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Zoning the Quality Assessment of Marvdasht-Kherameh plain's ground water as Agricultural Water usage by Geographical Information System (GIS)

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ABSTRACT: Considering that the groundwater in our country was one of the main sources of agricultural water, provide groundwater quality maps can be an important step in the proper utilization of water resources. In this research Ground water quality status of Marvdasht-Kherameh plain were evaluated for agricultural usage. In the study area chemical analysis of Ground water quality from 58 water wells were used. Water quality parameters such as electrical conductivity, sodium absorption ratio, were collected during September 2009 to September 2010. In order to integration of spatial data and preparation of raster maps, ArcGis 9.3 software were applied and Kriging interpolation method was used to estimation of spatial distribution of the water quality data in different wells. The Result of Wilcox diagram showed water quality in 46.5% of aquifers wells were located in the C3S1 class, with high salinity risk and low alkalinity levels.

Key words: Quality zoning, Marvdasht-Kherameh plain, kriging, underground water quality, GIS

INTRODUCTION

Because of the frequency of droughts and poor temporal and spatial distribution of rainfall and lack of appropriate management technologies in the field of water resources, Industrial and agricultural development activities in communities to large extent dependent on utilization of groundwater resources. This not only increases water demand but the by discharge of pollutants into natural systems also provides the groundwork for the destruction of existing resources. As a result, consumption arrowhead is toward to the water quality for the needs of communities. Currently, there are two basic techniques to protect groundwater resources, including groundwater vulnerability assessment and mapping of groundwater resources (Panda and Rmsan, 2008). In fact, on the basis of this analysis we can express temporal and spatial changes in groundwater quality and by map, indicate areas with underground water suitable or inappropriate irrigation and in terms of TDS, hardness, chloride and salt found (Yamany, 2006). Based on the research done in this field, there are four key issues related to the quality of ground water for irrigation and drinking water for animals: 1) salt 2) alkalinity that reduces soil permeability 3), toxic ions 4) the effects of ions on water quality.

These problems can change the soil and thus reducing the usefulness of the irrigation and rainfall on agricultural products (Suresh *et al*., 1991). An example of efficient and advanced capabilities is using geographic information systems that is considered recent years To ability of the aquifer in a region that is costly and time-consuming than traditional methods is being identified ad introduced, so with high speed and lower cost and update of information at any time we can learn about the region's water resources And apply the necessary measures and proper management on water resources (Spring, 2011). The GIS is a tool that can show relationship between water quality data obtained in the study area well And is an effective tool for qualitative mapping and land cover mapping for monitoring, modeling and evaluation of environmental changes (Barvkv and Byalv, 1993). Kherameh - Marvdasht- plains are important plains in province of Fars and also Iran in terms of agriculture and industry. Since groundwater provides the primary source of water for these purposes are required to measuring the quality of groundwater in this area is important. Also, due to the daily use of water resources and excessive harvests and droughts in recent years, caused declining water level of underground water.

And also increase human pollutants, agricultural and industrial water pollution has been reduced water quality. Therefore, with regard to these factors monitoring of the ground water in the region is to correct management of groundwater resources. Several experimental studies have been done in this area. Bazargan *et al*. (2010), studied the chemical quality of groundwater Dezful - Andimesh to agriculture use in dry and wet years and concluded that Groundwater in terms of nitrate contamination are not infected but given that nitrate pollution is not only from agricultural sector And features such as improper disposal of garbage and sewage Andimesh, to slope of the ground, coarse-grained aquifer and the water table have impacts in the transfer of concentration of pollution that should be taken proper administrative process. Ostavari (2010), studied spatial groundwater quality parameters of Lordegan plain for drip irrigation. In this study, indices EC, TSS, pH, TDS and LI index was studied in 32 agricultural wells. Each component was drawn and appropriate variogram models were fitted to them. . Comparing the two kriging and inverse distance, kriging had about 15% higher accuracy. The maps showed that the aquifer water of Lordegan except for the northern part was appropriate for drip irrigation. Selva *et al*. (2009), in a study of investigating for planning drinking and agricultural water resources management using an appropriate index based on GIS in Tunisia stated that Degradation of water quality across the aquifer was observed and compliance of hydrological and hydrochemical maps with data and role of human activity made it more visible. The aim of this study was to evaluate the quality of agricultural water sources Plains Marvdasht-Kherameh to determine the spatial distribution of chemical parameters and preparing the final map and quality of groundwater in this area maps using Arc GIS 3.9 edition.

