Ecogeomorphology of Zilaki and Disum Rivers by Emphasis on Dissolution Load

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Abstract

The geomorphic parameters are the most important and effective factors on the ecological quality of the rivers. The physical and chemical quality of the rivers water can be due to lithology of the formation existing in the water field, the sediments delivered to the river and the biological factors. In this study, the effects of parameters affecting the chemical quality of the water of the two rivers of Zilaki and Disum have been examined. The expansion of calcareous formation in the upstream of the field of these rivers, much rains, forest coverage and water branches and the entrance of water drainage resulted from cultivation of rice in the spring season is influential on the solvent salts of the river water and in the regions that the morphology of the river had a flat surface and condition has not caused a negative effect on the ecology of the river. By using the hydrometric stations available on the water of these rivers, the quality statistic of their water was obtained in three sections of minimum, medium and maximum and the Water Quality software was used to analyze it. The results which were provided from the salts of different solvents of water in the rivers of Zilaki and Disum indicate that under the ordinary situation, the geological factors and geomorphology did not have a negative effect on the quality of the water and by interference of ecological factors such as the entrance of water drainage resulted from agriculture in the spring causes that the salts of the water to be approximately increased which had the most impact on electrical conductivity of these rivers.

1. Introduction

The prerequisites of sustainable development, having confident information regarding the quality and quantity and the needs of the users are varied. In order to review the situation of water sources, the thickness and types of different salts in the water of rivers should be reviewed. It means the ecogeomorphologic of the river water can exhibit the effect of different natural and unnatural parameters on these sources. Generally, Ecogeomorphology means a combination of the results of reviews of geology and ecology and biology. These variables usually are dependent to some factors such as the nature of the geology formations of the catchments of the rivers, geomorphology of the field, water regime of the river, water wastes resulted from human activities and eventually about the exchange of superficial and underground waters in their drainage basin. Production of data, collecting information and also technique for their analysis can be useful for the future studies and using them in the other fields can be also beneficial. The level of the produced and delivered sediments by the rivers also are some of the factors affecting the quality of their water as well; for sure only by knowing the quality measurements of water we can manage for more and better exploitation from water sources of an area. The thickness of the materials existing in the water though might be less, but they play significant roles in the situation of the use of that water for drinking, agriculture and industry.

The water source of these rivers and the expansion of many springs in their domain have caused upstream water of Zilaki and Disum. According to the morphology and lithology of the formations of two fields of Zilaki and Disum, the forest coverage and the level of rains have caused that the sediments which consists carbonates, bicarbonates, sulfate, calcium and magnesium and other salts to be as a solution and due to washing by the rains to enter the rivers of Zilaki and Disum. On the sidelines of these rivers, due to their physiographic situation, the fertile lands have been created for the purpose of agriculture and a great land of the desert flooding and the reasonable sediments of that for the purpose of agriculture have caused that in this area of rivers, rice to be cultivated.

These factors play an important role in changing the physical, chemical, microbiological measurements of water. The entrance of farming water drainage consisting the pollutants resulted from the use of fertilizers; poisons to remove the pests have caused an increase of the pollution charge of these rivers in some seasons of the year. In this research according to the parameters of geology, geomorphology and ecology, the effective factors on the soluble salts of these rivers have been reviewed and the quality of their waters have been compared according to the drinking and agriculture purposes.

2. Methods and Materials

The drainage basin of Zilaki and Disum in Gilan province and respectively in the cities of Roodbar and Siyahkal have been expanded; the drainage basin of Zilaki river after Tarik Dam located near Imam Zadeh Hashem and the drainage basin of Disum after the Sangar Dam enter to the field from the eastern side of the White River. The source of Zilaki River of Deilaman mountainous areas and Darfak Mountain and the source of Disum River are the Deilaman mountainous areas (Figure 1 & 2).

This research is based on the environment observation and the library method- analysis by using topography maps 1:50000, the geographical organization of the armed forces, the geology map and 1:100000, the geology department, and the maps 1:250000 geology, soil and the vegetation of the forest and lands organization, the climate data of the weather organization and the studying center of water, the quality and quantity statistic of hydrometric stations of this center.

