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(24)

( )

,Global Mapper v.7

( ) (6)

Minitab v.14

(E.C)

## Using the Cluster Analysis to Classify the Quality of Ground Water in Wells of Bashiqa Region in Governorate of Ninaveh

**ABSTRACT** In this study, the use of cluster analysis to classify  
(24) wells in the aquifer of water existed within the Pilaspi

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- / / 2

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Formation in the area of Bashiqa region depending on the quality of ground water in order to determine whether water quality samples in different locations could be joined to homogeneous areas. The wells locations for the groundwater on the topographic map of the study area have been determined according to the latitude and longitude coordinates by using Global Mapper v.7. It has been observed from the data obtained on the wells that they contain six attributes (variables) in different measured units. Data were analyzed by using the software Minitab v.14 in a multivariate technique that used cluster analysis. The gained results could be considered positive. The wells were divided into groups based on the Electric Conductivity (E.C) to know water competence range human, agricultural, animal and industrial use graded according to portability of water.

(1)

.(Global Mapper V.7)

(43 10 00 - 43 30 00)

(36 20 00 - 36 30 00)

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.( )

(Bashiqa Anticline)

(2)

,<sup>2</sup> (315)

.(Global Mapper V.7)

(Pilaspi Formation Limestone)

.(Injana Formation)

(Fataha Formation)

(Tertiary Period)

.(Quaternary Period)

.(النعيبي, 2010)

(Confined Aquifer)

(2000 , )

(Todd, 1980)

(النعيمة, 2010).

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(Parson Company, 1955)

(Ingra Company, 1967)

(1999 )

(2000 )

**(Cluster Analysis)**

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(2009 , )

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(Clusters)

(SSE)

(Matrix)

(Euclidian

:(2009 , ) distance)

$$d_{j' i} = \sqrt{\sum_{i=1}^n (x_{j' i} - x_{j' i})^2} \dots (2)$$

j' i x<sub>j'i</sub> j ( ) i ( ) x<sub>ji</sub>

(Similarity Coefficient)

( )

.(1992 , )

**(Statistical Classification)**

(Clusters)

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,(

.(Rao and Srinivas, 2008)

**(Dendrogram)**

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**(Cluster Methods)**

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(  
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**(Divisive or Nonhierarchical Method)**

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.(2009 , ) K-Means

**(Agglomerative or Hierarchical Method)**

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( )

(d<sub>0</sub>)

.(2009 , )

:

(Median \_ Average \_ Centroid \_ Complete \_ Single \_ Ward) Linkage

(Ward linkage)

:(Webb, 2002)

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$$d_{i+j,k} = \frac{1}{n_k+n_i+n_j} [(n_k+n_i) d_{ik} + (n_k+n_j) d_{jk} - n_k d_{ij}] \quad \dots(3)$$

.(i, j, k) (n<sub>i</sub>, n<sub>j</sub>, n<sub>k</sub>)

(1:100000) (Topographic Map)

.(1)

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(DEM)  
(Gps)

(Global Mapper v.7)