MATERIALS AND METHODS

A. Geographical location of studies

Research range is Marvdasht- Kherameh with area of 3941 square kilometers in the center of Fars province between geographical lengths 15' and 27' and 53° 52° to the east and latitude 19' to 25' 29° 30° to the North in Bakhtegan's catchment area. Fig. 1 shows Location of Plains Marvdasht - Kherameh. Marvdasht provonce is in this plain. Marvdasht is the center of the city. The city is located 35 kilometers north of Shiraz and the weather is mountainous and temperate. According to the 2011 census, population is equal to 137,087 tons. The land because of having a privileged geographical location and temperate climate and abundance of water and soil have always been considered And because of the physical and strategic characteristics, it developed quickly And now is the second largest city in Fars province And with regard to commercial and business position and very appropriate and reasonable living conditions populations are growing (see Wikipedia). According to the folds of the region, the Plains Marvdasht - Kherameh is located in the folds of the Zagros. Geological formations were in the central Sarvak limestone plains and are pressed, and hard. around the plain there are formations of limestone and in the southwestern of Marvdasht - Kherameh plain there are formations like Sachoon, Sery Hormuz and Gachsaran (Sangab Zagros, 2009).

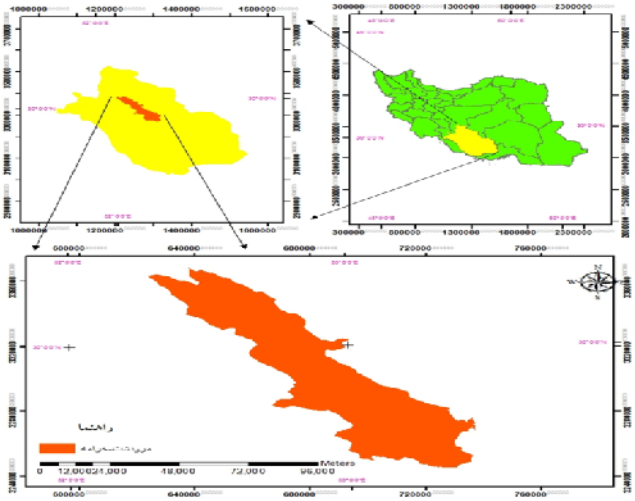

Fig. 1. The geographic location of the study area.

B. Data collection for the study of groundwater quality

To investigate the situation groundwater quality Marvdasht - Kherameh the results of chemical analysis of 58 rings of deep and semi-deep wells in the region is in a period of one year were used. In Fig. 2 Location map of water wells in 2010-2009 are presented. Groundwater sampling is performed in autumn by Farsab industry and is done in chemical analysis laboratory on samples.

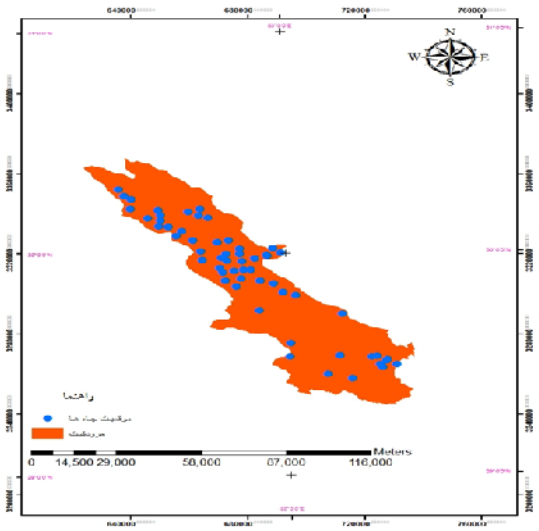

Fig. 2. Location of wells.