At first, the drainage basin areas of Zilaki and Disum rivers have been determined by using the software Arc Gis have on the topography maps 1:50000 and they are specified in the environment of this software, the physiographic specifications such as area, figure and height surfaces have been determined.

The geology of the fields is determined according to stratigraphy, penetration, permeability and the intensity of erosion for each field. The physiographic of these basins is in a way that a section of that is mountainous and the other section which includes their output has a nature of foothills and desert. So in order to verify the climate of these two basins 6 vaporization stations that were close to their station were opted. The two stations of Shah Shahidan, Spili and Pirkuh with the mountainous nature and the station Totaki, Sharbijar and Sanger dam with the desert nature were considered. In Zilaki basin, the weather stations of Shah Shahidan, Sharbijar and Spili and in the Disum basin, the weather stations of Pir Kuh, Spili, Totaki and Sanger Dam were used. The statistical eras for these six stations from 1985 to 2007 were selected and according to the rain relationship and the height of fix coefficients for the purpose of estimating the rains and temperature for these basins were presented. The water level of these two rivers basins also were calculated by using Hydrometric stations which had been stationed on them. The statistical eras for these two stations were considered from 1985 to 2007. According to the above hydrometric stations, the dissolution loads of the rivers were extracted in three sections of minimum, medium and maximum. The extracted data were analyzed and then by using to the software of Water Quality, the quality of the rivers waters for the purpose of agriculture and drinking water were assessed.

3. Geology and Climate

The details of the geological information iz given in Table 1. According to the following table, it can be observed that the

Table 1: The specifications of the formations of basin geology

Geology unit	Aga	Kind of Formation	Permeability	expansion	Erosion class	Erosion intense
TRJs	Jurassic	Sandstone, siltstone and claystone with thin coal	Low	Zilaki -disum	III	Low
Jk	Jurassic	Conglomerate, Sandstone and shale	Low	Zilaki -disum	III	Low
K2l2	Cretaceous upper	Limstone	Medium to proper	Zilaki	VI	Moderate
K2sh,m	Late Cretaceous	Shale - Limestone	Medium	Zilaki	V	Moderate
Kbv	Late Cretaceous	Basalt	Low	disum	II	Low
Ek	Eocene	Green tuff fade outs shale	Low	Zilaki	V	Moderate
Qft2	Quaternary	Young deposit alluvial fan	Good	disum	VII	High
Qtr	Quaternary	Allusion	Medium	disum	V	Moderate
Qft1	Quaternary	Old deposit alluvial fan	Good to excellent	disum	VI	Moderate

