROUND THE RIVER NILE, MINIA AND ASSIUT GOVERNORATES UPPER EGYPT: DISCRIMINATION OF WATER POLLUTION

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ABSTRACT

The present study deals with the discrimination of the pollution recorded in the groundwater and the surface water samples distributed in the area between Maghagha city at the north of Minia Governorate and El-Badary and EL ghamaym at south of Assiut Governorate. Quantitative analyses of 256 water samples (cluster analysis and principal coordinate analysis) revealed the distinction of seven clusters each of which has its characteristic conditions (according to cluster analysis) and separation of the very high polluted samples of the study area according to principal coordinate analysis. Moreover, the use of GIS technique helped to draw a general map introducing the different zones of pollution in the study area.

INTRODUCTION

Water is a rudimentary essential of life, not only for survival of human but also for plants and animals as well. Water represents about 65% of our body weight, and its drop to about 12% would lead to death. It is compulsory in all features of life and health for creating food, agricultural activity and energy generation. Groundwater is rarely preserved and supposed to be naturally protected, it is considered to be free from impurities, which are related with surface water, because it comes from deeper parts of the earth. Water value is everybody's professional because eventually we all attraction from the same stock of water. Most people live downstream from somebody else, not to reference the fact that the same basic supply of water, refilled over and over again through the hydrologic cycle, has been used millions of times over in the long times past of the earth. We are now aware of limits to the reuse of water, when and where it is repaid to nature reduced in quantity and quality [1]. Therefore, we must learn to understand water use much better: where we use it, what to measure, what the foremost uses are, how they contend and affect with each other, and how to succeed the growing competition.

Groundwater is an important source of drinking and irrigation, so that the qualitative and quantitative evaluations of the groundwater resources for sustainable development is continuously required, especially in most of arid and semi - arid countries. There are contact between surface water and groundwater which appear in high concentration between the deferent chemical elements of our samples in the study area [2].The study area has high pollution

in the deferent position in the north, center and south of the location but Assiut Governorate is more pollution than Minia Governorate. The principle of the quantities analyses of water, the water can not the permissible for drinking without Processing. The groundwater and surface water in the study area were studied by many authors [3, 5, 8, 12-24, 30, 32, 38, 39].

THE STUDY AREA

Minia is located in Egypt with coordinates 28° 6´35.5680''N 30° 45´ 1.0800'' E Minia Governorate in Upper Egypt. It is located approximately 245 km (152 mi) south of Cairo on the western bank of the Nile River, which flows north through the city. The inhabited area attains about 2.4 thousand kilometers and represents 7.5% only of the total area, upon which lives more than four million people. The following cities are located in this governorate:

El Edwa, Maghagha, Beni Mazar, Matai and Samalut, Minia (Men'at Khufu), Abu Qurqas, Mallawi, Deir Mawas, and Assiut **is bordering River Nile between Dirout at the North and EL Badary at the south On the other hand, Assuit Governorate bounded by the limestone plateau, it is located between latitudes 26° 45´) and 27° 40´ N and longitudes 30° 40´ and 31° 30´ E (Fig. 1). The calculate flying distance from Minia to Assiut is equal to** 69 miles **which is equal to 112 km. Assiut comprises 11 towns, 56 main villages and 235subordinate villages. The total number of population is about 4 million person, from which 73 % are living in rural areas.**

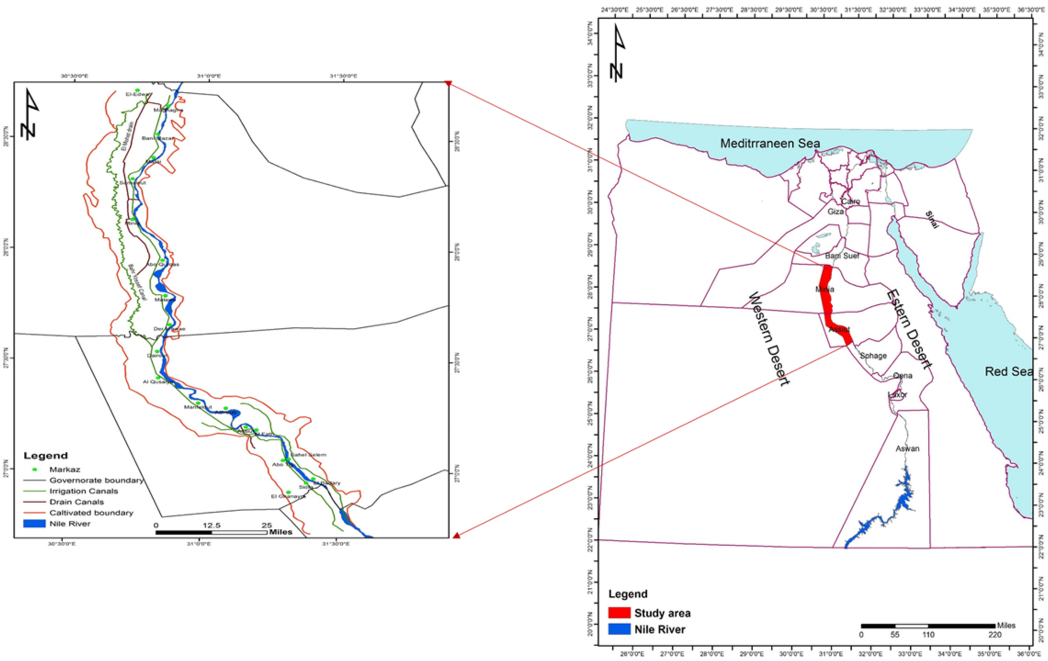


Fig. (1): Location map of study area in Minia and Assiut Governorates

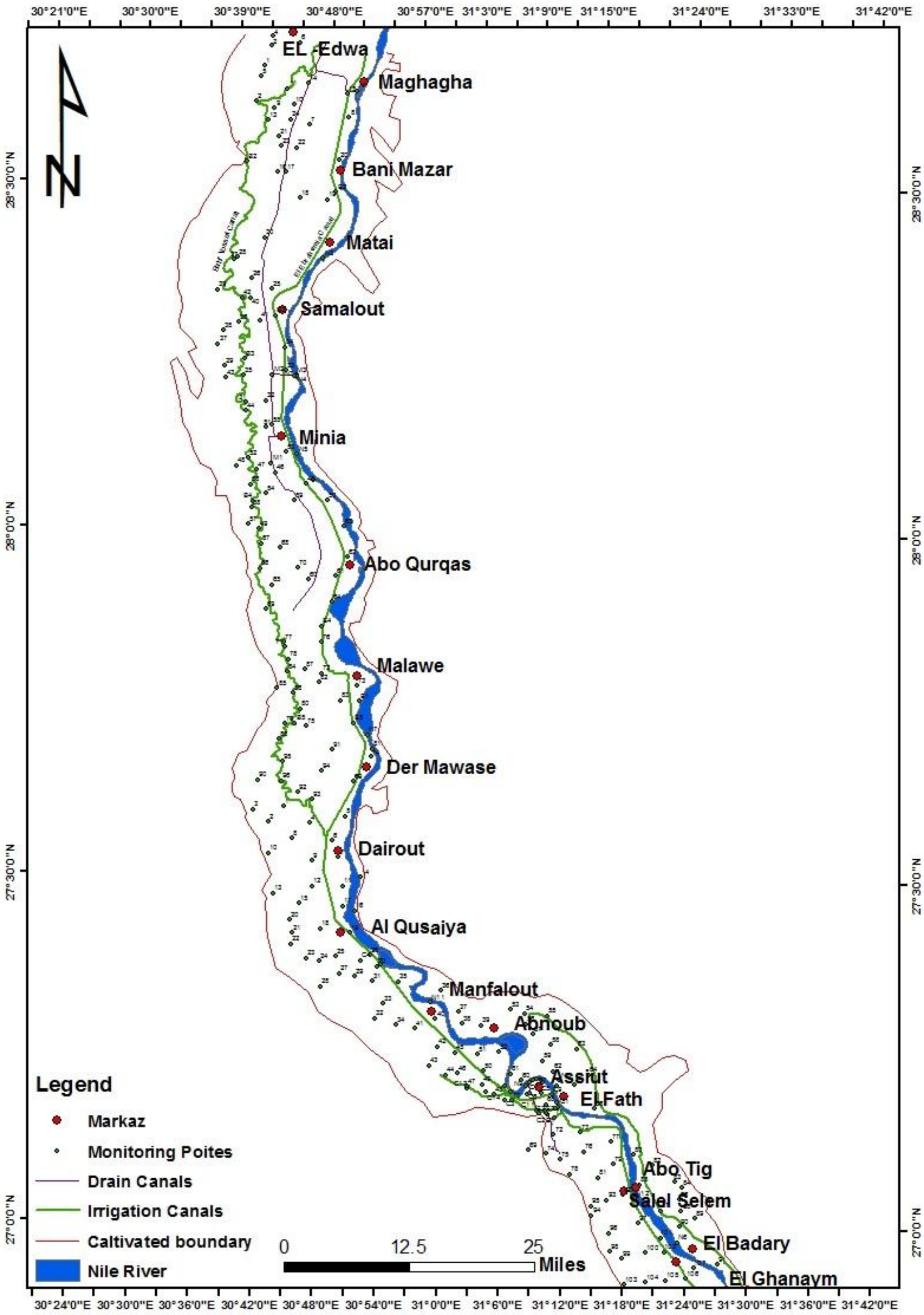


Fig. (2): **Location map of monitoring pointes of surface and groundwater in study area.**

MATERIALS AND METHODS

In the present study, analysis of the final element concentrations (as well as the field Values for conductivity, pH and select concentration ratios) was performed in multiple stages including exploratory data analysis, indicator variable analysis, variogram analysis, cluster analysis and principal component analysis. Two hundred and five groundwater samples and fifty one surface water samples from the area, were collected in autumn (Fig.7). Some computer programs were applied such as surfer 13 for window, geographic information system (GIS) for window, Win, word and Excel 2008 for windows and using Glober mapper16. GPS instrument is used to locate the studied sites where the water samples were collected. The water analyses were

carried out in the Geological Department, Faculty of Sciences, Mania University, and Environmental Agency Affair. The samples were acidified with ultra-pure nitric acid, after filtration, to avoid complication and adsorption. The acidification was accomplished in situ in case of toxic metals determination. Then the samples transported to laboratory and kept in a fridge at approximately – 200 C to prevent change in volume due to evaporation The toxic metals (Cd, Cr, Cu, Pb, Ni, Mn, Fe, &NO2) were determined by the ICP (Inductive Couples Plasma)-AES. According to the methods adopted by Rainwater FH and Thatcher LL [10], and the methods described by Fishman MG and Friedman LC [11]. PH, TDS, electrical conductivity, and water temperature were measured in situ using Ultrameter tm 6p in situ. Cl, HCO3, Ca, and Mg were measured by titration, while SO4 content is estimated by turbidity. Na and K were analyzed by flame photometer. GPS device is used to locate the studied locates where the water samples were collected. The water analysis was carried out in the Geological Department, Faculty of Sciences, Mania University, and Environmental Agency Affair.

RESULTS AND DISCUSSION

The quantitative analyses techniques for evaluating the water excellence is herein established to be effective in detecting the most severe localities prohibited for drinking and irrigation purposes. [12].

Cluster analysis (CA) based on the relationship coefficient of likeness (the corresponding group average method) has been useful to the raw data matrix of both the groundwater samples and to that of the surface water samples, to classify the existing groups of water samples. In the meantime the many data analyses were effective in solving problems related to different features of paleoecology and morphometrics. Then principle coordinate analysis (PCOA), based on the correlation coefficient of resemblance, of the two raw data matrices was achieved to differentiate the most important elements affecting the water quality. The computer programs used are comprised a software package called PAST, version 2.09. The results were analyzed in comparing with the guidelines of Singh et al. [25] and Egyptian standards [26] (Table 1).

Otherwise, it can be practicable to differentiate the studied localities into collections; each has its individual arrangement and geographic situation; taking into consideration the representation of the different elements in water and water use.

Tab. 1: WHO [25] and Egyptian standards [26] guidelines for drinking water quality and domestic uses.

Parameter mg/l	Unit	WHO Guideline[1]	Egypt Standards[2]
Alkalinity	mg / L	*	*
Aluminium (Al)	mg / L	0.1	0.2
Ammonia (NH3)	mg / L	1.5	.5
Barium (Ba)	mg / L	0.7	0.7
Arsenic (As)	mg / L	.01	.01
Bicarbonate (HCO3)	mg / L	#	#
Boron (B)	mg / L	0.5	0.5
Cadmium (Cd)	mg / L	0.003	0.003
Calcium (Ca)	mg / L	*	200
Chloride (Cl)	mg / L	250	250
Chromium (Cr)	mg / L	0.05	0.05
Conductivity	µs / cm	250	*
Copper (Cu)	mg / L	2	2
Cyanide (Cn)	mg / L	0.07	0.05
Hardness	mg / L	200	500
Iron (Fe)	mg / L	0.3	0.3
Lead (pb)	mg / L	0.01	0.01
Magnesium (Mg)	mg / L	*	150
Manganese (Mn)	mg / L	0.4	0.4
Mercury (Hg)	mg / L	0.001	0.001
Nickel (Ni)	mg / L	0.02	0.02
Nitrate (NO3	mg / L	50	45
pH	mg / L	L 6.5 – 8	6.5 - 8.5
Selenium (Se)	mg / L	0.01	0.01
Sodium (Na)	mg / L	200	200
Sulfate (SO4)	mg / L	250	250
Total Dissolved Solids	mg / L	600	1000
Turbidity NTU	NTU	5	1
Zinc (Zn)	mg / L	3	3

Tab. 2: **Descriptive statistic data of surface water and groundwater samples in the study area.**

Parameter Min Max Average	Min	Max	Average
pH	5	9.7	7.35
EC	226	2100	1163
TDS	170	1410.71	790.355
Ca	24.3	345	184.65
Mg	10	180	95
Na	12.56	197.57	105.065
K	0.8	25	12.9
SO4	6.5	751	378.75
HCO3	45	730	387.5
Turbidty.	0.014	205	102.507
T. H	62	882	472
T.Alk	102	695	398.5
NO2	0	0.98	0.49
Fe	0	3.5	1.75
Mn	0	9	4.5
Pb	0	0.34	0.17
Cd	0	0.45	0.225
Ni	0	0.25	0.125
Cu	0	1.85	0.925
Cr	0	0.102	0.051
B	0.008	1.8	0.904
Cl	2	505	253.5

CLUSTER ANALYSIS

Agglomerative Hierarchical cluster are formed successively, by starting with the most similar pair of objects and forming higher cluster step by step.In this study a cluster analysis helps in grouping cases into clusters on the bases of resemblances within a group and variations between dissimilar clusters. . The consequences of cluster analysis aid in understanding the data and indicate designs. To detect spatial similarity among groups, cluster analysis was applied on 51 surface water and 205 groundwater samples. The corresponding group regular method was applied (in this method using correlation similarity measure).Fig (3).