C. The parameters needed to assess groundwater quality

For Typical parameters for identifying and studying the geochemistry of groundwater in the area of agriculture we can mention electrical conductivity (EC), sodium adsorption ratio (SAR), the percentage of soluble sodium and remaining sodium carbonate (RSC). One of the main tasks in groundwater researches is translation of chemistry data translation in a proper way so that they can be visually examined (Frazer, 1974). So, draw diagrams and providing maps of these parameters in addition to providing a spatial view to the interpreter, it makes regional geochemical interpretation easier. Wilcox classification and chart is of the most practical methods for the classification of water in terms of agricultural and hydrological studies. In Wilcox diagram) Fig. 3) horizontal axis is for salt water (according micromhos cm) and the vertical axis is dedicated to sodium adsorption ratio. Different groups listed in the vilkaks classification create 16 different classes (see Tables 1 and 2). In this classification C is an indicator of salt and S represents sodium absorption. The values 1, 2, 3 and 4 respectively represent low, medium, high and very high.

Table 1: Classification water in terms of agriculture (Alizadeh, 2004).

classification	Sodium absorption ratio	classification	The electrical conductivity
S_1	10SAR<	C_1	250 EC<
S_2	18<SAR<10	C_2	750<EC<250
S_3	26<SAR<18	C_3	2250<EC<750
S_4	26SAR>	C_4	5000<EC<2250

Table 2: Different Categories of water and the type of quality of Wilcox classification (Karant, 1987).

Quality of water for agriculture	Water category
Sweet, harmless	C_1S_1
Slightly salty, almost appropriate	C_2S_1 ،C_2S_2 ،C_1S_2
Salty, with appropriate necessary measures	C_3S_3 ،C_1S_3 ،C_2S_3 ،C_3S_1 ،C_3S_2
Very Salty, harmful	C_1S_4 ،C_2S_4 ،C_3S_4 ،C_4S_4 ،C_4S_1 ،C_4S_2 ،C_4S_3

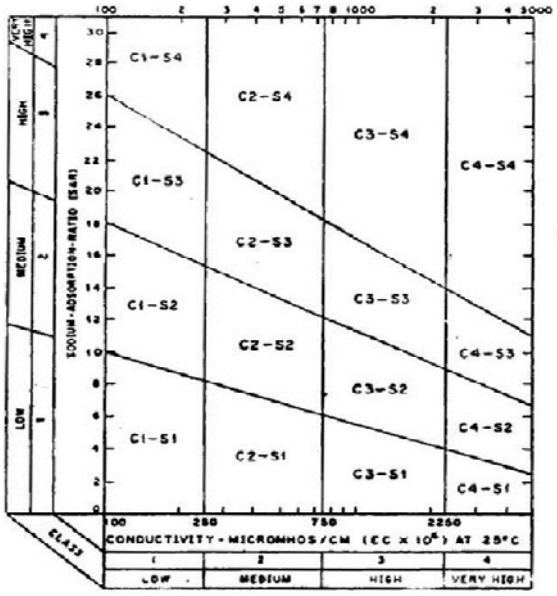

Fig. 3. Diagram of Wilcox to determine the quality of irrigation water.

According to Wilcox Classification EC very well waters all have less than 250 cm micromhos EC and placed in C1S1, good water in C1S2, C2S1, C2S2, average water-in C3S3, C1S3, C3S2, C3S1, and the rest of the water is inadequate. To this end, the point values of quality parameters plain Marvdasht - Kherameh for a period of one year was transferred to GIS software, interpolated by Kriging method and zoning map of quality of groundwater in terms of agricultural was prepared.