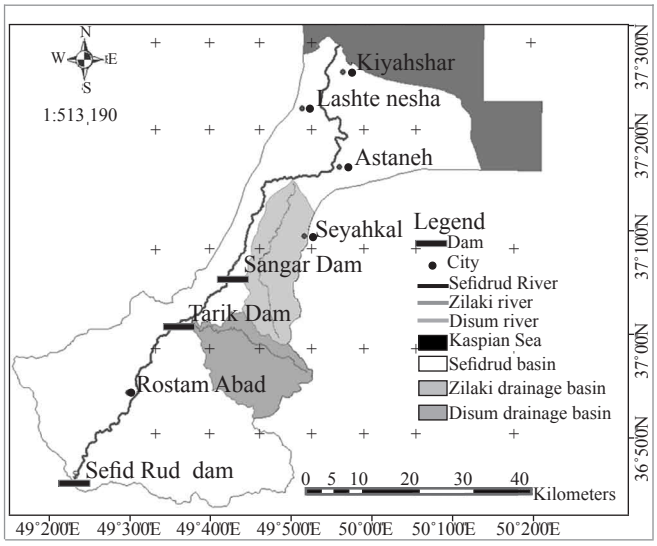


Figure 1: The map of the location of drainage basins of Zilaki and Disum

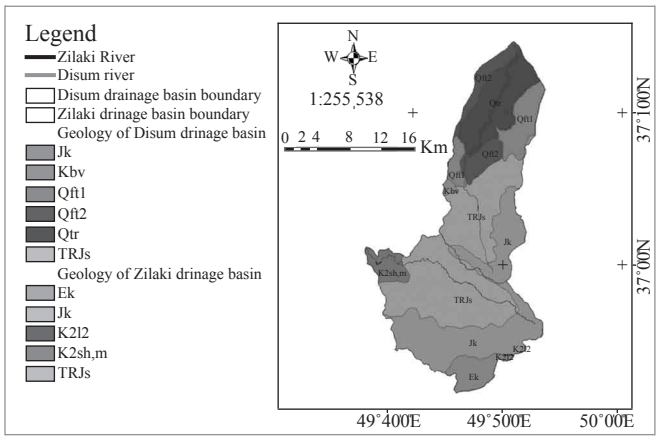


Figure 2: Geology map of drainage basins of Zilaki and Disum

level of rain and temperature in the Disum drainage basin is higher than the Zilaki drainage basin, but the procedure of rain and temperature are approximately equal in different months in the two basins. In both basins, the maximum temperature are in July and the minimum in February.

In order to study the water level of the rivers, the statistic of hydrometric stations of Sharbijar were used on the Zilaki River and statistic of hydrometric stations of Pashaki on Disum River. The area of Zilaki and Disum are almost equal with each other and the level of rain for the drainage basin of Disum is more than the drainage basin of Zilaki , but the water level of Zilaki is more than Disum basin and the reason of this issue is the high expansion of calcareous masses in the Zilaki basin, mountainous areas of this basin and much concentration of snows in this area.

The Zilaki and Disum basins are considered as the long basins and they have an area more than respectively 241.70 and 240.12 square kilometers. The slope studies in this two basins indicate that the highest level of slopes exist in the Zilaki basin in the class of 30-60 and <60 respectively with the frequency 46.72 % and 32.27 % which they indicate the mountainous areas of this basin. In Disum basin the highest level of the slope is located in the classes 0-2 % and 30-60% respectively with the frequency of 49.73 % and 23.74 %. So a great proportion of this basin is as a desert. This factor has caused according to the same area of these two basins, the water level of Zilaki basin to be more than Disum basin. The majority stone units of the two drainage basins of Zilaki and Disum to be made of calcareous masses.

The length of the main waterway of Zilaki is estimated 31.55 km and the general average slope is 3.64 % and the length of the main waterways of Disum 39.17 km and the general average slope of that is 1.78 %.

At the sidelines of these rivers, due to physiographic situations of them, some fertile lands have been created for the purpose of farming and agriculture. A great deal of the floodwater of the desert can be used for cultivation of rice because it is a reasonable land due to the appropriate soil of this land for agriculture and this has caused that this region of the area, rice to be cultivated. These factors play an important role in changing the physical, chemical and microbiological properties of water. According to the morphology and lithology of the formations of two basins of Zilaki and Disum, the forest coverage and the level of rain it has caused that the sediments that contain carbonates, bicarbonates, sulfate, calcium and magnesium and other salts as solutions due washing of rains to enter the rivers of Zilaki and Disum. On the other hand, the entrance of agricultural water drainage consisting pollutants resulted from the use of fertilizers, poisons to kill the pests and the herbicides, the pollution charge of these rivers to be increased in some seasons of the year.

4. Results and Discussion

4.1. Quality parameters

The type of level of physical, chemical and biological properties of water in fact is one of the main factors to determine the quality of the water. The water of Zilaki and Disum Rivers is really important for the purpose of agricultural and drinking uses. So in this case, identifying the quality of the rivers water for the purpose of environment management can be so beneficial for the future as well. In order to asses the quality parameters of waters of these two rivers, the hydrometric stations of Sharbijar and Disum have been used (Table 2 & 3). In the statistical era, the bases of the maximum, minimum and medium results of these parameters were extracted and analyzed.