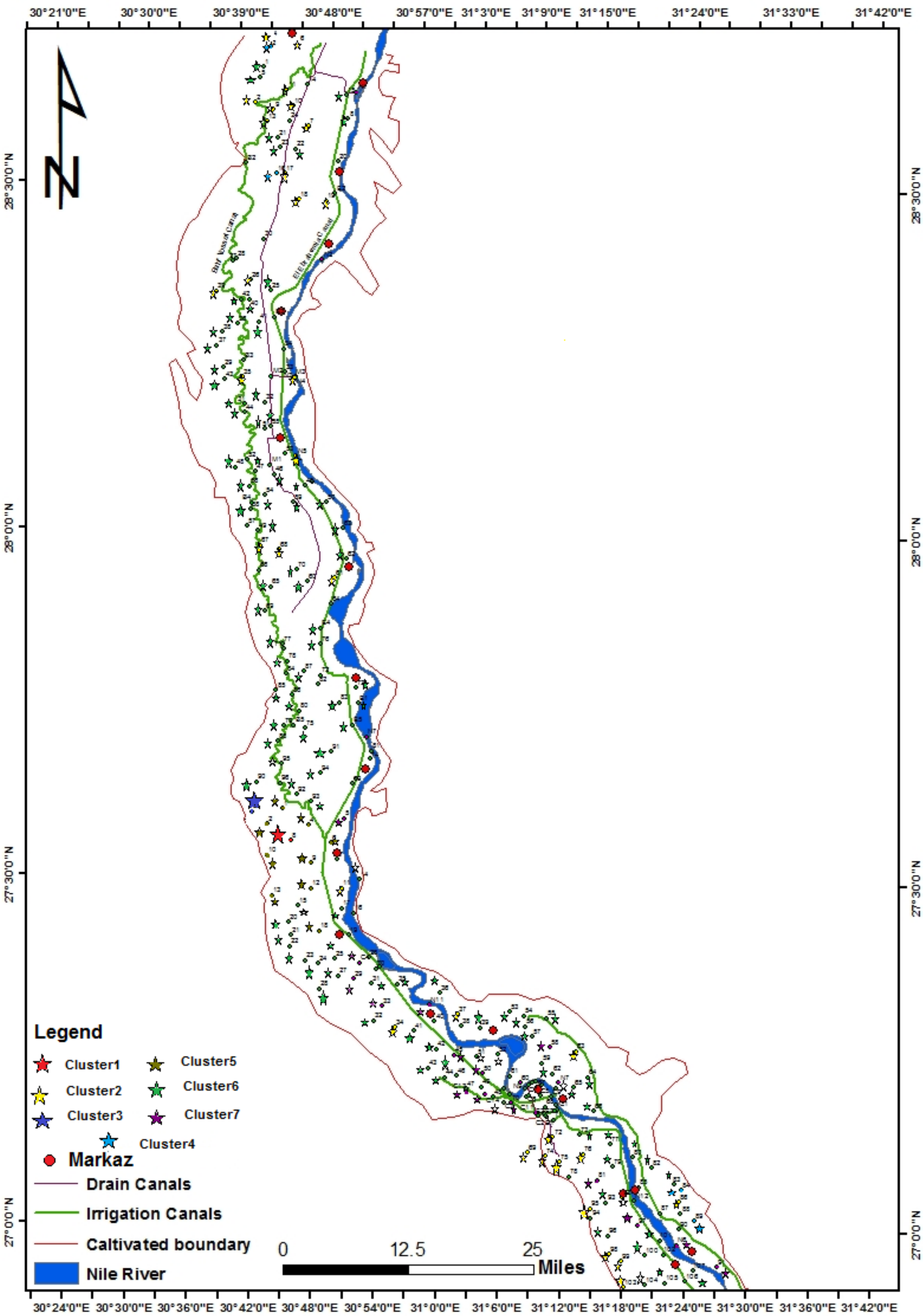


Fig. 3: **Clusters point identification by HCA of surface water samples in the study area.**

Tab. (3) **Cluster Analysis (CA) for surface water and groundwater system**

cluster1
cluster2
cluster3
cluster4
cluster5
cluster6
cluster7
very high

	totol hardnes s as CaCo3(mg/l)	TDS	pH	So4	Cl	Ca	Mg	Fe	B	Mn	Ni	pb	cr	Cd
Cluster1	8-Assiut	8-Assiut	8-Assiut							8-Assiut	(M3)Minia			
Cluster2	(M3-2-3-4-5-6-7-9-10-11-13-14-17-18-19-25-35-39-68-72-75-76-82-83-87-90-92-94)EL-Minia-(7-11-34-37-63-64-69-72-74-75-76-88-92-95-98-99-103)Assiut	(2-4-5-6-7-8-9-11-13-15-16-19-20-21-27-37-41-68-72-75-76-84-85-87-90-92-94)EL-Minia-(7-11-34-37-63-64-89-69-72-74-73-78-82-88-92-95-98-99-103)Assiut	(34-72)Assiut	(72-74-75-78-93-97-99-103)Assiut	(2-4-5-15-17-18)EMinia			(2-5-7-75-82-83-94-87)EL-Minia-(7-11-34-64-74-75-78-84-95-98-99-103)Assiut	(M3-9-12-35-39-90)-Minia-(63-64-98)Assiut	(68-72-75-82-87-92-)-Minia-(11-34-37-64-72-74-75-78-88-98-99-103)Assiut		(63-88-92-95-98-99-103)Assiut		(M3)ELMinia-(N11-63-88-92-95-98-99-103)Assiut
Cluster3	3-Assiut	3-Assiut	3-Assiut	3-Assiut	3-Assiut	3-Assiut	3-Assiut	3-Assiut	3-Assiut			3-Assiut		**3-Assiut**
Cluster4	(12)EL-Minia-(55-83-84-89)Assiut	(12)EL-Minia-(55-83-84-89)Assiut		(55-83)Assiut	(16)EL-Minia-(84)Assiut				(55-83-84)Assiut	(89)Assiut		(83-84-89)Assiut		(12)EL-Minia-(84-89)Assiut
Cluster5				(1-2-4-6-9-10-11-12)Assiut		(2-4)Assiut		(2-4-6-12-13)Assiut	(2-10-13)Assiut	(6-42-13-18)Assiut		(2-10-12-13)Assiut		(1-2-4-12-13-18)Assiut
cluster6	(M1-M2-1-8-15-16-20-21-22-23-24-26-27-29-30-32-33-34-36-38-40-42-43-46-50-54-55-58-59-77-78-79-80-81-84-85-86-89-91-93-95-96)EL-Minia-(14-15-19-20-25-27-29-31-32-36-38-39-41-43-44-47-48-52-53-54-56-57-57-65-66-80-87-90-93-94-96-97-100-104-105-108-109)Assiut	(M1-M2-1-15-21-22-24-30-34-59-71-74-93-95)EL-Minia-(20-21-24-25-65-109)Assiut	(52-53-76)Assiut	(8)Assiut				(63-79-84-85)-Minia-(E3-19-20-21-22-24-27-31-32-41-43-44-52-54-65-76-86-94-104-105-109)Assiut	(M1-M2-36-66)Minia-(E2-E3-32-48-53-54-56)Assiut	(30-46-54-55-59-60-62-63-70-73-74-81-84-85-91)EL-Minia-(19-20-21-22-23-24-27-32-36-41-43-44-52-53-54-65-76-96-104-105109)Assiut	(M1-M2)Minia-(20)Assiut	(91-93)Minia-(14-15-20-21-24-25-27-31-32-37-52-57-86-90-93-96-100-105-108-109-)		(M2)-Minia-(14-15-19-20-21-23-24-27-31-32-43-52-57-86-90-93-96-100-104-105-109)Assiut
cluster7			(N6-N7-N8-N9-N11-N12-N13-C1-49-51-95)Assiut					(C2-C3-C4-C5-C6-C7-C8-C9-C10-C12-C14-5-8-26-46-78-85)Assiut	(37-65-67-88)EL-Minia-(E1-28-50)Assiut		(N1-N3-N4-N6-B2)EL-Minia-(N1-N4-N5-N6-N8-N11-N12-C2-C3-C4-C5-C6-C7-C8-C9-C10-C12-C13-C14)Assiut	(E1-E2-E3-E4-E5-E6-N1-N2-N3-N4-N5-N6-N7-B1-B2-B3-B4-B5)E-Minia-(N6-C13-26-28-33-50-51-81-106-107)Assiut	(N1-N3-N4-N5)EL-Minia	(N1-N3-N4)EL-Minia-(C2-C13-C14-5-26-28-33-45-50-51-58-81-85-91-97-101-106-107)Assiut

CLUSTER ANALYSIS (CA) FOR SURFACE WATER AND GROUNDWATER SYSTEM

Cluster analysis led to differentiate seven clusters of surface water samples where the resulting dendrogram is illustrated in figure (2). The association of the defined clusters of samples with their geographic location is shown in Figure (1).

An example of a graph of spatial groups is shown in Figure 2.

Specifically, Figure (1) provides a spatial map of the location of 256 sample locations that have the most similar values.

Cluster 6 and 7contain both surface water and groundwater samples.

Cluster-1 is represented by one groundwater sample No. 8 which belong to Dairot city. It is characterized by high concentrations of Mn, PH, TDS and total hardness, while the concentration of SO4, Pb, Ca, Cl, B, Fe, Ni, Cd, Cr, PH and Mg are in the permissible level for drinking [25] and [26]. Fig. (4)

Cluster-2: is represented by one surface water sample in Samalout is (M3) which is very high in Cd, Ni, B, TDS and total alkaline of $CaCo_3$, and the groundwater samples in (2, 3, 4, 5, 6, 7, 9, 10, 11,13 & 14) in Maghagha (17,18,19) in Bani Mazar (25) in Matai (35&39) in Samalout (68) in Minia (72, 75, 82 & 92) in Abu Qurqas, Malawe and Der Mawas. While, samples No (7&11) in Dairot (34 & 37) in Manfalout (63 & 64) in Assiut, (69, 72, 73, 74 & 78) in EL-Fath, (82) in Abo Tig, (88, 89, 92 & 95) in Sahel Selem, (98 & 99) in El Badary, and (103) in EL-Ghanaym. This cluster is considered by high concentration of SO4, Fe, Ni, Pb, B, Cl, Cd, Mn, PH, TDS and total hardness as $CaCo_3$, while the concentrations of Ca, Cr and Mg are in the permissible level for drinking Fig. (4).

Cluster- 3 is represented by one groundwater sample No. (3) in Dairot city. It contains high concentrations of Cd, Pb, B, F, Ca, Cl, SO4, Mn, PH, TDS and Total hardness, while the concentrations of Cr and Ni are in the permissible level for drinking Fig. (4).

Cluster- 4 is characterized by one sample No.12 in Maghagha, and four samples (55) in Abnoub and (83, 84, 89) in Abo Tig, which all samples in Cluster- 4 have very high concentration of SO4, Pb, B, Cl, Cd, Mn, PH, TDS and total hardness as $CaCo_3$, while the concentrations of Ca, Cr, Fe and Mg, are in the permissible level for drinking Fig. (4).

Cluster-5 refers to the groundwater samples, which have nine samples in (1, 2, 4, 6, 10, 12 & 13) in Dairout, (18) in Al Qusaiya. There are having different very high values in different samples in its in study area represented in Cd, pb, Mn, B, Fe, Ca, SO4 and total hardness, while the concentration of Cr, Ni , Cl , PH, TDS and Mg, are in the permissible for drinking Fig. (4).

Cluster-6 includes the surface water and groundwater samples, which having different highest dissimilar values of Cd, pb, Mn, B, Fe, Ni, SO4, PH, TDS and total hardness in samples in its in location study; area represented in (M1and M2) in Samalout, (1, 8, 15 & 24) in Maghagha, (16, 20&21) in Bani Mazar (26, 27, 29 & 30) in Matai, (32, 34, 36, 38, 40, 42, 43) in Samalout, (46, 50, 54, 55, 58 & 59) in Minia, (77) in Abu Qurqas, (81,84-86) in Malawe, (89, 91, 93, 95 & 96) in Der Mawas, and (E2, E3, 14 & 15) in Dairot, (19, 20, 25, 27, 29 & 31) in Al Qusaiya , (32, 36 & 38) in Manfalout, (39, 41, 43, 44, 52, 54, 56 & 57) in Abnoub, (47, 48 & 65) in Assiut, (66 & 80) in EL-Fath , (87, 90, 93, 94, 96 & 97) in Sahel Selem , (100) in El Badary, (104, 105, 108 & 109) in EL-Ghanaym. While the concentrations of Cr, Cl, Ca and Mg are in the permissible for drinking.