RESULTS

In the classification of water for agricultural purposes in addition to determining the chemical properties of water, various properties such as soil, land rinse position, water, irrigation, temperature, chemical elements in the soil and type of cultivated plants should be studied. To prepare water quality map of plain Marvdasht- Kherameh according to Wilcox classification (Table 1), electrical conductivity and sodium adsorption ratio produced in the GIS environment has been reclassified, then these maps are put on each other and the final map is produced. In Table (3) the quality and extent of the study area is presented. As (Table 3) observed the highest rate of agricultural water was related to C3S1 with 55/46 percent of the total area in water year 2010-2009 . In this class, the electrical conductivity between 750 to 2250 cm micromhos and in this respect is a risk of high salinity. The water samples with average facilities such as leaching of soils and good drainage networks, selecting plants with good salt tolerance are available. Class C3 wells have waters with high salinity they cannot be used in soil with limit drainage. Even with adequate drainage a special management maybe required to control salinity. Water that are placed in the S1 class, are water which has low sodium and can be taken almost all the soil for irrigation, while the risk of developing sodium in this condition is low in, but sodium sensitive products, such as seeded fruit trees may accumulate harmful element in the leaves and fruit. Generally, this water samples is recommended for soils with high permeability and good drainage. But in the eastern and southern of plains, groundwater is in class C4S2 and C4S3 that are considered very salty and is harmful for agriculture, Therefore, it is better to use surface waters in these areas (rivers and irrigation channels) for agricultural purposes. Table (4) is relating to the quality of water for agriculture in the region due to the Wilcox classification. In Figure 4 Wilcox charts of water year 2010-2009 for limited wells in the study area is provided, as well as figure (5) shows spatial distribution of agricultural water quality, according to the Wilcox classification.

Table 3: Percentage of each Wilcox classification of water for agricultural purposes in plain Marvdasht-Kherameh in water year 2010-2009.

C4				C3				C2				C1			
S4	S3	S2	S1	S4	S3	S2	S1	S4	S3	S2	S1	S4	S3	S2	S1
10.34	10.34	8.62	0	0	0	6.9	46.55	0	0	0	17.24	0	0	0	0

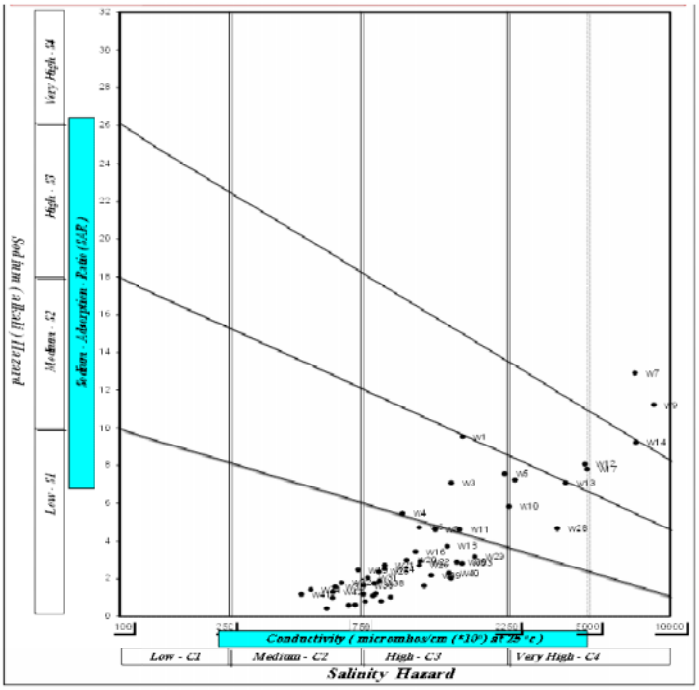

Fig. 4. Wilcox charts for observation wells in plain Marvdasht- Kherameh in water year 2010-2009.

Table 4: Marvdasht- Kherameh groundwater quality in agriculture, according to the classification of Wilcox in year 2010-2009.

The quality of water for agriculture	Water class	EC	SAR	Abbreviation	Sampling location
salty - usable for agriculture	C3-S2	1770	9.55	w1	Fakhr Abad
Very salty - unsuitable for agriculture	C4-S4	11085	23.51	w2	Maghsood Abad
salty - usable for agriculture	C3-S2	1612	7.09	w3	Amie Abad
salty - usable for agriculture	C3-S2	1071	5.48	w4	Haji Abad
Very salty - unsuitable for agriculture	C4-S2	2516	7.57	w5	Az Abad
salty - usable for agriculture	C3-S1	1232	4.74	w6	Alia
Very salty - unsuitable for agriculture	C4-S4	7453	12.9	w7	Chartagh
salty - usable for agriculture	C3-S1	1408	4.64	w8	Fath Abad
Very salty - unsuitable for agriculture	C4-S4	8714	11.24	w9	Bahman Beigi
Very salty - unsuitable for agriculture	C4-S2	2609	5.84	w10	Abegarm