TDS or Total Dissolved Salts is an important factor for the quality of the water and it causes many effects for movement, chemical conversion and ionization of materials. Also it plays a great role in determining the aquatic and plant creatures. This

parameter is also so effective in determining the ratio of water in the agricultural uses, drinking water and industry. Sediments containing calcium carbonates to the water of these rivers have affected pH in Zilaki river. pH of the river water has is between at least 6.55 and at most 8.49. The average of this parameter in the Zilaki River is 7.62. These levels for Disum River are variable between 4.1 and 8.87. But the average of this parameter in Disum River indicates 7.48. Totally, the averages of pH of the two rivers indicate the levels higher than 7. The changes of electrical conductivity in Zilaki River are more than Disum River. These levels for Zilaki River indicate at most 1099, at least 151 and averagely 302.35 µmohs cm^{-1} and it is in a way that the level of electrical conductivity in Disum water has a lower level and it is between the maximum 711, at minimum 78 and averagely 268.63 µmohs cm^{-1}. The reason of the increase of electrical conductivity level in these rivers should be considered as the entrance of agricultural water drainage. The usage of electrical conductivity is in the classification Wilcox for the purpose of agricultural uses. The level of calcium and magnesium in Zilaki River is more than Disum river. One of the quality indices of drinking water is its hardness which is measured based on the calcium carbonate. The highest level of water harness is related to the ions of calcium and magnesium and expressed in mg l^{-1}. As it is observed in the following table, the water of these rivers does not have permanent hardness and they only have temporary hardness. In the field of hardness level, the water of Zilaki River is harder than the water of Disum River (only under the maximum level). The geology sections that cause the increase of chlorine in the two rivers of Zilaki and Disum have not been expanded in the basins of these two rivers; so in this case the thickness of different chlorines in the two rivers of Zilaki and Disum are so low. These levels for Zilaki are between minimum 0.09, and maximum 4.51 and averagely 0.27 mg l^{-1} and for the river of Disum minimum 0.09, maximum 3 and averagely 0.57 mg l^{-1}. The results indicate that the level of chlorine in the river of Zilaki is a bit more than Disum River. The thickness of sodium salts also the same as chlorine in the two rivers of Zilaki and Disum have little expansion. But their level in the Zilaki River in the maximum level of this parameter is more than Disum River. The results sourced from the thickness of sulfate salts in the two rivers of Zilaki and Disum indicate that the level of these salts is so less in the water and its reason is the lack of gypsum layers in the two drainage basins of Zilaki and Disum. Only under the maximum condition, the thicknesses of different types of sulfate have been estimated for the two rivers of Zilaki and Disum respectively 2.79 and 2.01 mg l^{-1}. The expansion of calcareous masses in the upstream of the drainage basin of Zilaki and Disum, much rains and forest plant coverage have cause an erosion and dissolution of calcium carbonate and the entrance of bicarbonate ion to the water of the river and it leads to the increase of its thickness in the water. The results sourced from the thickness of salts of bicarbonate in the two rivers of Zilaki and Disum indicate that these thicknesses of salts in these rivers are almost the same. The level of CO_3 in both rivers is considered so little. In the regions where the level of rain is high and there is an expansion of forest coverage, CO_3 is formed. The thicknesses of potash salts also are little in the water of these two rivers. The potash existing in the water of the two rivers of Zilaki and Disum are mostly formed due to entrance of water drainage resulted from agriculture which consist potash fertilizer.

4.1.2. Wilcox and Schoeller Diagram

In order to classify the quality of water in agriculture, the two factors of salty and sodium are really significant. The electrical conductivity is shown in diagram of Wilcox with C and the Sodium Absorption Ratio is shown with S. C_1 is the small electrical conductivity, C_2 is the medium electrical conductivity, C_3 is the high electrical conductivity and C_4 is the very high electrical conductivity, also $S_1$is the small Sodium Absorption Ratio, S_2 is the medium Sodium Absorption Ratio, S_3 is the high Sodium

Table 2: Dissolution load of the Rivers during the statistical era, 1986-2007

Hydrometer station	parameter	SAR	K	Na	Mg	Ca	SO_4	Cl	HCO_3	CO_3	pH	EC	TDS
Sharbijar (zikli)	max	3	0,22	5,58	2,9	4	2,79	4,51	4,8	0,2	8,49	1099	692
	min	0,03	0,01	0,04	0,09	0,7	0,1	0,09	1,17	0,001	6,55	151	95
	mean	0,21	0,03	0,26	0,74	2,13	0,29	0,27	2,63	0,005	7,62	302,35	190,26
Pashakei (disum)	max	3	0,3	3,81	2	3,6	2,01	3	4,6	0,15	8,87	711	448
	min	0,01	0,02	0,01	0,1	0,5	0,09	0,09	0,7	0,05	4,1	78	49
	mean	0,41	0,03	0,47	0,65	1,65	0,32	0,57	1,96	0,10	7,48	268,63	169,33
Index			1.3-2.3	5.1-6.3	4	13-15	8.3-11.2	-		0	4.5-8.5	70	73-89
Changes range			0.02-189	-	0-379	0-954	-	0.5-2			1-9	40-1500	5-317