Cluster -6 has a large number of samples 5 surface water and 84 Groundwater. The surface water samples no. (M1 and M2) in Samalout and (E2 and E3) in Dairout are specifically representing the most polluted surface water samples in the study area Fig. (4).

Cluster-7 includes remaining the surface water and groundwater samples, that having many highest values of Cd, Cr, pb, Ni, B, Fe and PH in north, center and south location of study area in samples nos. (E1 and B5) in Malawe, (N1), in Maghagha, (N7and E6) in Der Mawas, (B1) in El Edwa, and (N1, N4 and N5),(N6) in El Badary, (N11) in Manfalout, (N12) in Sahel Selem, (C2) in El Fath, (C14 & N8) in Assiut in surface water.

As to groundwater, the highest values of Mn, Cl, Ca, SO4, PH, TDS, Mg & total hardness are represented in samples nos. (28) in Matai, (31, 41 & 44) in Samalout , (45, 47, 49, 52 & 53) in Minia, (61 & 65) in Abu Qurqas, (88) in Malawe, and (5) in Dairout, (26 &28) in Al Qusaiya, (33) in Manfalout , (45, 50, 51 & 58) in Abnoub, (81 & 85) in Abo Tig, (91, 97 & 101) in Sahel Selem, (106) in Sidfa, (107) in El Badary. Which are in the permissible level for drinking Fig. (4).

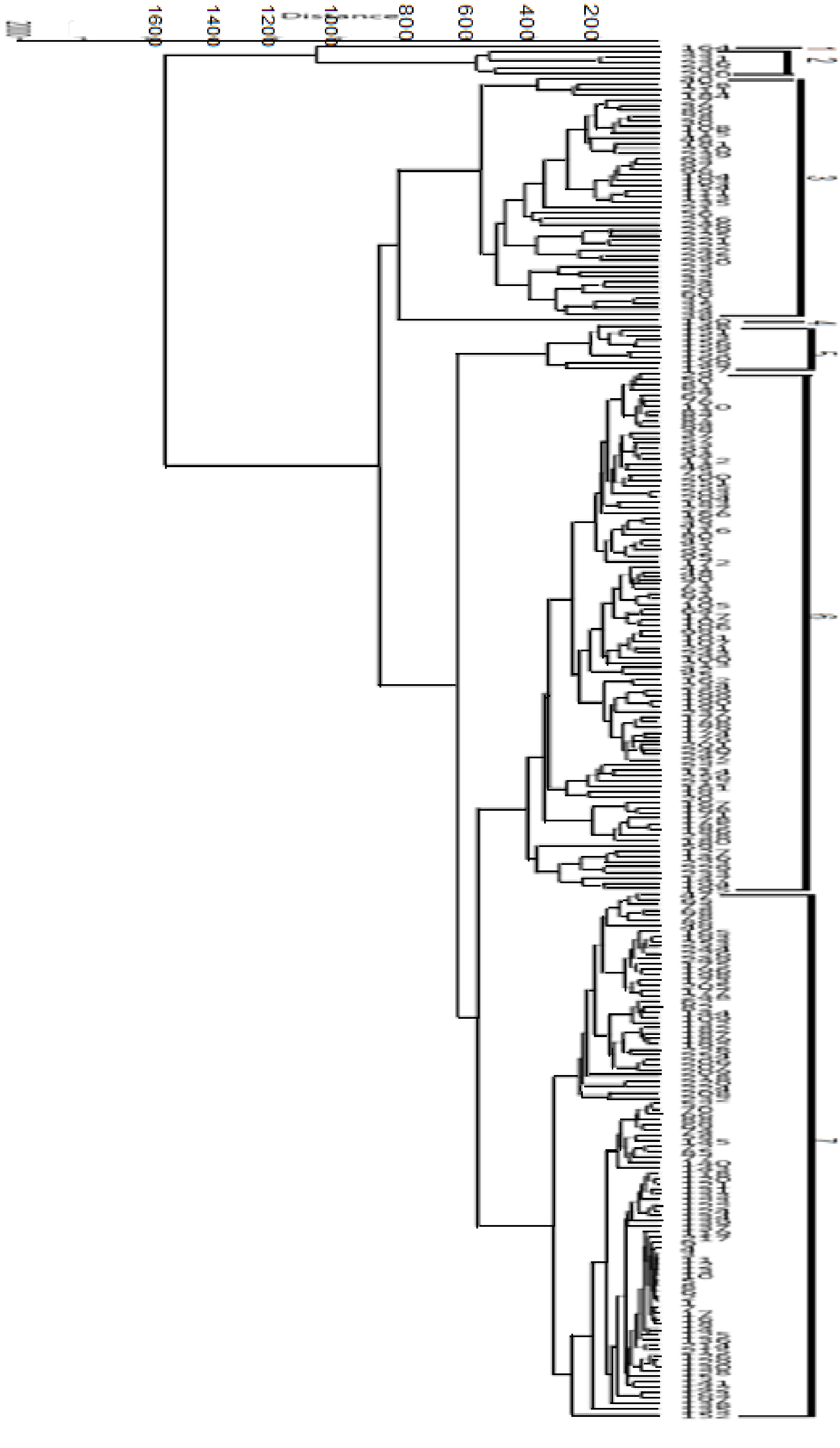


Fig. (4): **Hierarchical Cluster Analysis (HCA) for surface water and groundwater system**

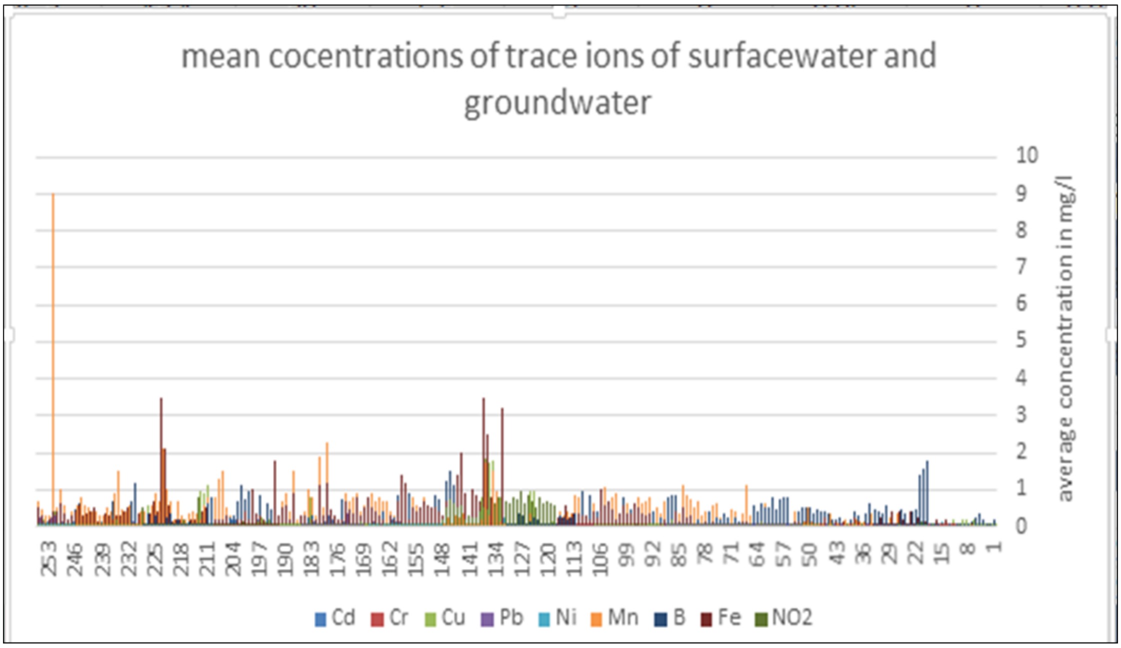


Fig. (5): Mean concentration of trace ions in surface water and groundwater.

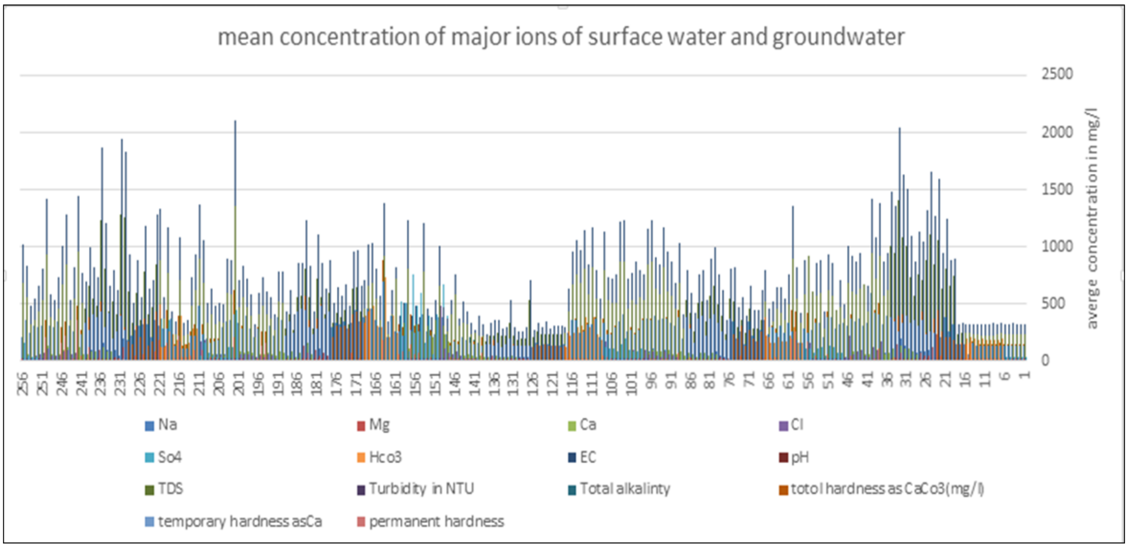


Fig. (6): Mean concentration of major ions in surface water and groundwater

Cluster Analysis (CA) for surface water system

Cluster analysis distinguished two Clusters of surface water samples where the resulting dendrogram is illustrated in Figure. The relationship of the defined groups of samples with their geographic location is shown in Figure (9).

Cluster-1 is represented by five samples Nos. (M1, M2& M3) in Samalout and (N10 & E2) in EL-Fath. It is characterized by high concentration of Cd, B, Ni, PH , TDS and Total hardness, while the concentration of SO4, Cu, pb, Fe, Mn, Cl, Ca & Cr are in the permissible level for drinking . Cluster 1 has highest values of BOD and COD which have El Moohet and El Zenar Drains, high BOD and COD characterize it due to the discharge of the Sanitation and industrial wastewater to

the mentioned drains. It is unsuitable for drinking or domestic uses directly without treatment. Fig. (9).

Cluster-2 refers to residual samples of surface water which have high concentration in chemical elements Cd, B, Ni , Cu, pb, Fe, Mn, PH ,and Total hardness as CaCo3 while the concentration of SO4 , Cu, pb, Fe, Mn, Cl, Ca & Cr are in the permissible level for drinking ,which represented by samples nos. (E1, E5& B5) in Malawe, (E2 & E3) in Samalout, (E4) in Abu Qurqas, (E6) in Der Mawas, (N1) in Maghagha, (N2) in Matai, (N3, N4 & B3) in Samalout, (N5 , N6 & B4) in Minia, (N7) Der Mawas, (B1) in El Edwa , (B2) in Bani Mazar, and (N1, N4 & N5), (N11) in Manfalout, (N12) in Sahel Selem, (C2, C3 & E3) in El Fath, (C4) in Al Qusaiya, (C5, C6, C7, C8, C9, C10, C12, C13, C14 & N8) in Assiut. Cluster 2 has very high values in (B1, B2, B4, C1, C5, C13 and C14) and very low values in (C6, C7, C8, C9, C11 & C12) of BOD and COD which (N6) in El Badary has highest value in BOD and COD are (108 & 70).Changes from the two preceding clusters. BOD and COD are very the high values , outstanding to the direct discharge of the sewage water into El Moohet and El Zenar Drains, which composed from the septic containers from the neighboring villages.

It is unsuitable for drinking or domestic uses directly without treatment Fig. (9).

The above-mentioned remarks indicate that pollution has reached high level on the surface water samples of the study area in El Zenar Drain from estuary of sewage water treatment station to estuary of irrigation drain that discharging into River Nile on front of El-badary Drain and on front of abattoir (Shambles) on El Waledia, Arab El Madabek canals. This bad situation could be related to more anthropogenic activities in these areas when it is compared with the other areas.

Hydro geochemically regarding to Table (1) and Figure (3) it is clear that; Cluster-1 high concentration of Cd, B, Ni, PH, TDS and Total hardness as $CaCo_3$ than the remain surface water cluster due to wastewater discharge from abattoir (Shambles). Cluster-2 It high Cd, B, Ni, Cu, pb ,Fe, Mn, PH & total hardness value due to the discharge of industrial and sewage wastewater which included samples located in El Moheet and El Zenar Drains and in front its estuary into River Nile Fig. (9).