salty - usable for agriculture	C3-S2	1725	4.63	w11	Kharameh
Very salty - unsuitable for agriculture	C4-S3	4919	8.08	w12	Ekrad
Very salty - unsuitable for agriculture	C4-S2	4176	7.09	w13	Bijagh
Very salty - unsuitable for agriculture	C4-S3	7527	9.24	w14	Dolat Abad
Very salty - unsuitable for agriculture	C4-S4	10167	12.02	w15	Kachal Ahmadi
salty - usable for agriculture	C3-S1	1193	3.46	w16	Esmaeel Abad
Very salty - unsuitable for agriculture	C4-S3	5003	7.81	w17	Mohammad Abad
salty - usable for agriculture	C3-S1	1556	3.75	w18	Kooshak
Slightly salty - Suitable for agriculture	C2-S1	740	2.47	w19	Garm Abad
salty - usable for agriculture	C3-S1	1109	3.01	w20	Avanjan
salty - usable for agriculture	C3-S1	923	2.74	w21	Kenare
salty - usable for agriculture	C3-S1	1241	2.94	w22	Aliaye Sofla
Very salty - unsuitable for agriculture	C4-S4	14615	11.37	w23	Sajl Abad
salty - usable for agriculture	C3-S1	922	2.52	w24	Fotooh Abad
salty - usable for agriculture	C3-S1	880	2.37	w25	Hassan Abad
salty - usable for agriculture	C3-S1	1232	2.73	w26	Hossein Abad
Very salty - unsuitable for agriculture	C4-S4	13616	9.02	w27	Kharameh
Very salty - unsuitable for agriculture	C4-S2	3903	4.68	w28	Reza Abad
salty - usable for agriculture	C3-S1	1957	3.19	w29	Kenare (Amin Abad)
The quality of water for agriculture	Water quality	EC	SAR	abbreviation	Sampling location
salty - usable for agriculture	C3-S1	1686	2.91	w30	Joonjoon
salty - usable for agriculture	C3-S1	802	2.06	w31	Naghsh Rostam
Slightly salty - Suitable for agriculture	C2-S1	645	1.8	w32	Sahl Abad
salty - usable for agriculture	C3-S1	1761	2.84	w33	Nasr Abad
Slightly salty - Suitable for agriculture	C2-S1	499	1.43	w34	Ghale Nou
Slightly salty - Suitable for agriculture	C2-S1	611	1.59	w35	Hashtgerd
salty - usable for agriculture	C3-S1	773	1.65	w36	Emad Abad
Very salty - unsuitable for agriculture	C4-S3	12708	7.07	w37	Kharameh
salty - usable for agriculture	C3-S1	848	1.76	w38	Khalf Tahooneh
salty - usable for agriculture	C3-S1	1362	2.19	w39	Kharameh
salty - usable for agriculture	C3-S1	1584	2.29	w40	Fath Abad Sofla
Slightly salty - Suitable for agriculture	C2-S1	461	1.19	w41	Golmakan Abraj
Slightly salty - Suitable for agriculture	C2-S1	599	1.31	w42	Dare Bad
salty - usable for agriculture	C3-S1	1610	2.04	w43	Mian Ghale
Very salty - unsuitable for agriculture	C4-S3	11982	5.77	w44	Maghz Abad
salty - usable for agriculture	C3-S1	1286	1.63	w45	Shams Abad
salty - usable for agriculture	C3-S1	772	1.2	w46	Hessam Abad
salty - usable for agriculture	C3-S1	858	1.22	w47	Boorki