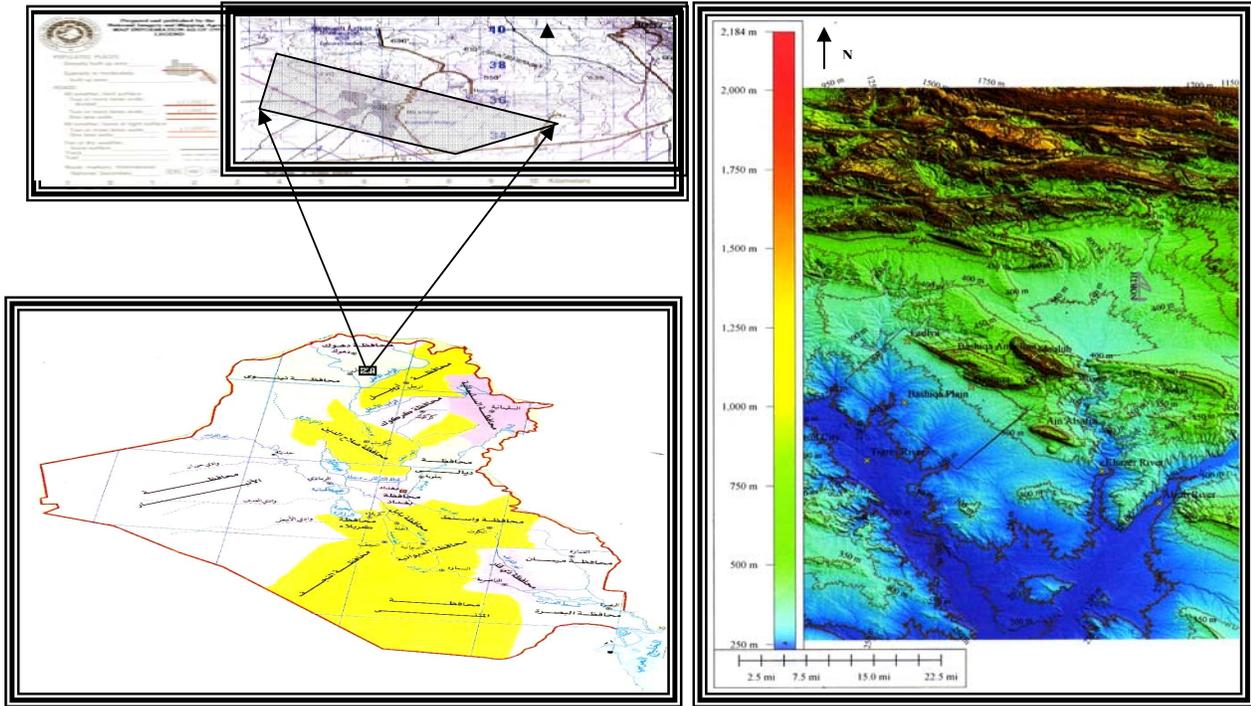
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.(2)

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(Global Mapper V.7)  
.(3)

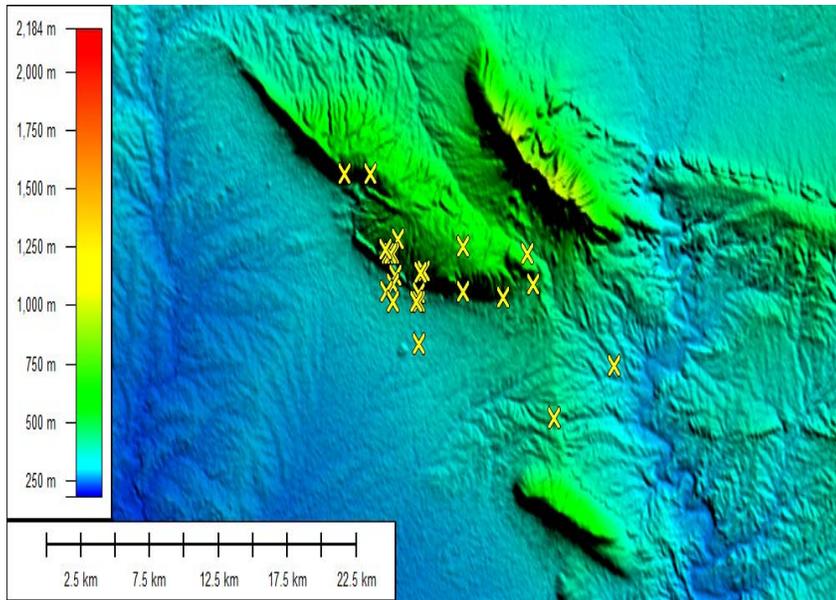


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:(3)

**X**: Pilaspi well

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:(1)