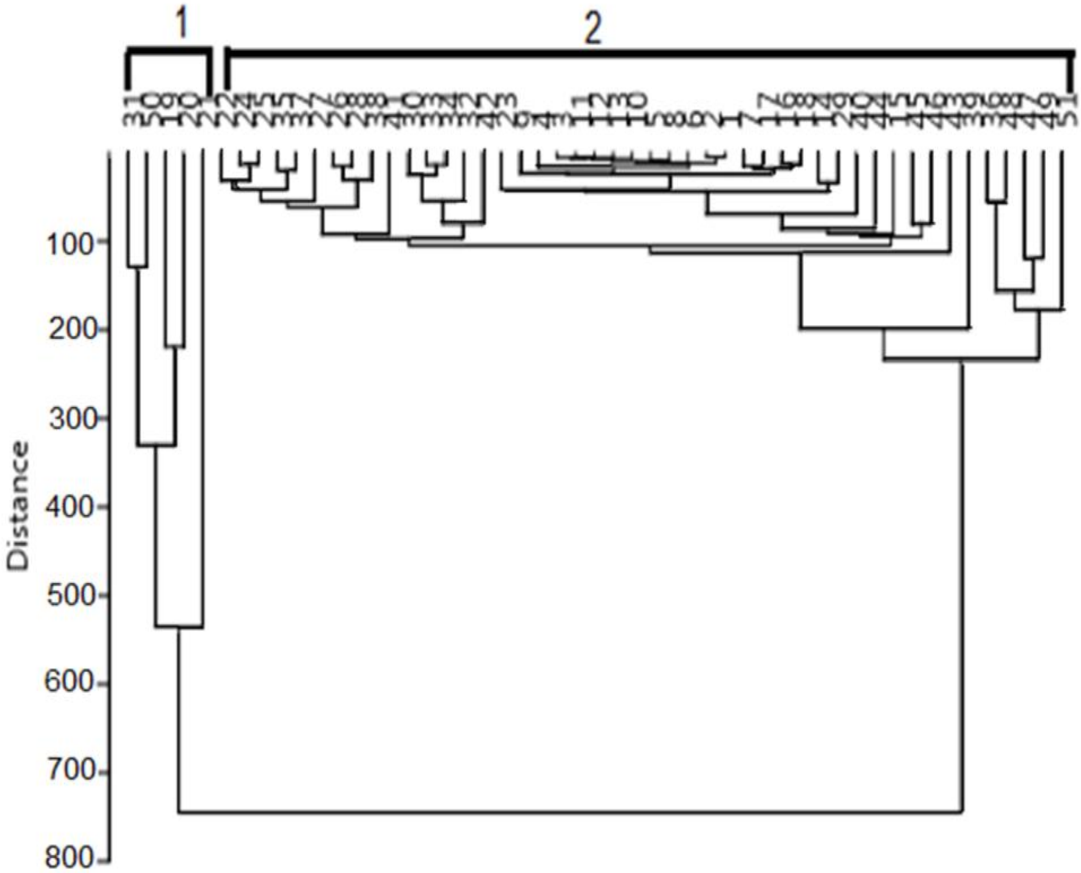


Figure (7): Hierarchical Cluster Analysis (HCA) for surface water system

Tab. (4): Cluster Analysis (HCA) for Surface water system

cluster1 | cluster2 | very high

	PH	totol hardness as CaCo3(mg/l)	TDS	Fe	B	Mn	Ni	pb	cr	Cd
cluster1	N10	M1-M2-M3	M1-M2-M3		E2)AsM1-M2-M3)EL-Minia-siut		M1-M2-M3			M2-M3
cluster2	(N6-N7-N8-N9-N11-N12-N13-C1-C3)Assiut	C9-C14)Assiut		(C2-C5-C6-C7-C8-C9-C10-C12-C13-C14-E3)Assiut	(E1-E3)Assiut	(C4-C5-C7)Assiut	(N1-N4-N5-N8-N11-N12-C2-C3-C4-C5-C6-C7-C8-C9-C10)Assiut	E1-E2-E3-E4-E5-E6-N1-N2-N3-N4-N5-N6-N7-B1-B2-B3-B4-B5)EL-Minia-(N6)Assiut	(N1-N4-N5)EL-Minia	(N1-N4-N5)EL-Minia-(C2-C13-C14)Assiut

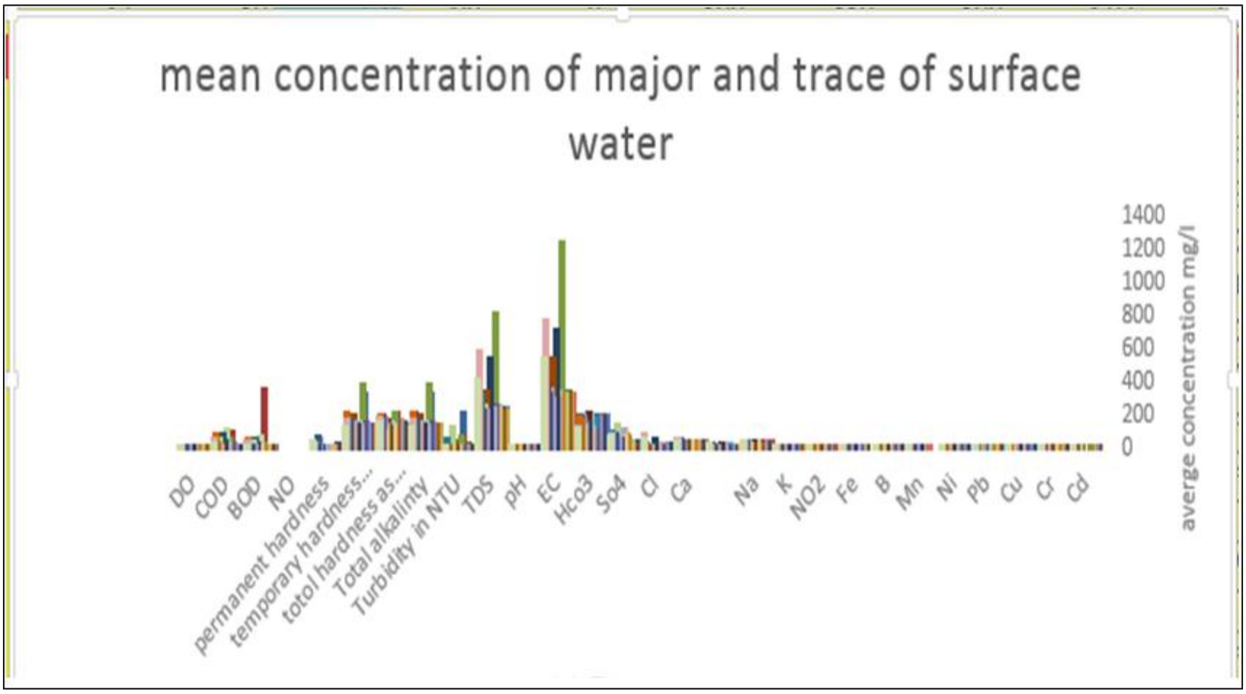


Fig. (8) Mean concentration of major and trace ions in surface water

Cluster Analysis (CA) for groundwater system

Cluster analysis renowned six Clusters of groundwater samples where the resulting dendrogram is illustrated in Figure (10). The relationship of the defined groups of samples with their geographic location is shown in Figure 3.

Cluster-1 is represented by one groundwater sample no. 17 in Dairot. It is characterized by high concentration of Mn, TDS and total hardness as CaCo3, while the concentration of SO4, Pb, Ca, Cl, B, Fe, Ni, Cd, Cr, PH and Mg, and are in the permissible level for drinking. Fig. (10)

Cluster-2 is characterized by five groundwater samples Nos. (12) in Maghagha , (55) in Abnoub, (83, 84, and 89) collected in Abo Tig . All samples in Cluster- 2 hase very high concentration of SO4, Pb, B, Cl, Cd, Mn, PH, TDS and total hardness , while the concentration of Ca, Cr, Fe and Mg, are in the permissible level for drinking Fig. (10)

Cluster-3 refers to a large number of samples in study area which samples nos. (2, 3, 4 & 6) in El Edwa, (5, 7, 9, 10, 11, 13 & 14) in Maghagha, (17, 19) in Bani Mazar, (25) in Matai, (35 & 39) in Samalout, (68) in Abu Qurqas, (72, 75, 82, and 87) in Malawe, (92) in Der Mawas, while samples nos. (7 and 11) in Dairot, (34 and 37) in Manfalout, (63, 64) in Assiut, (69, 72, 73, 74, 78) in EL Fath, (82) in Abo Tig, (88, 89, 92, 95 & 98) in Sahel Selem, (99) in El Badary, (103) in EL Ghanaym. It is considered by high concentration of SO4, Fe, Ni, Pb, B, Cl, Cd, Mn, PH, TDS and total hardness, while the concentration of Ca, Cr and Mg are in the permissible level for drinking. Fig (10).

Cluster-4 is characterized by the largest number of samples in study area (8 and 15) in Maghagha, (20-24) in Bani Mazar, (26- 28, 30, and 42) in Matai , (29, 31- 34, 40, 41, 43 and 44) in Samalout, (45- 47, 49, 50, 52- 54 and 57) in Minia, 63, 65, 69, 70- 72 and 74) in Abu Qurqas, (73, 77- 81, 84, 85 and 88) in Malawe, (89, 91, 93, 95 and 96) in Der Mawas and (5, 14 and 15) in Dairot, (18, 19, 30 and 35) in El Qusaiya, (33, 36, 38- 41) in Manfalout, (42- 44, 46, 51, 54 and 56) in Abnoub, (47, 48, 49, 62 and 65) in Assiut, (71, 74, 79 and 80) in EL Fath, (85) in Abo Tig, (87, 90, 91, 93, 94, 96 and 97) in Sahel Selem, (100) in El Badary, (102, 104, 105, 106, 108 and 109) in EL Ghanaym having different highest dissimilar values of Cd ,pb ,Mn, B ,Fe, Ni, SO4 , PH ,TDS and total hardness, while the concentration of Cr, Cl, Ca and Mg are in the permissible level for drinking Fig. (10).

Cluster-5 refers to nine samples in Assiut. It has very high dissimilar values of Cd, pb, Mn, B, Fe, Ca, SO4 and total hardness, while the concentration of Cr, Ni, Cl, PH, TDS and Mg are in the permissible level for drinking Fig. (10)

Cluster- 6 represented by one groundwater sample No. 3 in Dairot city It is characterized by high concentration of Cd, pb, B, F, Ca, Cl, SO4, Mn, PH, TDS and total hardness, while the concentration of Cr and Ni are in the permissible level for drinking Fig. (10).

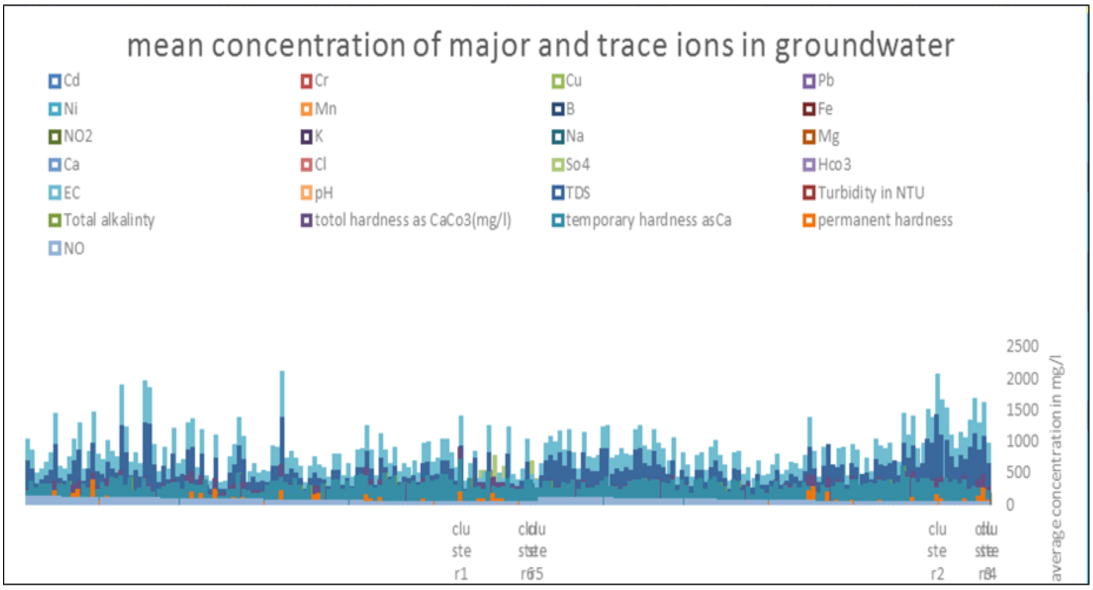


Fig. (9): Mean concentration of major and trace ions in groundwater.