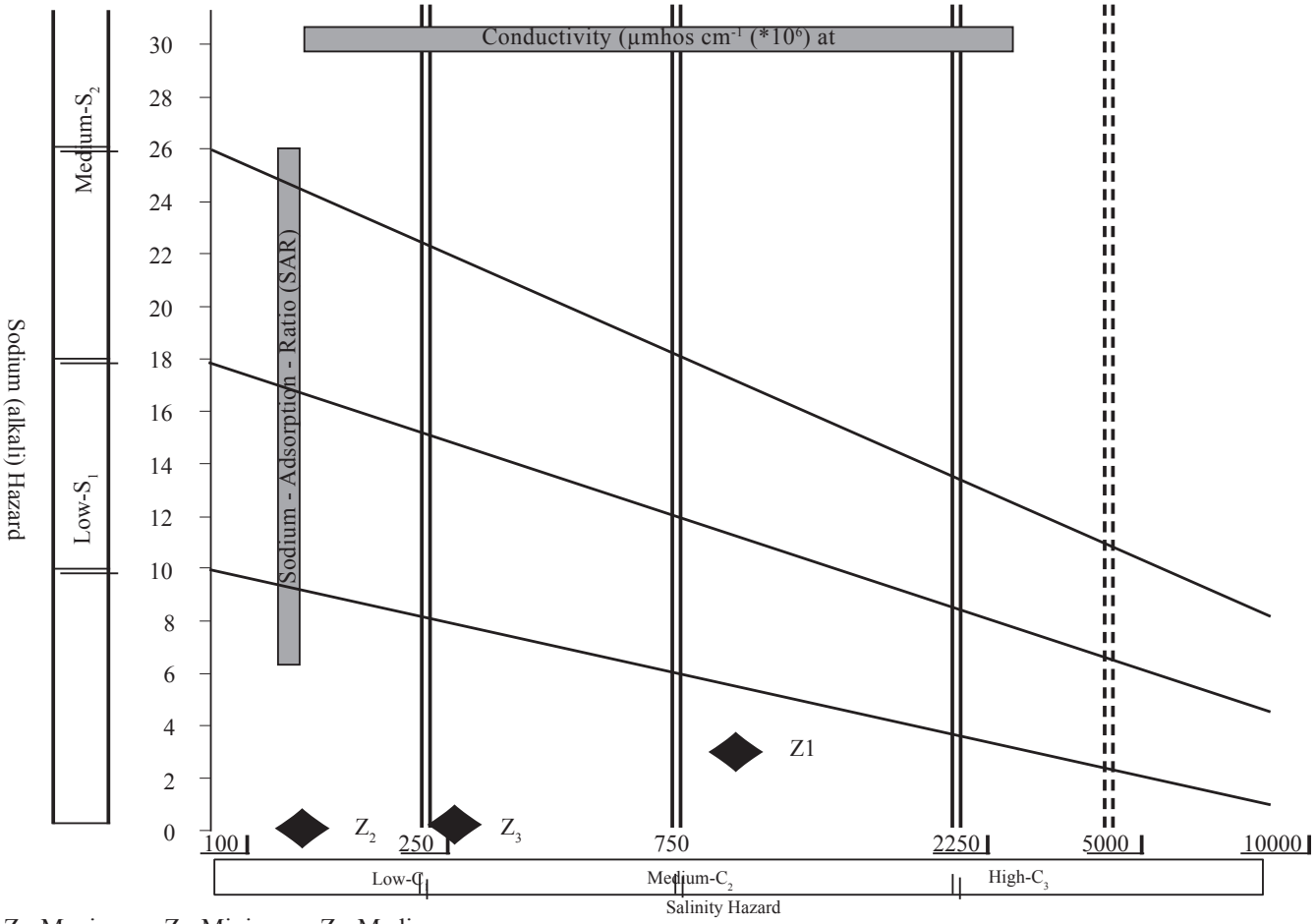
All values in meg l^{-1} except pH in NTU and EC in µmohs cm^{-1}