Date	( / ) T.D.S	( / ) E.C	Draw down static(s)	Yield	Static	Depth	Latitude			Longitude			No.
							"	'	0	"	'	0	
1976	360	509	32	11,2	18	124	0	30	36	36	18	43	1
1977	570	700	1,5	11,2	3	84	42	27	36	36	20	43	2
1978	737	959	5	17	22	127	30	28	36	42	20	43	3
1978	850	900	2	9	25	102	30	27	36	30	20	43	4
1979	360	450	3	16,5	21	145	12	28	36	30	20	43	5
1980	650	700	9	12	26	112	12	28	36	18	20	43	6
1981	2010	2250	63	3,7	25	246	20	27	36	15	20	43	7
1989	386	460	22	8,6	18	115	12	28	36	24	20	43	8
1990	460	500	23	3,5	3	180	6	27	36	30	20	43	9
1994	682	941	22	9	22	120	18	27	36	30	21	43	10
1995	1150	1230	21	5,8	30	190	6	27	36	30	21	43	11
1995	1230	1500	21	5,8	30	190	48	27	36	42	21	43	12
1996	760	850	7	10,5	26,5	110	10	26	36	30	21	43	13
1997	1340	1500	9	15	19	229	20	28	36	15	23	43	14
1998	220	350	25	6,75	35	132	20	27	36	15	23	43	15
1998	630	750	8	2,25	42	100	12	27	36	48	24	43	16
1999	441	838	12	17	15	100	18	28	36	12	20	43	17
1999	740	850	10	3	72	155	30	27	36	0	26	43	18
2000	1000	1100	1	5	103	200	30	24	36	48	26	43	19
2000	650	772	40	3	78	100	40	25	36	10	29	43	20
2001	260	360	10	12	28	146	45	27	36	35	21	43	21
2001	750	860	10	11,25	48	120	12	28	36	45	25	43	22
2002	950	1120	5	16,5	24	120	6	27	36	25	21	43	23
2002	522	682	8	11,2	22	104	0	30	36	36	19	43	24

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.(Total dissolved Solid) (T.D.S) ( / )  
 .(Hem, 1971) (2)

.( / ) (T.D.S) : (2)

Water Class	Concentration
Fresh	Less than 1000
Moderately Saline Brine	3000 – 10,000
Very saline	10,000 – 35, 000
Brine	Over 35,000

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(E.C) (Mho\cm) ( / )  
 (Electric Conductivity)

:(Todd, 1980)

$$T.D.S = 1.5 (E.C) \times 10^6 \quad \dots(1)$$

.(Wilcox, 1955) (E.C.) (3)

:(3)

250	
250-750	
750-2000	
2000-3000	
3000	

(T.D.S)

(T.D.S) (E.C)

(E.C)

(E.C)

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(3)

( / ) (959-350) (E.C)

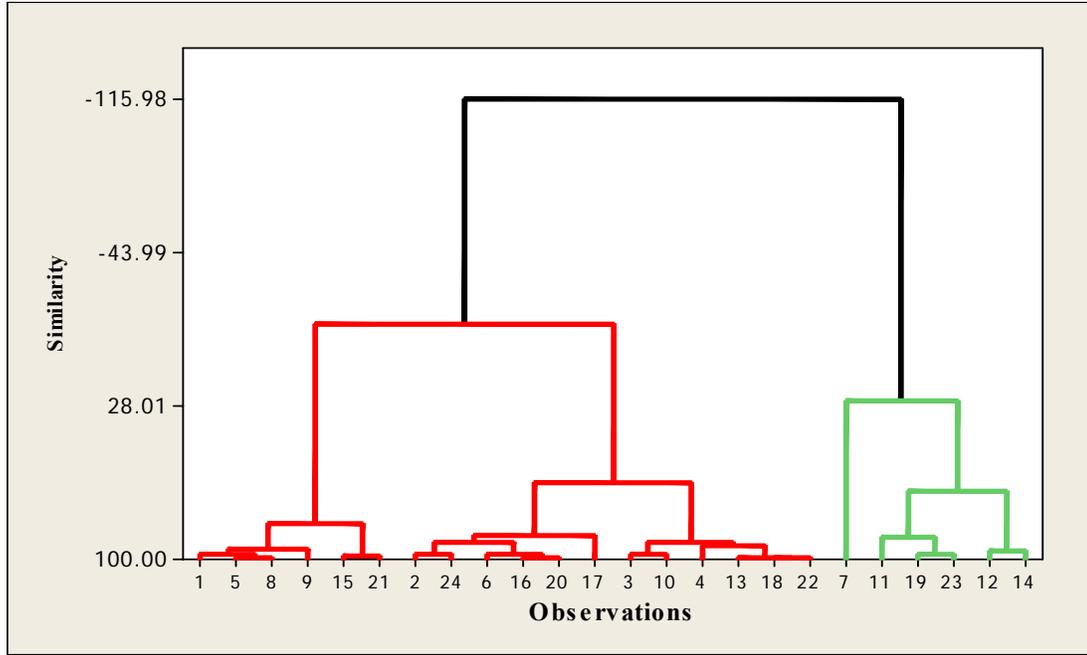
(E.C) (7, 11, 12, 14, 19, 23)  
( / ) (2250-1100)