Principle coordinate analysis

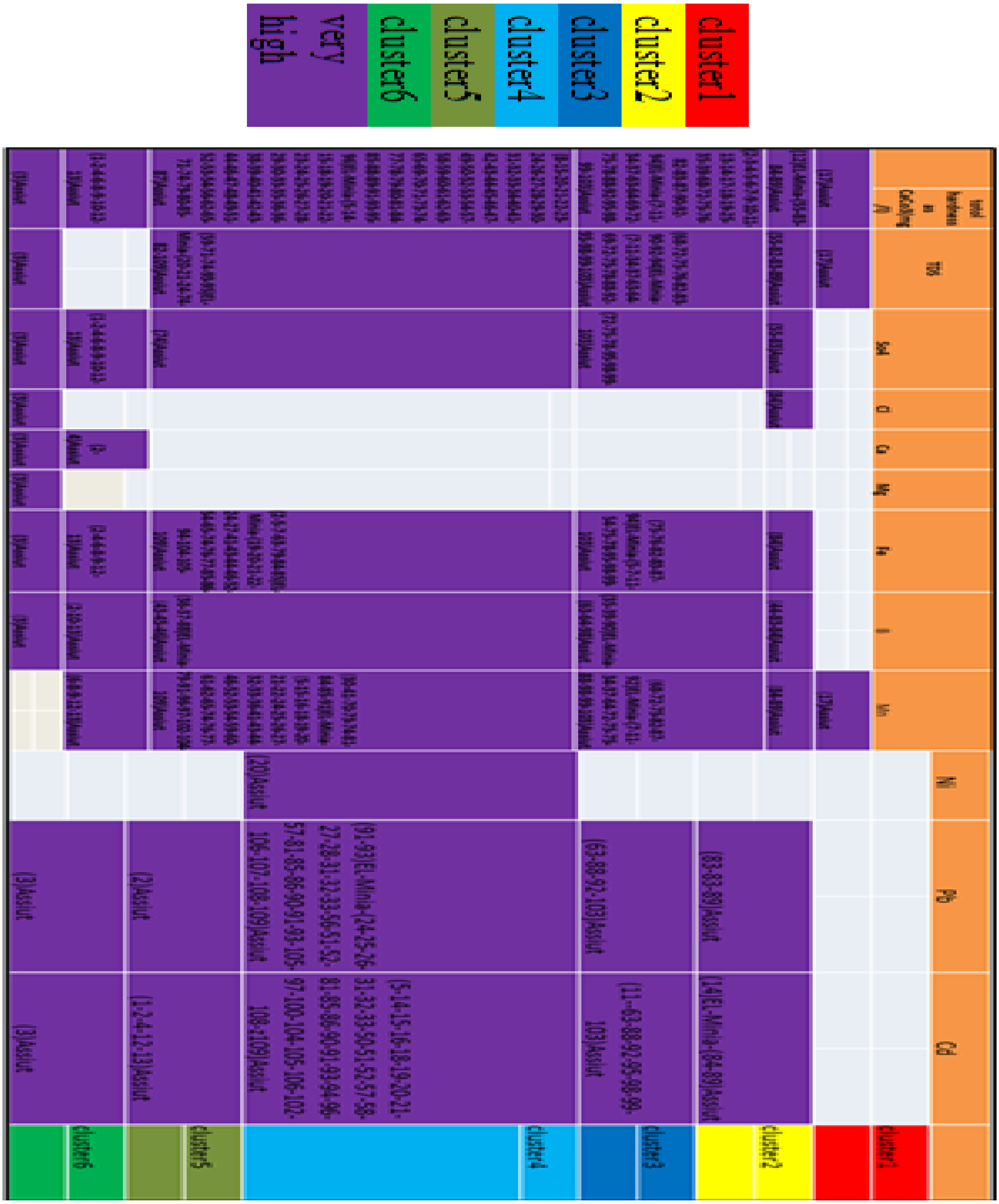
Principal coordinate analysis (PCoA) summaries and attempts to represent inter-object dissimilarity in a low-dimensional, Euclidean space (Gower, 1966). Rather than using raw data, PCoA takes a dissimilarity matrix as input. (PCOA) is a method to explore and to visualize similarities or dissimilarities of data. It starts with a similarity matrix or dissimilarity matrix (=distance matrix) and assigns for each item a location in a low-dimensional space, e.g. as a 3D graphics (Gower, 1966).The choice of measure will also, together with the number of input variables, determine the number of dimensions that comprise the PCoA solution.

Eigenvalues are usually ranked from the greatest to the least. The first eigenvalue is often called the "dominant" or "leading" eigenvalue. Using the eigenvectors we can visualize the main axes through the initial distance matrix. Eigenvalues are also often called "latent values".

The result is a rotation of the data matrix: it does not change the positions of points relative to each other but it just changes the coordinate systems. Cluster analysis could not discover new information such as Principle coordinate analysis which has been applied to detect new information.

Fig. (10): Cluster Analysis (HCA) for groundwater system

Tab. (5): Cluster Analysis (HCA) for groundwater system



Principle coordinates analysis for surface water and groundwater system (Table 6).

According to PCoA, there are 13 different samples in chemical elements than the remaining studied samples table (8). Samples No.: (2&4) in El Edwa, (12) in Maghagha, and

(N10) in Assiut, (2, 3, 8, 10 &12) in Dairout, (71) in El Fath, (82) in Abo Tig, (95) in Sahel Selem, and (98) in El Badary.

On the other hand, it can be noticed that sample (10) exhibited the highest value of all elements, and sample (82) exhibited the lowest value of all elements. Samples (2 & 4) in Dairout and No. (95) in Sahel Selem, and 98 in El Badary are belonging to cluster (2), sample No 12 in Maghagha is relationship to cluster (4). Samples (2,10 & 12) in Dairout are relation to cluster -5, sample 8 in Dairout, (71) in El Fath, (85) in Abo Tig are connecting to cluster -7 , sample (3) in Dairout is relevance to cluster -3 , sample (82) in Abo Tig is corresponding to cluster -6 .

Sample No (2) in Minia is high concentration of B, Ca, Cl, Mg, EC and TDS, Permanent and total alkalinity and low concentration of cu, pb, Ni, Mn, Fe, No_2, sample No 4 in El Edwa is high concentration of Ca, Cl, Mg, EC, TDS and total hardness and low concentration of cu, pb, Ni, Mn, No2 , Permanent hardness.

Sample No (12) in Maghagha has high concentration of Cl, Mg, EC, TDS, Permanent hardness and Total hardness as $CaCo_3$ and low concentration of cu, pb, Ni, Mn, No_2, sample No .(N10) in EL-Zenar drain is high concentration of Ni, No_2, Turbidity and low concentration of cu ,pb, Ni, Mn, No_2 , Permanent hardness, Ca, Cl, SO_4, Na, Fe, Mg, EC, TDS and total hardness, which the only surface water in PCO .

Sample No (2) in El Edwa is high concentration of pb, No_2, B, Ca, Cl, SO_4, Na, Temporary, HCO_3, total alkalinity and total hardness and low concentration of Cu, Mn, Permanent hardness, Fe, K, PH, TDS, EC and Ni .

Sample No (3) in Abo Karem is high concentration of pb, Cd, Cr, EC, B, Ca, Cl , SO4, TDS, Temporary, HCO_3, Total alkalinity and Total hardness and low concentration of cu, Mn, Permanent hardness, NO2, Na , PH.

Sample No (8) in Dairout is high concentration of K, SO4 , Mg , Permanent hardness and Total alkalinity and low concentration of Cu, Pb, Fe, Na, EC, TDS, sample No (12) in Dairout is high concentration of Pb, TDS, Mg, Permanent hardness and total hardness as $CaCo_3$ and low concentration of Cu, Pb, Na, EC, total alkalinity and temporary.

Sample No (13) in Dairout is high concentration of Pb, B, K, Mg, Permanent hardness and Total hardness and low concentration of TDS , PH , EC, sample No (82) in Abo Tig is high concentration of Cu, PH, EC and low concentration of SO_4, Pb, Fe, total alkaline, temporary, Permanent hardness and total hardness which the sample only has very high concentration of Cu.

Sample No (95) in Sahel Selem is high concentration of Cd, Pb, EC, TDS, permanent hardness and total hardness and low concentration of Cu, B, Fe, PH, total alkalinity, temporary as Ca, sample No 98 in Dkran in Assiut is high concentration of Cd, Pb, EC, TDS, K, PH ,permanent hardness and total hardness (Table, 7).

On the other hands, there are compare between sample No. (10) in Minia and No.(12) in Assiut in the chemical elements and samples No.(71) and (95) in Assiut which are nearby in the PCO. The Cd in sample No.12 is low but in sample No. (10) is high. The Cr in sample No, (12) is high but in sample No. (10) is low. The Cu in two samples are very low. The pb in the sample No.

(12) is very low but in the sample No.10 is very high. The Ni in sample No.12 is very low but in sample No. (10) is low. The Mn in sample No. (12) is very low but in sample No. (10) is low. The B in sample No.(12)is high but in sample No. (10) is very high. The Fe in two samples are very low. The NO_2 in sample No.12 is very low but in sample No. 10 is low. The k in the sample No. (12) is very low but in the sample No.(10) is very high. The Na in sample No, (12) is very high but in sample No.(10) is low. The Mg in two samples are very high

The Ca in two samples are high. The Cl in sample No (12) is very high but in sample No.10 is low. The SO_4 in sample No.12 is low but in sample No. 10 is very high. The HCO_3 in two samples are high. The EC in sample No, 12 is very high but in sample No.10 is very low. The TDS in sample No (12) is very high but in sample No.(10) is very low. Turbidity in two samples are low. Total alkaline in two samples are low. Total hardness in two samples are high. Permanent hardness in two samples are very high. Temporary in two samples are low.

. **Tab. (6): Identify the samples in PCOA for the study area samples**

Samples numbers in PCOA	Samples numbers in the study area
23	S. No 2 in Minia
24	S. No 4 in Minia
33	S. No 12 in Minia
127	S. No N10 in Assiut
149	S. No 2 in Assiut
150	S. No 3 in Assiut
155	S. No 8 in Assiut
159	S. No 12 in Assiut
160	S. No 13 in Assiut
218	S. No 71 in Assiut
229	S. No 82 in Assiut
242	S. No 95 in Assiut
245	S. No 98 in Assiut

Tab. (7) Principle coordinate analysis for surface water and groundwater system

NO	2	12	4	N10	2	3	8	12	13	82	95	98
City	Minia	Minia	Minia	Assiut	Assiut	Assiut	Assiut	Assiut	Assiut	Assiut	Assiut	Assiut
Very High	B	Cl	Mg	Ni	cd	cd	K	Pb	Pb	cu	Cd	cd
	Mg	,Mg	ca	No2	cr	cr	Mg	Mg	Mg	Ec	pb	pb
	Ca	EC	cl	Turbidity	pb	pb	So4	TDS	B	PH	EC	B
	Cl	TDS	Ec		B	B	T.Alkalin	T.Hardness	K		TDS	K
	Ec	Permanent hardness	TDS		Mg	Mg	Permenant	Permenent	T.Hardness		Permanent hardness	Ec
	TDS	Total hardness as CaCo3	T.Hardness		ca	ca			Permenent		Total hardness as CaCo3	PH
	T. Alkalin				So4	cl						TDS
	Permanent				T. Alkalin	So4						T.Hardness
					T.Hardness	Hco3						Permenent
					Temporery	Ec						
					Hco3	T.Alkalin						
						T.Hardness						
						Tempotery						
						TDS						
Very low	cu		cu	cu	cu	cu	cu	cu	Ec	Pb		cu
	pb	cu	pb	cr	Ni	Mn 0	pb	Na	PH	fe	Cu	cr
	Ni 0	pb	Ni 0	pb	Mn 0	No2	fe	Ec	TDS	So4	B	Ni
	Mn	Ni	Mn 0	Mn	fe	Na	Na	T.Alkalin		T.Alkalin	Fe	T.Alkalin
	fe	Mn	No2 0	fe	K	PH	Ec	Temporary		T.Hardness	PH	Temporary
	No2 0	No2	Permanent 0	Na	PH	Permenant 0	TDS			Tempotary	Total alkaline	
				Mg	TDS					permenent 0	Temporary as Ca	
				ca	Permenent 0							
				So4	Ec							
				T.Alkalin								
				T.Hardness								
				Temporary								
				Permenent 0								

The Cd in the sample No (71) is very low but in the sample No.95 is very high. The Cr in sample No (71) is high but in sample No.(95) is low. The Cu in sample No (71) is high but in sample No. (95) is very low. The Ni in sample No (71) is very low but in sample No.(95) is low. The Mn in two samples is low. The B in two samples are very low. The Fe in two samples are very low. The NO2 in the sample No (71) is very high but in the sample No.(9) is high. The K in sample No.(71) is low but in sample No. (95) is high. The Na in sample No (71) is very low but in sample No.(95) is low. The Mg in the sample No (71) is very low but in the sample No(95) is high. The Ca in the sample No. 71 is low but in the sample No (95) is high. The Cl in the sample No (71) is very low but in the sample No.(95) is very high. The SO_4 in the sample No (71) is very low but in the sample No (95) is very high. The HCO_3 in the sample No (71) is high but in the sample No (9) is low.

The EC in the sample No (71) is very low but in the sample No (9) is very high. The PH in the sample No (71) is low but in the sample No (9) is very low. The TDS in the sample No (71) is very low but in the sample No.(95) is very high. Turbidity in two samples are low. The total alkalinity in the sample No (71) is very low but in the sample No (95) is very high. The total hardness as $CaCo_3$ in the sample No (71) is low but in the sample No (95) is very high. The Temporary in the sample No (71) is very high but in the sample No (95) is very low. The Permanent hardness in the sample No (71) is very low but in the sample No (95) is very high, in table (8)

Tab. (8): Compare between samples No. 10 in Minia and No.12 in Assiut in the chemical elements and value and samples No.71and 95 in Assiut which are nearby in the PCOA.