Table 3: Ion Frequency of water in Zilaki and Disum Rivers

Type and facies	Water facies	water type	Conc. of cations	Conc. of anions	Brief mark	Sample location
Sodium Bicarbonate	Na	HCO_3	Na+K > Ca > Mg	HCO_3 > Cl > SO_4	Maximum	Shahrbijar
Calcium Bicarbonate	Ca	HCO_3	Ca > Mg > Na+K	HCO_3 > SO4 > C_l	Minimum	(zilki)
Calcium Bicarbonate	Ca	HCO_3	Ca > Mg > Na+K	HCO_3 > SO4 > C_l	Medium	
Sodium Bicarbonate	Na	HCO_3	Na+K > Ca > Mg	HCO_3 > Cl > SO_4	Maximum	Pashaki
Calcium Bicarbonate	Ca	HCO_3	Ca > Mg > Na+K	HCO_3 > SO4 > C_l	minimum	(disum)
Calcium Bicarbonate	Ca	HCO_3	Ca > Mg > Na+K	HCO_3 > Cl > SO_4	Medium	

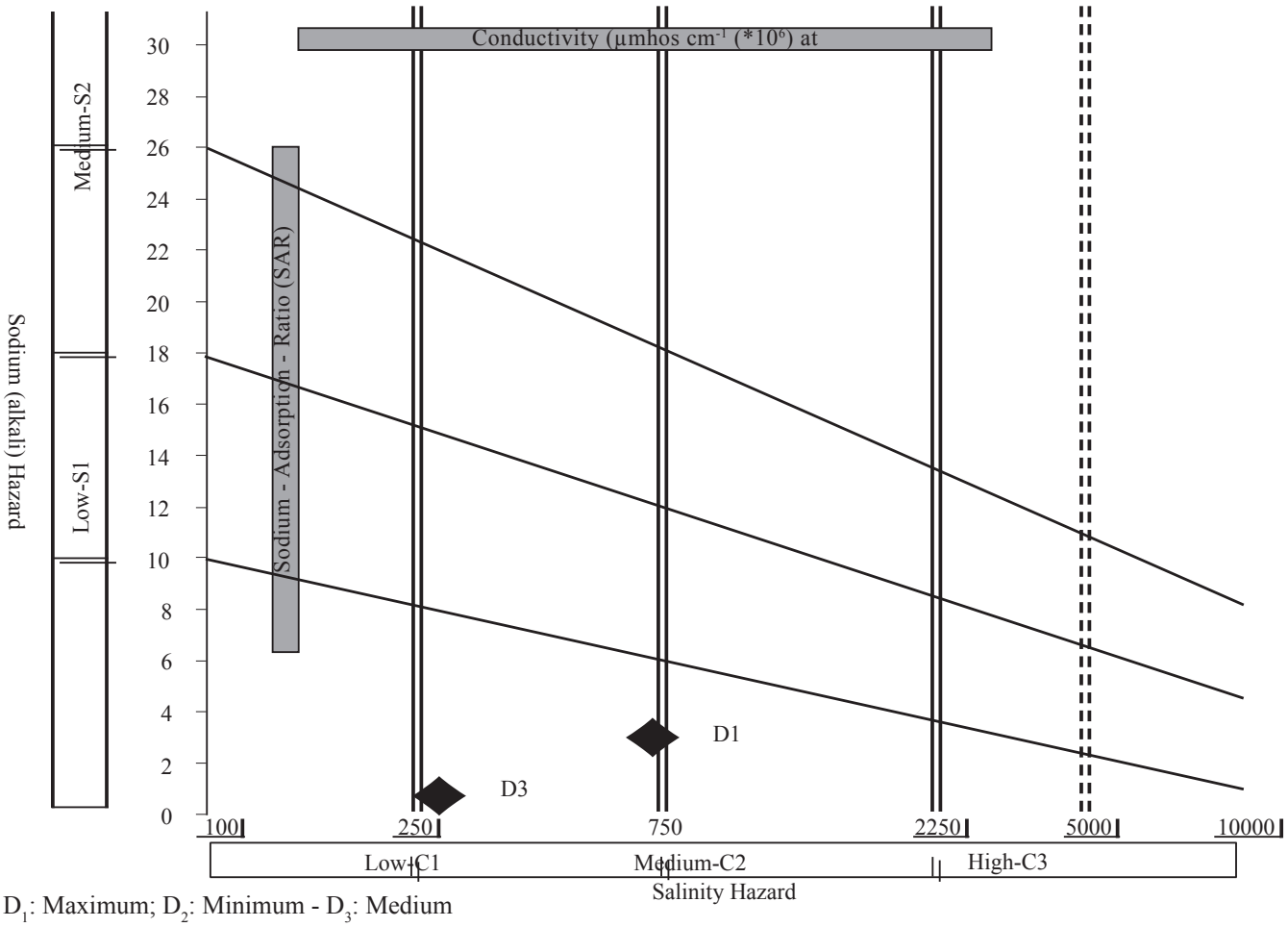
Absorption Ratio and S_4 is the very high Sodium Absorption Ratio. So in this case, the salts and the Sodium Absorption Ratio of waters each are classified in four groups which from the combination of these two standards, the waters are classified into 16 groups (based on the Diagram of Wilcox) as follows: The very good waters with the class of C_1S_1 (µmohs cm^{-1} 250 < EC). Waters with medium quality which are relevant to one of the classes of C_3S_3, C_1S_3, C_2S_3, C_3S_1, C_3S_2 (EC is between 750 to 2250 µmohs cm^{-1}). At the same time, Waters with inappropriate quality in the classes of C_1S_4, C_2S_4, C_3S_4,C_4S_4, C_4S_1, C_4S_2, C_4S_3 (EC is between 2250 to 5000 µmohs cm^{-1}). The quality structure of drinking water: In order to verify the quality structure of drinking water, the salts HCO_3, SO_4, Cl, TDS, Na, Mg, Ca were used and the Schoeller Diagram for the purpose of water quality of these two rivers was drawn (Figure 3 & 4).