:(7)

:(7)

<b>No. of wells</b>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>Cluster m-ship</b>	1	1	1	1	1	1	2	1	1	1	2	2	1	2	1	1	1	1	2	1	1	1	2	1

:(4)



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(1, 5, 8, 9, 15, 21) ,

(E.C) بين (509-350) ( / ) .

اثني عشر

(E.C) (2, 3, 4, 6, 10, 13, 16, 17, 18, 20, 22, 24)

(3) ( / ) (959-682)

2250-) (E.C) (7, 11, 12, 14, 19, 23) ستة

( / ) (1100)

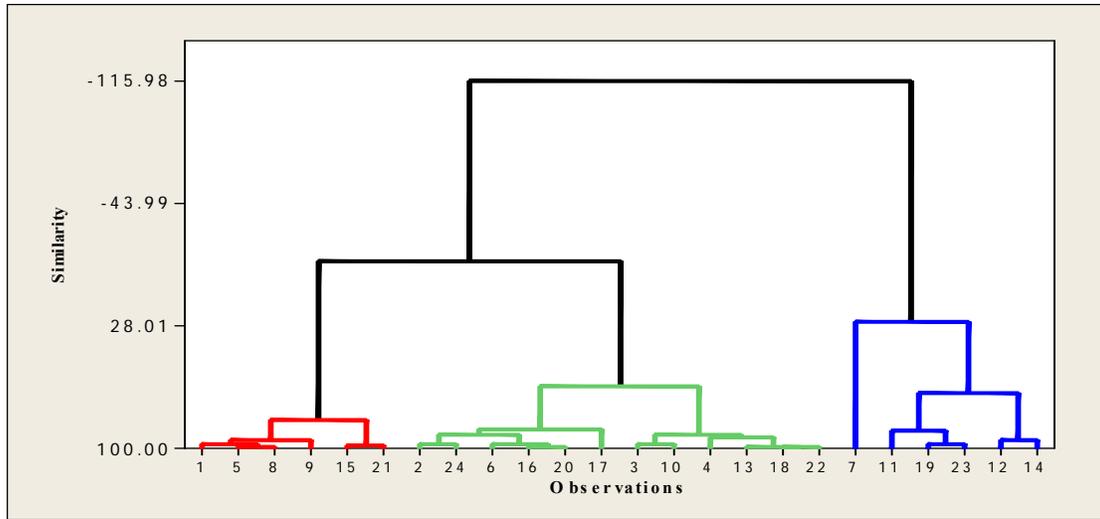
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: (8)

No. of wells	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Cluster m-ship	1	2	2	2	1	2	3	1	1	2	3	3	2	3	1	2	2	2	3	2	1	2	3	2