95 Assute	71 Assute	10 Assute	12 Minia	
Very High	Very Low	High	Low	cd
Low	High	Low	High	cr
Very Low	High	Very Low	Very Low	cu
Very High	Very High	Very High	Very Low	pb
Low	Very Low	Low	Very Low	Ni
Low	Low	Low	Very Low	Mn
Very Low	Very Low	Very High	High	B
Very Low	Very Low	Very Low	Very Low	fe
High	Very High	Low	Very Low	No2
High	Low	Very High	Low	K
Low	Very Low	Low	Very High	Na
High	Very Low	Very High	Very High	Mg
High	Low	High	High	ca
High	Very Low	Low	Very High	cl
Low	Very Low	Very High	Low	So4
Low	High	High	High	Hco3
Very High	Very Low	Very Low	Very High	EC
Low	Low	Very Low	Low	PH
Very High	Very Low	Very Low	Very High	TDS
Low	Low	Low	Low	Turbidity
Very Low	Very High	Low	Low	T.Alkalin
Very High	Low	Very High	Very High	T.Hardnes
Very Low	Very High	Low	Low	Temporery
Very High	Very Low	Very High	Very High	Permanent Hardness

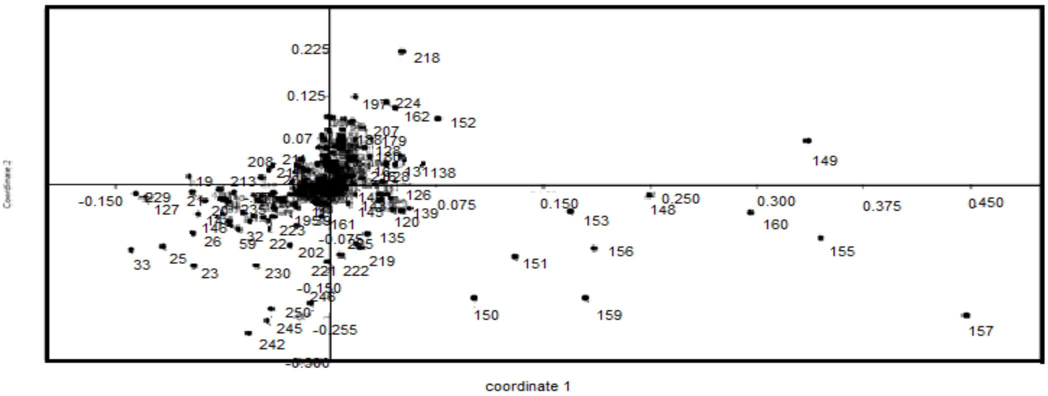


Figure (11): Principle coordinate analysis (PCOA) for surface water and groundwater

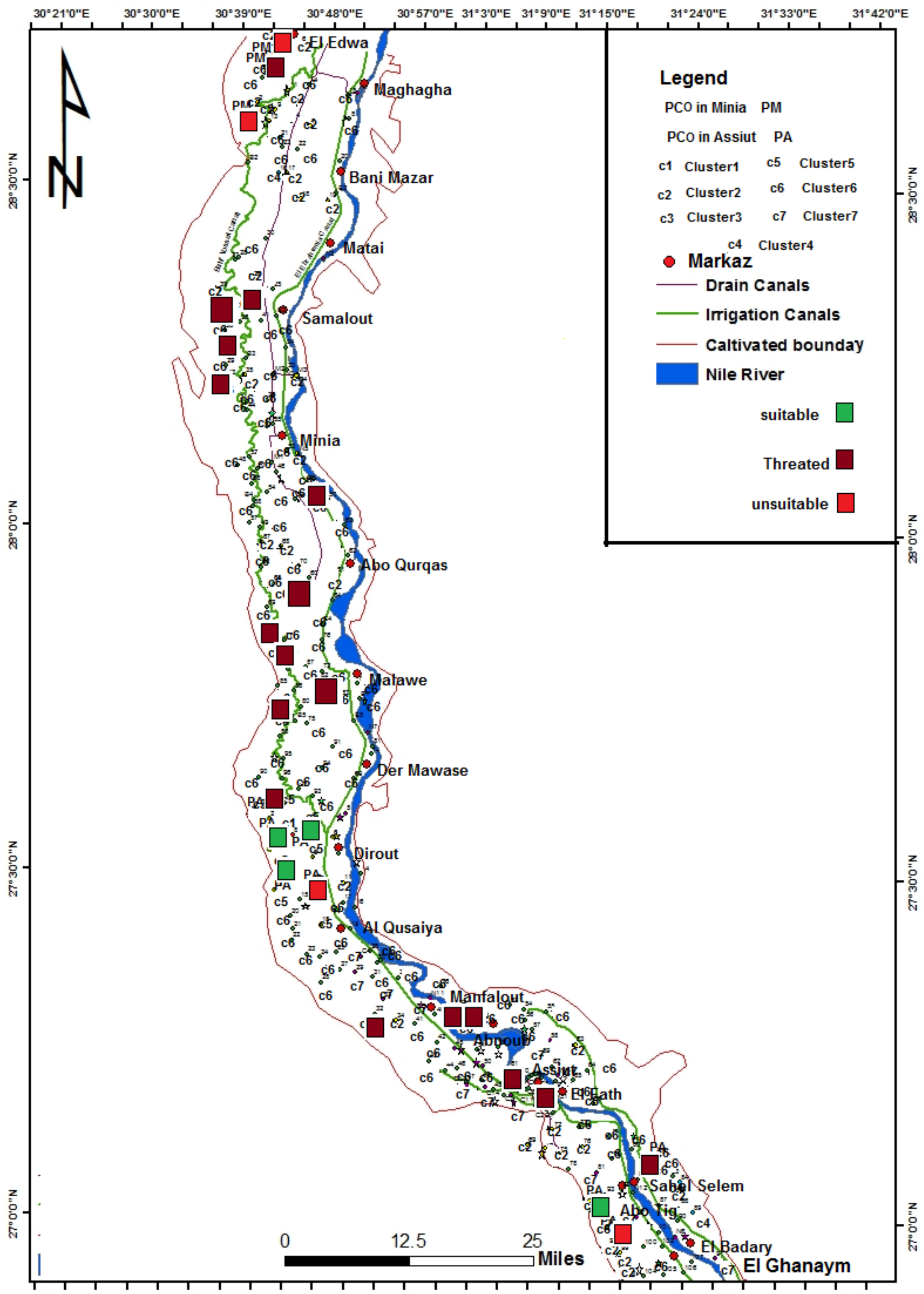


Fig.(12): **Water quality for drinking of surface water and groundwater according to clusters and principle coordinate analysis which classification of WHO guidelines (2011) .**

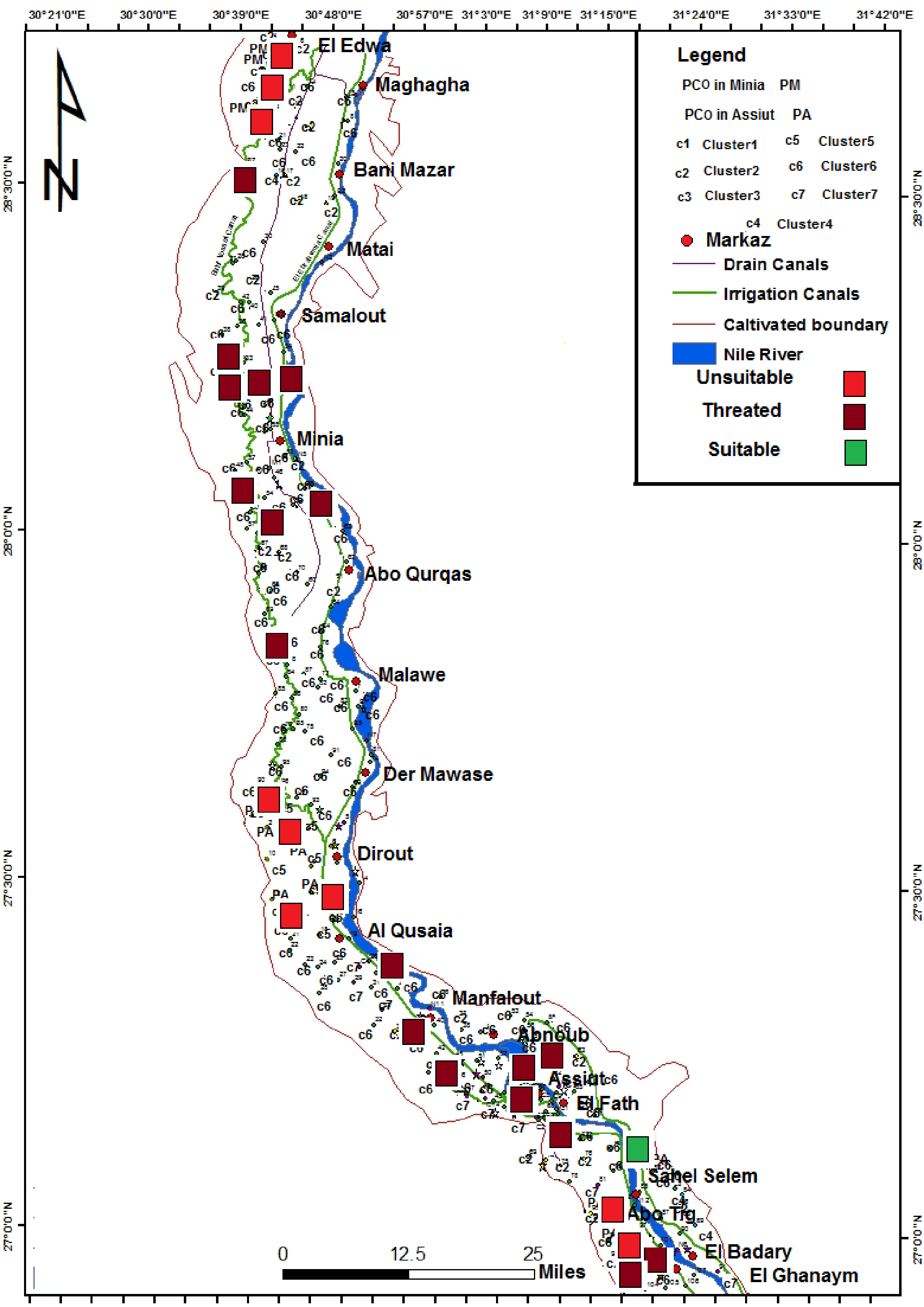


Fig. (13): **Water quality for domestic of surface water and groundwater according to clusters and principle coordinate analysis samples.**

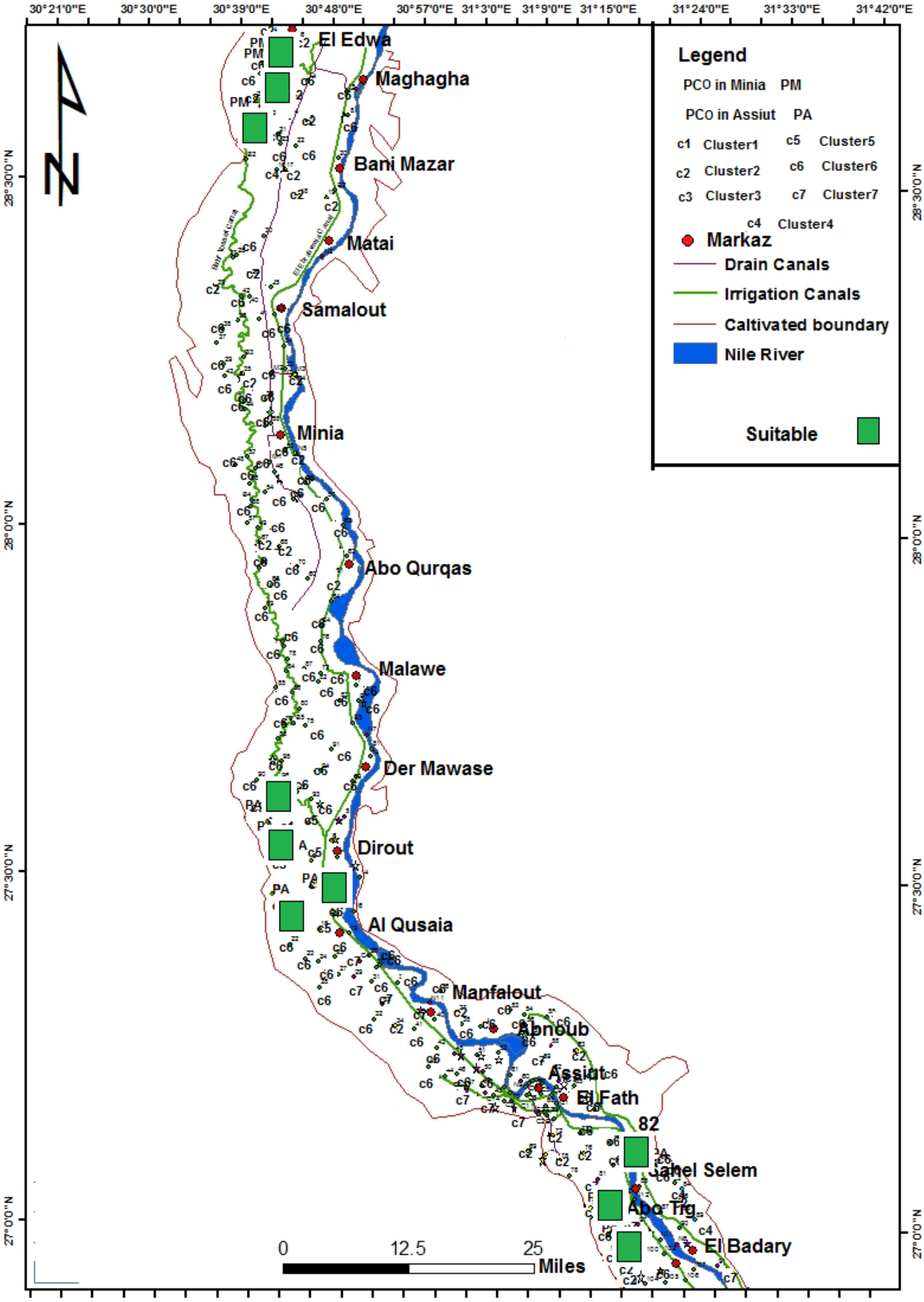


Fig. (14): **Water quality for irrigation of surface water and groundwater according to (PCO) samples.**