Slightly salty - Suitable for agriculture	C2-S1	597	1	w48	Doroodzan
salty - usable for agriculture	C3-S1	839	1.11	w49	Dashtak
Slightly salty - Suitable for agriculture	C4-S3	16339	4.99	w50	Sajl Abad
salty - usable for agriculture	C3-S1	969	1.03	w51	Sharak
salty - usable for agriculture	C3-S1	786	0.79	w52	Ghasr Khalil
salty - usable for agriculture	C3-S1	897	0.8	w53	Jashnian
Slightly salty - Suitable for agriculture	C2-S1	685	0.59	w54	Mehr Abad
Slightly salty - Suitable for agriculture	C2-S1	570	0.41	w55	Hossein Abad Dardan
Slightly salty - Suitable for agriculture	C2-S1	722	0.61	w56	Dashtball
salty - usable for agriculture	C3-S1	883	1.87	w57	Haji Abad Khafrak
Very salty - unsuitable for agriculture	C4-S2	2735	7.24	w58	Sahl Abbad

Other irrigation water quality standards, the remaining sodium carbonate (RSC), which represents the risk of bicarbonate. High concentration of bicarbonate leads to deposition of calcite, increasing erosion and reduce soil permeability. If the RSC is more than 2.5 meq per liter this water is inappropriate for irrigation. Table (5), shows the RSC and also classification according to the percentage of soluble sodium of plain Marvdasht - Kherameh. According to the table of RSC most samples of studied area are negative so there is no limit on the irrigation water and are suitable. In terms of percentage of solution of sodium are also many samples have acceptable quality.

Table 5: Analysis of observation wells Plains Marvdasht -Kherameh in terms of agricultural water quality based on the RSC and% Na, in water year 2010-2009.

Water quality based on RSC	RSC	Water quality based on Na%	Na%	SAR	Sampling location
Acceptable	2	Suspected	77.25	9.55	Fakhe Abad
Suitable	-40.5	Suspected	71.42	23.51	Mghsood Abad
Suitable	1	Suspected	68.24	7.09	Amir Abad
Suitable	0.5	Suspected	67.56	5.48	Haji Abad
Suitable	-4.5	Suspected	63.64	7.57	Az Abad
Acceptable	2	Suspected	60.22	4.74	Alia
Suitable	-40.5	Acceptable	58.06	12.9	Chartagh
Suitable	0.3	Acceptable	56.12	4.64	Fath Abad
Suitable	-37.5	Acceptable	55.28	11.24	BeigiBahman
Suitable	-2.5	Acceptable	54.58	5.84	Abegarm
Suitable	-4.5	Acceptable	53.84	4.63	Kharameh
Suitable	-20	Acceptable	53.56	8.08	Ekrad
Suitable	-16.5	Acceptable	51.87	7.09	Bijagh
Suitable	-30.5	Acceptable	51.87	9.24	Dolat Abad
Suitable	-58	Acceptable	51.71	12.02	Ahmadi Kachal
Suitable	-1.7	Acceptable	50.25	3.46	Esmaeel Abad
Suitable	-28	Acceptable	49.39	7.81	Mohammad Abad
Suitable	-3	Acceptable	48.65	3.75	Kooshak