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- (E.C) (1, 5, 8, 9, 15, 21) ( / ) (509-350)  
 (2, 3, 4, 6, 10, 13, 16, 17, 18, 20, 22, 24) اثني عشر ( / ) (959-682) (E.C)  
 (E.C) (7) ( / ) (2250)  
 (11, 12, 14, 19, 23)

( / ) (1500-1100) (E.C)  
 .( )

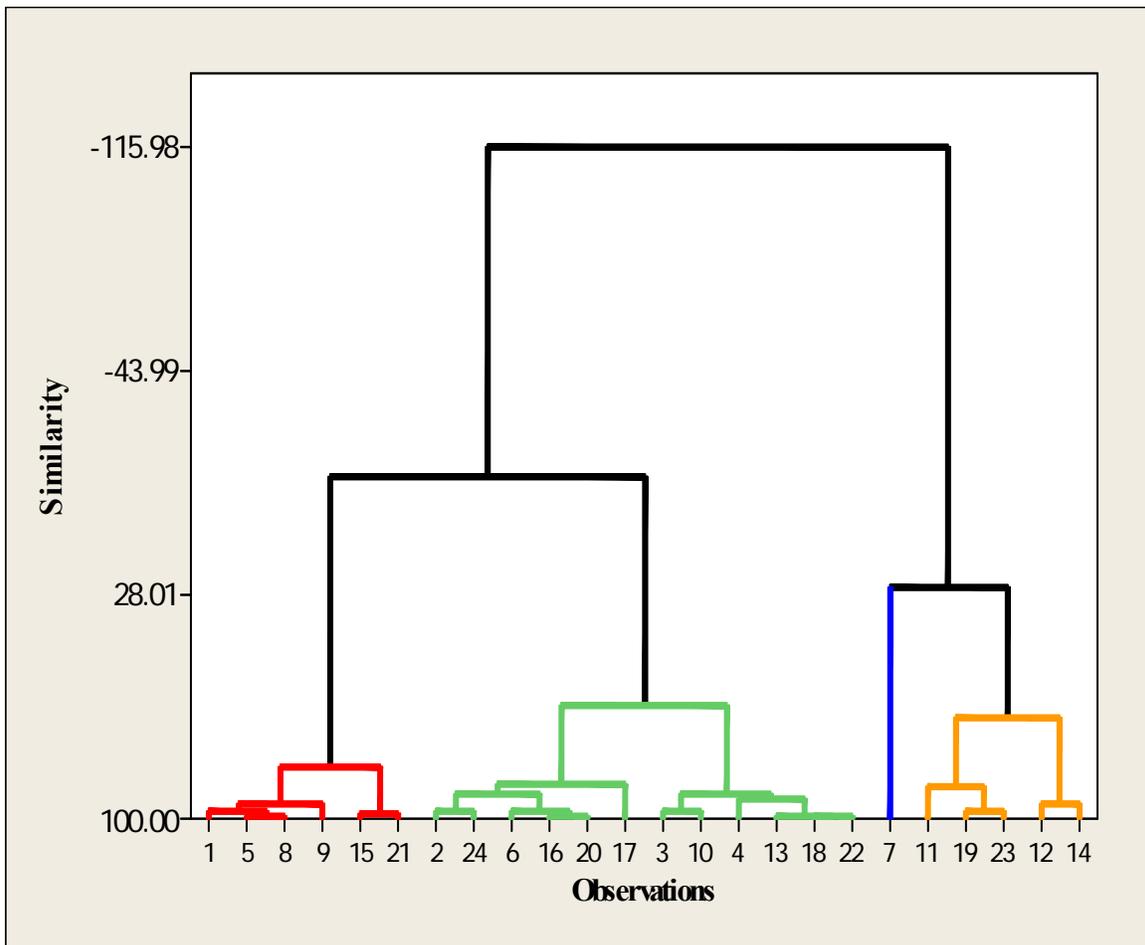
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:(9)