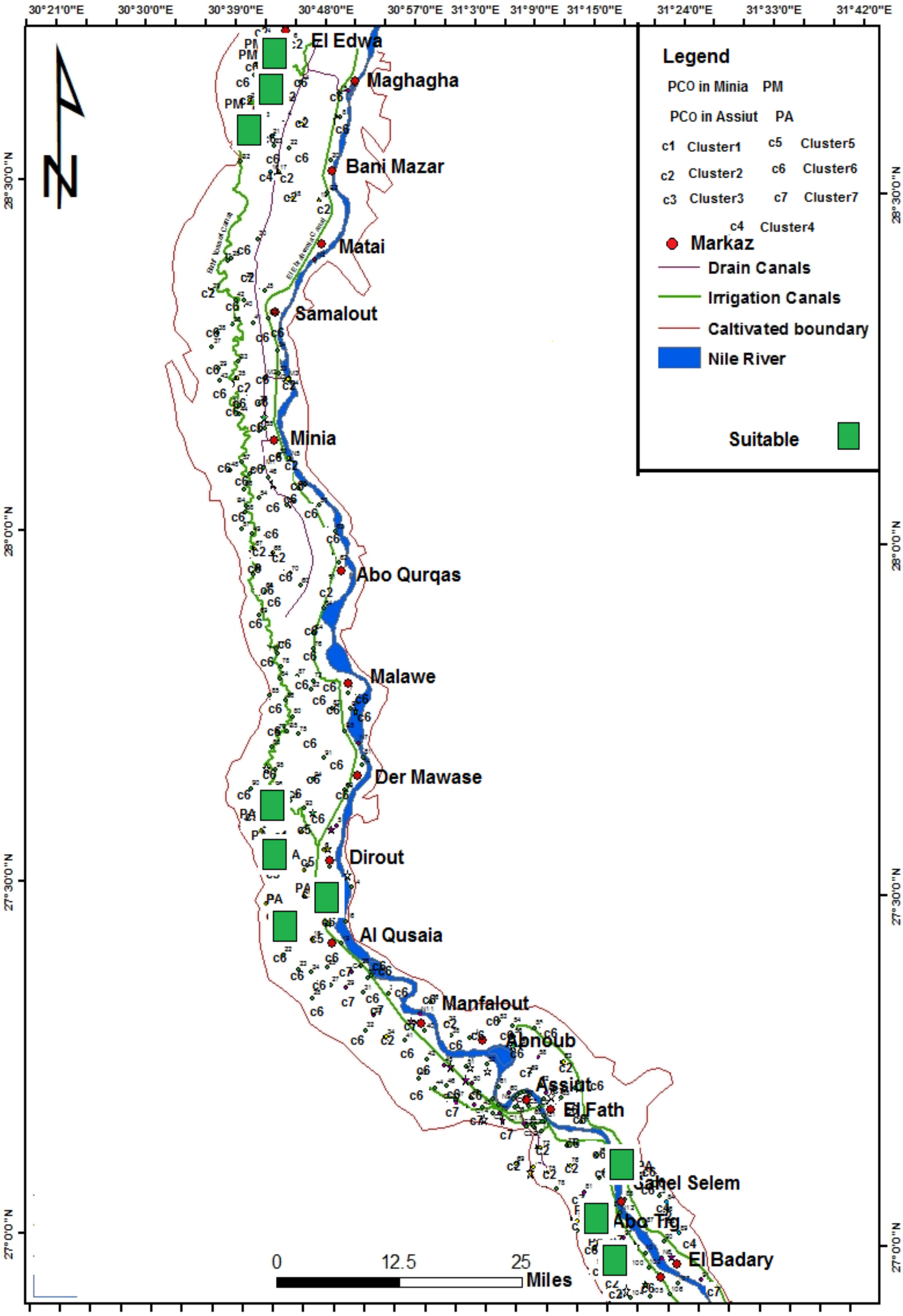


Fig.(15) **water quality for livestock of surface water and groundwater according to classification of TDS**

RESULTS

According to the obtained results the evaluation of surface and groundwater was summarized as the follows:

For human drinking uses (Fig.16)

According to WHO guidelines (2011), salinity and TDS, (94.11%) of surface water samples are acceptable, in which (3.92%) of these samples could be threated in the future, (e.g.N10, E2 in Assiut). (5.8%) of surface water samples are unsuitable. (67.31%) of groundwater samples are ranging between acceptable, to permissible for human drinking, in which (19.51%) from suitable samples are threated in the future, (No. 8 in Maghagh, Nos.16, 23 in Bani Mazar, nos.. 29, 32, 33, 36, 38 in Samalout, Nos.46, 54 and 55 in Minia, nos.60, 62, 63, 66, 70 and 71 in Abu Qurqas, nos.74, 77, 78 and 80 in Malawe, no.91 in Der Mawase, nos. 19 and 31 in El Qusaia, nos.33 and 36 in Manflout, nos.38, 39, 43, 44, 53, 56 and 57 in Abnoub, no.80 in El Fath, no. 86 in Abo Tig, nos.91, 94 and 96 in Sahel Selem , nos.104 and 108 in El Ghanaym) . (32.68%) of groundwater samples are unsuitable due to their high content of total dissolved solids in El Edwa, Abo Tig, Dirout.

According to minor and trace constituents, 86.27% and 69.26% of surface and groundwater samples (respectively) are unsuitable for human drinking because its higher content of measured elements in most samples (Cd, Cr, Pb and Fe) in surface water and (Mn, Fe, Cl, SO4, Ca, Cd, B and Pb) in groundwater samples.

For domestic and laundry uses (Fig17)

According to Durfor et al. [33] classification based on hardness, about (27.45 %) of surface water are unsuitable for laundry purposes because they range from hard to very hard and (72.54%) in the range of moderate which (23.52%) from acceptable samples are threated in the future, there are (M1, M2, M3) in Samalout , (B2) in Bani Mazar, and (C2) in El Fath, (C6, C9, C11, C12, C13, C14, E1 and E2) in Assiut. while (14.63%) of groundwater samples in the range of moderate which (9.75%) from suitable samples are threated in the future, there are (45, 49 and 53) in Minia and (1and 4) in Dairout, (30) in El Qusaia, (40) in Manfalout, (59 and 60) in Assiut, (102) in El Badary, and (85.36 %) are very hard for domestic and laundry. According to WHO guidelines (2011).

For livestock and poultry (Fig18)

According to the guideline of Mckee JE, et al. and National Academy of science [31,34], all surface samples and most groundwater samples (100%) are suitable (Excellent) for livestock and poultry.

For irrigation purposes (Fig. 19)

According to the (TDS) concentration

The surface water of River Nile, main irrigation and drains canal samples are suitable of irrigation, [35 and 36. In the groundwater samples, about 100% of the samples are suitable water for irrigation,(within the range of none restriction for use). According to TDS concentration, the water samples of the study area (Fig. 19) are classified into two zones (suitable and marginal for irrigation).

According to boron

In the study area, the concentrations of boron have a wide range (0.008 – 1.8 mg/l). It is obvious that; all surface water and the majority of the groundwater samples 100% in the study area are suitable for irrigation of all crops.

According to trace elements

The chemical analysis data of the trace constituents in the surface water which are suitable for irrigation represent about (100%) , except Cd concentration in the south of Assiut have high concentration represented by 13.67% of total samples because they have a cadmium concentration above the recommended limits for minor and trace constituents of irrigation pollution (0.005 mg/l) which may be polluted by upward leaching of marine water rom fracture limestone aquifer, represented by (Nos 1. 14, 15, 21, 27, 28, 31-33, 50-52, 81, 83-93, 95-100, 105-109).

According to SAR

All surface water samples are excellent because they are located in class C1-S1 except M2 and M3 in Minia are found in class C2-S2. 50% of the groundwater samples are in class C1-S1 and this means that the water is excellent and 35% of the samples are in class C2-S2 and therefore the water is good, 10% in class C3-S3, the water is fair and 5% in class C4-S4 water is poor.

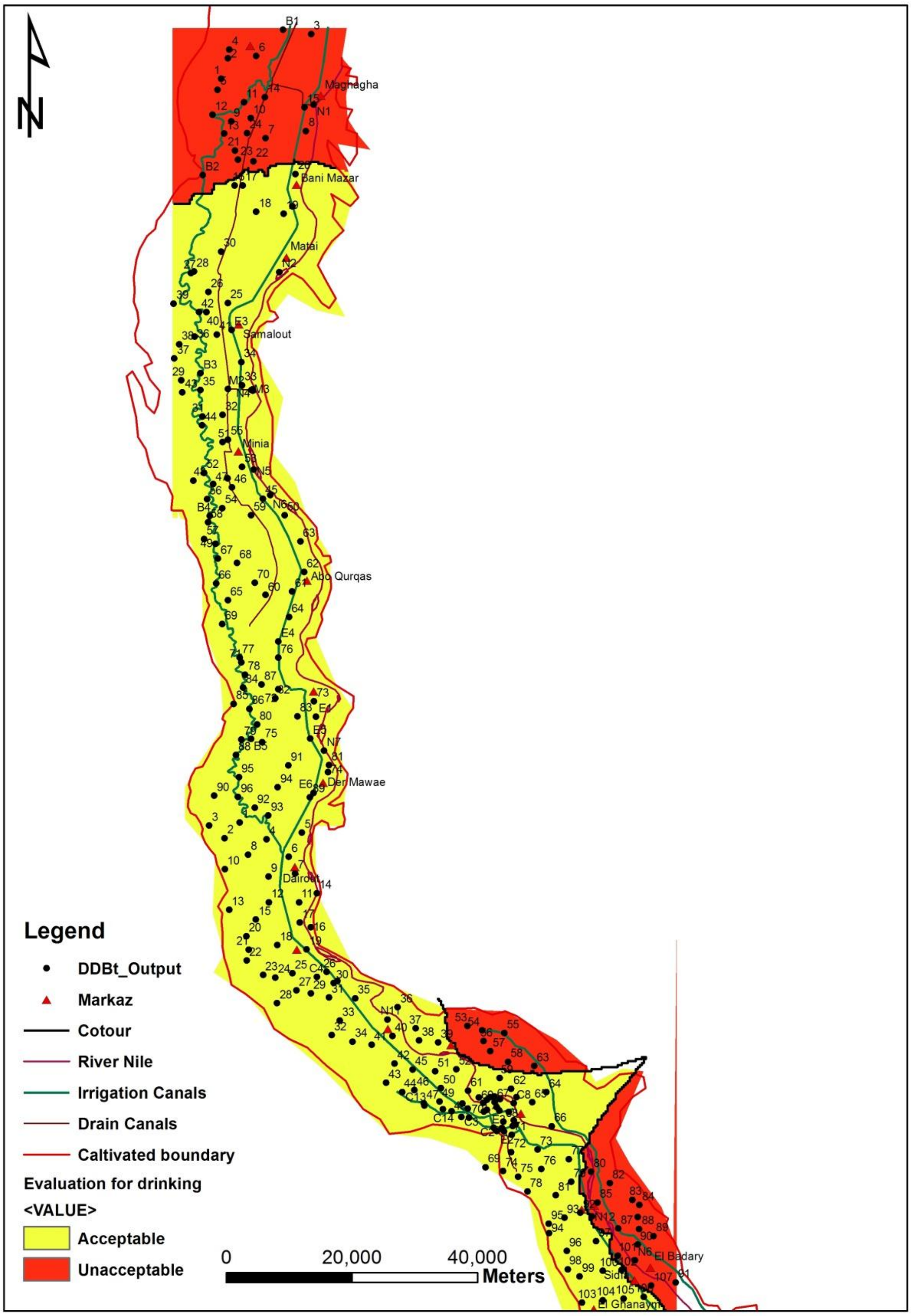


Fig.(16): **Water quality for drinking of surface water and groundwater according to classification of TDS which WHO guidelines (2011).**

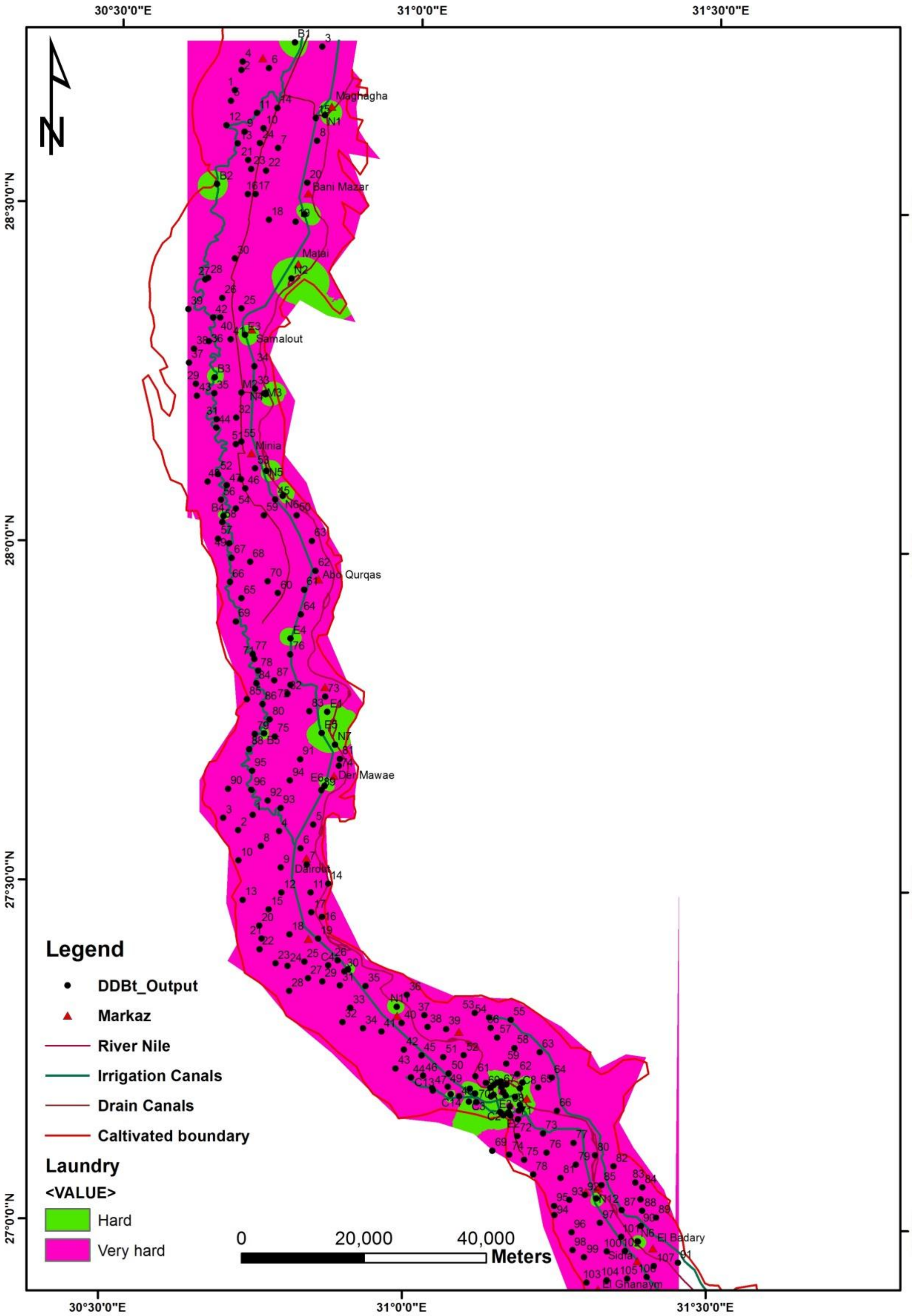


Fig. (16): **Water quality for domestic of surface water and groundwater according to Durfor *et al* (1964).**