The frequency of ion by using the thickness of ions and cations determine the type The type of the water of Zilaki and Disum is bicarbonate which exhibits the expansion of calcareous mass in the upstream of the rivers. The facies of the water of these rivers in the minimum and medium level of the salts soluble in the water is a classic type which this type of facies also indicate the expansion of calcareous masses. Only in the



Z_1: Maximum; Z_2: Minimum; Z_3: Medium

Figure 3: Wilcox diagram of Zilaki River.



D_1: Maximum; D_2: Minimum - D_3: Medium
Figure 4: Wilcox diagram of Disum River.

maximum condition, the salts existing in the water of these rivers, facies of the water is changed and it appears as sodium; which the expansion of this type of facies indicates the increase of soluble salts in the water only in some seasons of the year and due to ecological factors. According to the geology factors, geomorphology and ecology, the quality of the water sources of Zilaki and Disum Rivers are considered reasonable for the purpose of agriculture and drinking. The qualities of the water of Zilaki River in the hydrometric station of Sharbijar in the maximum level have the class C_3S_1 (Much salts with low Sodium Absorption Ratio), in the medium level, it has the class of C_2S_1 (Medium with low Sodium Absorption Ratio) and in the minimum level, it has the class of C_1S_1 (Low salts with low Sodium Absorption Ratio). The quality of Disum water in the hydrometric station of Pashaki at the maximum level and medium level have the class of C_2S_1 (Medium salts with low Sodium Absorption Ratio) and in the minimum level C_1S_1 (Low salts with low Sodium Absorption Ratio). According to Schoeller diagram, the water of both rivers is considered good and acceptable for drinking too. Of course the water of Disum River has a better quality in comparison to the water of Zilaki River. The ion frequency of the water of these rivers indicates the expansion of calcareous formations in the upstream of them in a way that the major type of the water of these rivers is bicarbonate and their major facies is Calcium.

5. Conclusion

The results of the soluble salts in the water of Zilaki and Disum Rivers indicate that at ordinary situation, the geology factors and geomorphology did not have an negative effect on the quality of water. Drainage resulted from agricultural waters in the spring season results in higher salt concentration.