No. of wells	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Cluster m-ship	1	2	2	2	1	2	3	1	1	2	4	4	2	4	1	2	2	2	4	2	1	2	4	2

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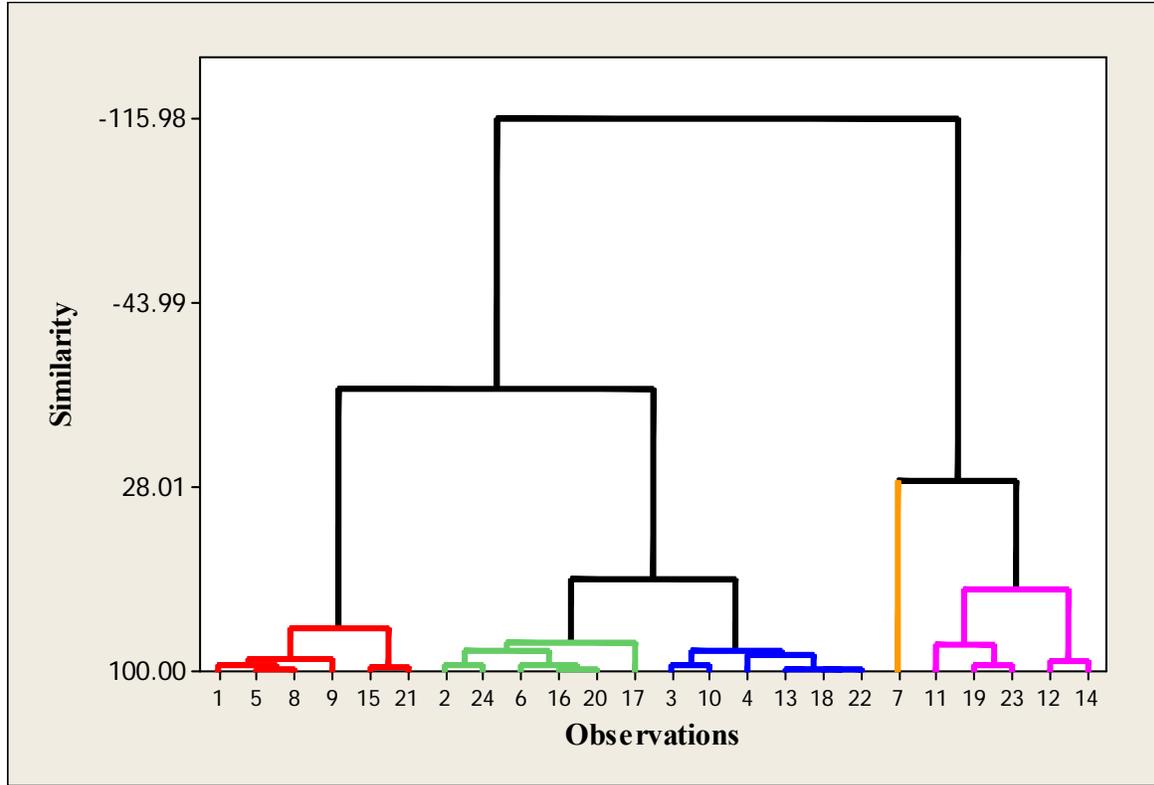
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 (E.C) (1, 5, 8, 9, 15, 21)  
 ( / ) (509-350)  
 (838-682) (E.C) (2, 6, 16, 17 ,20 ,24)  
 ( / )  
 (959-850) (E.C) (3, 4, 10, 13, 18 ,22)  
 ( / )  
 (E.C) (7)  
 ( / ) (2250)  
 (E.C) (11, 12, 14, 19, 23) متمثلة بـ  
 ( / ) (1500-1100)  
 .(3)  
 :(10)

:(10)

No. of wells	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Cluster m-ship	1	2	3	3	1	2	4	1	1	3	5	5	3	5	1	2	2	3	5	2	1	3	5	2

(7) يوضح عملية تصنيف آبار المياه الجوفية إلى خمس مجاميع:



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:(7)

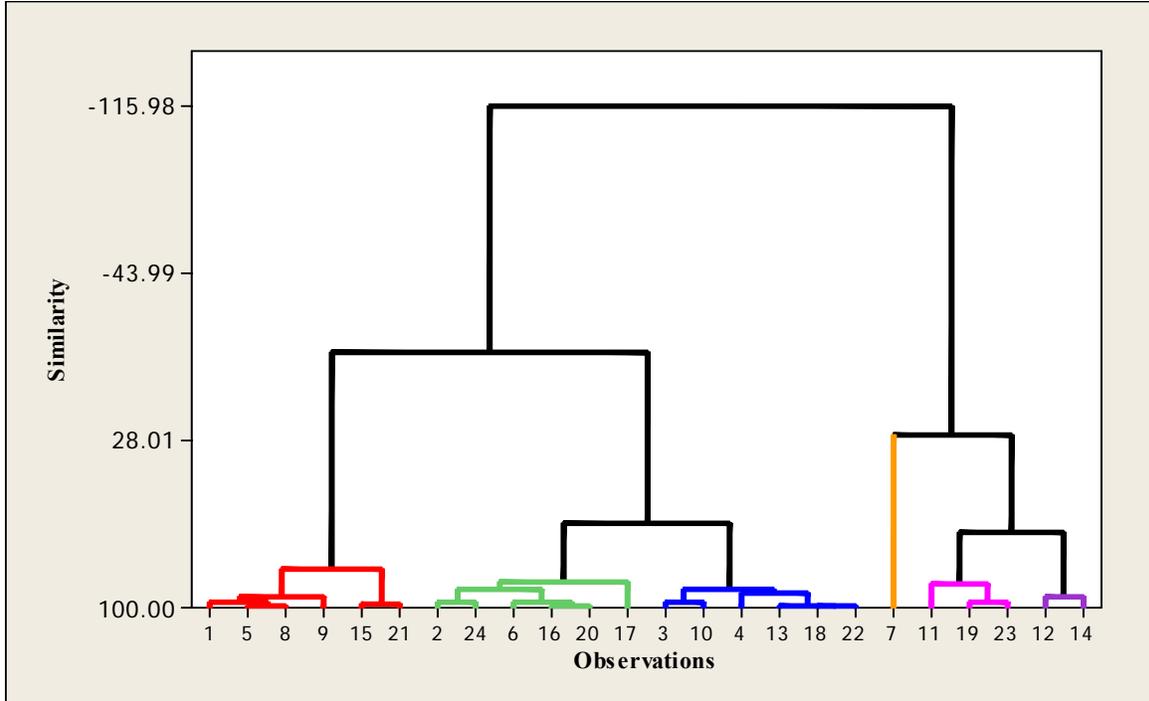
- - - )  
 - - -  
 وهي (1, 5, 8, 9, 15, 21) ، (E.C)  
 ( / ) (509-350)  
 سنة ،  
 وهي (2, 6, 16, 17, 20, 24) (E.C)  
 (838-682) ( / )  
 وهي (3, 4, 10, 13, 18, 22) (E.C)  
 (959-850) ( / )  
 (E.C) (7)

( / ) (2250)  
 (11, 19, 23)  
 ( / ) (1230-1100) (E.C)  
 (E.C) (12,14)  
 ( / ) (1500)  
 .(3)  
 :(11)

:(11)

No. of wells	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Cluster m-ship	1	2	3	3	1	2	4	1	1	3	5	6	3	6	1	2	2	3	5	2	1	3	5	2

(8) يوضح عملية تصنيف مياه الآبار الجوفية إلى ست مجاميع:



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			-1
	(E.C)		
		(E.C)	-2
			-3
		(3)	-4
		( )	-5
(7)			

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-2

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Varimax " ,(2009) , -2

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- " , (1999) , -3
- " , (1992) , -4
- " , (2010) , -5
- " , (2000) , -6
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