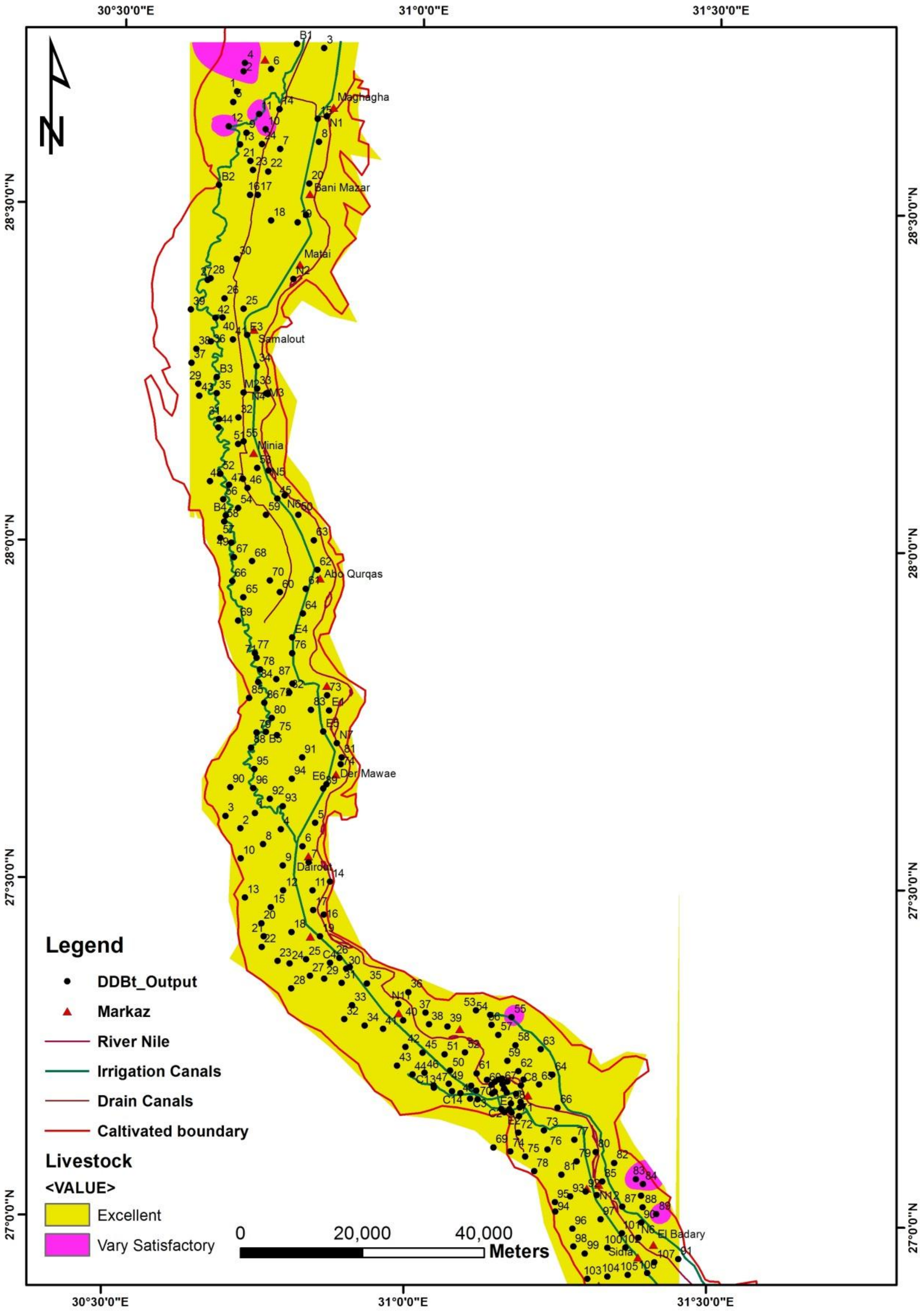


Fig. (18): **Water quality for livestock of surface water and groundwater according to NAS [34] and NATS 1972 & Mckee, 1963 guideline [31].**

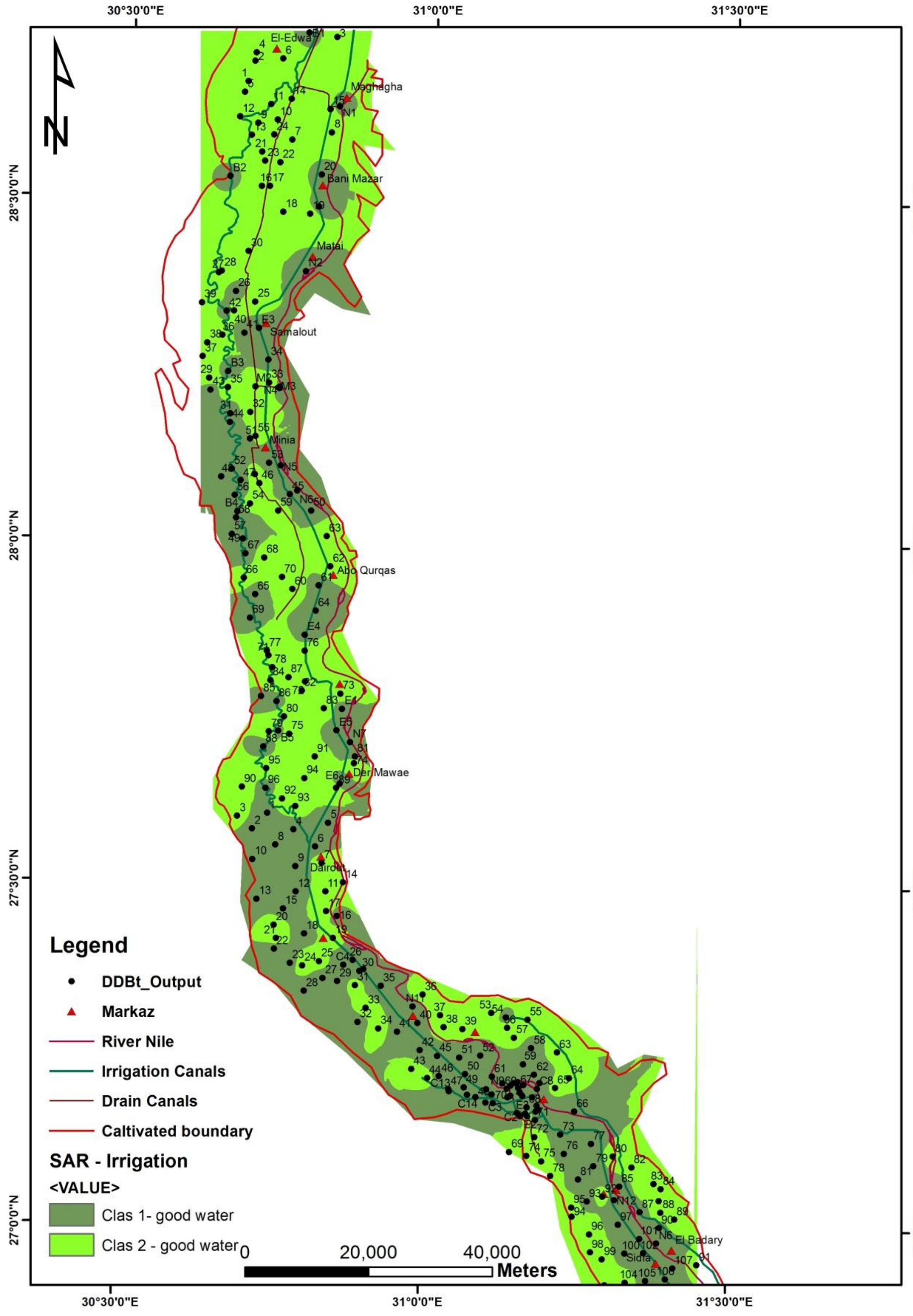


Fig. (19): **Water quality for irrigation of surface water and groundwater according to classification of U.S salinity laboratory staff classification (Rvehavel, 1991)** [35].

DISCUSSION

A comparison between the samples of the governorates of Minia and Assiut found in the study area showed that Assiut governorate has more water pollution than Minia (Figs. 16, 17, 18 and 19). This study shows the most polluted areas in the study area. It also includes drinking areas, agriculture, household work, livestock and threatened areas, which can be unsuitable in the future.

For human drinking uses

a- According to total dissolved solids

In the surface water; the TDS of the River Nile is ranging from 186 ppm in N13 to 533 ppm in N10 and main irrigation canal is ranging from 170 ppm in C8 to 336.5 ppm in C2, drain canals are ranging from 407 ppm in E3 to 804 ppm in M3, but drain canals are considered be higher in TDS concentration than the River Nile and main irrigation canals. So, the River Nile and main irrigation canals are suitable for human drinking.

In the groundwater samples are ranges between 210 and 1410.71 ppm in S.no 12 in Maghagha and considered as fresh water type to unsuitable according to (WHO) (2011) stander. The areas that are unsuitable for drinking in Minia Governorate are Al-Edwa City and Maghagha City in the north of the study area. The areas of suitable samples are threated in the future are in Maghagh, Bani Mazar, Samalout, Minia Abu Qurqas, in Malawe and Der Mawase in in Minia Governorate. in Assiut governorate El Qusaia, Manflout, Abnoub, El Fath, Abo Tig, Sahel Selem and El Ghanaym. This means that every Assiout is threatened in the future to become unfit to drink and should be observed and avoid pollutants. The areas of unsuitable areas in Assiut governorate in the east of El Fath city, Abo Tig city, Sahel Selem city and El Badary city in the south of the study area.

For domestic and laundry uses

According to hardness

According to Egyptian stander for the surface water of the study regions, about 100 % of surface water in the River Nile and main irrigation canals are suitable for domestic and laundry purpose, because they range from hard to very hard, but M2 and M3 drains canals are unsuitable.

In the groundwater samples of Pleistocene aquifer, by comparing the permissible limits (Table 5-4), about 9.22% of the total groundwater samples in the study area are suitable for domestic and laundry uses because it ranges from moderately hardness (Max. total hardness is 182 ppm). It should be treated before use by boiling, while the rest of the groundwater samples (90.77 %) in the study area are unsuitable for domestic and laundry uses as they are exceeding over than 200 mg/l.

For livestock and poultry

All surface samples and most groundwater samples (100%) are suitable (Excellent) for livestock and poultry in all of the study area.

For irrigation purposes

According to SAR, (TDS) concentration, boron and trace elements

Surface water samples of River Nile and main irrigation canals (100%) are suitable for irrigation of the surface water samples [28 and 29]. For groundwater about (100%) of the pumps are suitable water for irrigation, except (13.67%) of (Cd) concentration of the wells pumps are unsuitable for irrigation which concentrated in south Assiut.

RECOMMENDATIONS

This study indicates the serious dangerous effects of discharging waste water into soil, we maintain the water quality and control the sources of pollution in Minia and Assiut governorates recommended the following:

1- **Study the possibility to maxing the surface water and the groundwater for irrigation purpose by drilling wells near the homes area and pumping into branched canals, its helped to reduce the high level of the water table at suitable level which help to keep to constriction build, prevent the pollution to arrive the shallow groundwater reparation the deficiency in the mount of surface water.**
2- **Note leaking sewage, agriculture and industrial wastes to water must be deal with accordance with the criteria set out by law environmental affairs for the protection of the Nile River and its branches.**
3- **Prevent the use of permeable septic tanks for collecting domestic and industrial wastewater. While, the closed underground tanks are suitable and can be used.**
4- **Firm legislation must be issued to arrange the suitable ways to collecting and discharging wastewater.**
5- **When constructing new pumps they must be at enough depth (70-100) and be located at safe distance from all possible sources of contamination especial septic tank in urban area, and at the south direction from that.**
6- **Sewage network must be constructed and maintenance of sewage network must be done by high quality of materials and controlling prevent any leakage of the wastewater.**
7- **The public must be informed and educated about the dangers effect of the discharging wastewater into groundwater and soil.**
8- **Preparing complete environmental impact assessment study(EIA) before beginning in carrying out any project according to Law 4/1994 and 9/2009, especially the forest tree in western dissert (western Samalout and another area).**
9- **The effect of wastewater seepage into soil, groundwater and surface water should be addressed on national scale.**

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تحاليل كمية من المياه السطحية وموارد المياه الجوفية حول نهر النيل ، بمحافظتين المنيا و اسيوط مصر العليا: التمييز بتن تلوث المياه .

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الملخص

تتناول الدراسة الحالية تمييز التلوث المسجل في المياه الجوفية وعينات المياه السطحية الموزعة في المنطقة الواقعة بين مدينة مغاغة شمال محافظة المنيا والبادري والغاميم جنوب محافظة أسيوط. كشفت التحاليل الكمية لعينات المياه ٢٥٦ (تحليل العنقودية وتحليل التنسيق الرئيسي) التمييز بين سبع مجموعات كل منها له خصائصه المميزة (وفقا لتحليل العنقودية) وفصل العينات الملوثة العالية جدا من منطقة الدراسة (وفقا لتنسيق الرئيسي التحليل) علاوة على ذلك، ساعد استخدام تقنية نظم المعلومات الجغرافية في رسم خريطة عامة تقدم مناطق التلوث المختلفة في منطقة الدراسة.