Suitable	0	Acceptable	46.88	2.47	Abad garm
Suitable	0.3	Acceptable	46.32	3.01	Avanjan
Suitable	0.5	Acceptable	45.49	2.74	Kenare
Suitable	-1	Acceptable	44.27	2.94	Sola Aliayi
Suitable	-102	Acceptable	44.3	11.37	Sajl Abad
Suitable	-0.3	Acceptable	43.86	2.52	Fotooh Abad
Suitable	-0.5	Acceptable	43.05	2.37	Hassan Abad
Suitable	0.2	Acceptable	42.02	2.73	Hossein Abad
Suitable	-86	Acceptable	40.59	9.02	Kharameh
Suitable	-20.5	Acceptable	40.19	4.68	Reza Abad
Suitable	-4.5	good	39.7	3.19	Kenare (Amin Abad)
Suitable	-5.5	good	39.65	2.91	Joonjoon
Suitable	0	good	39.69	2.06	Naghsh Rostam
Suitable	0.2	good	39.21	1.8	Sahl Abad
Suitable	-5.5	good	37.5	2.84	Nsar Abad
Suitable	0	good	36.97	1.43	Ghale Nou
Suitable	-1	good	36.31	1.59	Hashtgerd
Suitable	0.9	good	35.57	1.65	Emad Abad
Suitable	-85.5	good	35.02	7.07	Kharame
Suitable	0.2	good	34.31	1.76	Khalaf Tahoone
Suitable	-4.5	good	34.35	2.19	Kharame
Suitable	-3.5	good	33.67	2.29	Fath Abad Sofla
Suitable	-0.9	good	32.2	1.19	Golmakan Abraj
Suitable	-0.5	good	31.97	1.31	Bad Dare
Suitable	-8	good	29.66	2.04	Mian Ghale
Suitable	-91.5	good	30.02	5.77	Maghz Abad
Suitable	-2	good	27.54	1.63	Shams Abad
Suitable	-1.8	good	26.4	1.2	Hesam Abad
Suitable	-2	good	25.63	1.22	Boorki
Suitable	-1	good	25.25	1	Dorood Zan
Suitable	-2.3	good	23.98	1.11	Dashtak
Suitable	-139	good	23.14	4.99	Sejl Abad
Suitable	-3.5	good	21.38	1.03	Shahrak
Suitable	-4.3	Excellent	17.97	0.79	Ghasr Khalil
Suitable	-2.3	Excellent	17.49	0.8	Jashnian
Suitable	-1	Excellent	15.38	0.59	Mer Abad
Suitable	-0.2	Excellent	11.97	0.41	Hossein Abad Dardan
Suitable	-3.5	Excellent	14.7	0.61	Dashtbal
Suitable	-0.5	good	36.27	1.87	Haji Abad Khafran
Suitable	-3.5	suspected	61.43	7.24	Sahl Abad

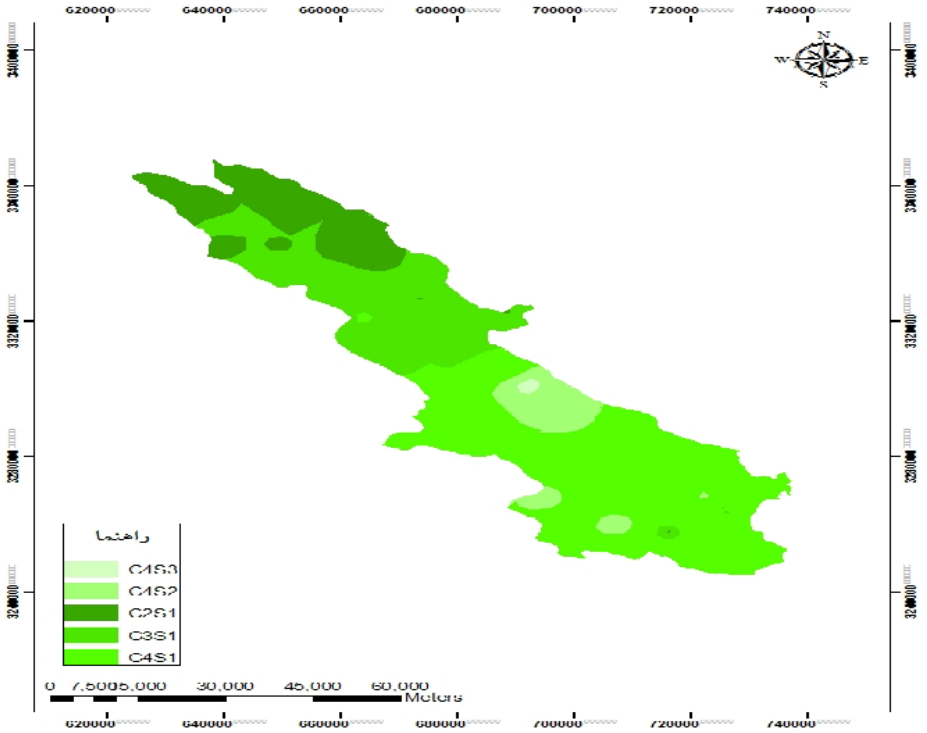

Fig. 5. Zoning map for groundwater quality, in terms of agriculture in Marvdasht- Kherameh in water year 2010-2009.

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