The effect of the water level decline on the ground waters quality in Ardabil plain

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Abstract: Today, the most part water consumptions of Ardabil plain and the remote villages (which haven't tap water) are supplied from sections of agriculture, drinking and industry. This research objective is the study of water level declines effect on the ground waters quality in Ardabil plain. According to the conducted studies, It has about 11 meters decline which has been encountered with tank loss in about cubic meters seriously. Therefore, Ardabil plain ground waters quality studied with use of 44 wells chemical analysis results . In this research, the most emphasis was on the parameters such as electrical conductivity ability, sodium (Na) absorption ratio, Total solid solutions, hardness and also ca^{+2}, Mg^{+2}, Na^{+}, Hco_3^{-}, CL, $SO4^{2-}$, ions.With considering of the decline level effect in the ground waters that Ardabil plains ground waters quality from drinking uses is medium to good level and from irrigation point of view is in desirable level according to wilcox classification .

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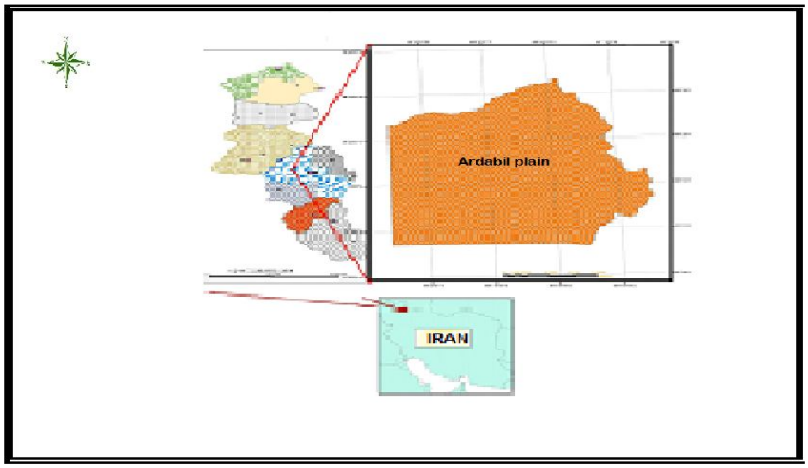
key words: Ground waters, Decline, Ardabil plain, Quality

Introduction

According to the geographical position of Iron and its placing in arid and semi-arid zone of the world, studies of the water resources have importance and priority not only for availability to full qualitative and quantitative information of the resources for desirable uses but also, for other factors such as the role of ground water resources in adjustment of floods and base flow, the excretion of urban and industrial drainage to the ground water resources in the most parts of country, the decrease of good quality of drinking water in cities and villages and the aquifers role in lands drain, case studies of the surface and ground waters are inevitable. There is a flat and fertile mid-mountain plain with 990 km width at the end of eastern side of Azerbaijan's volcanic plateau and the distance between heights of Baghrvdagh at the east, Anbaran at the north , Sabalan of Bozgoosh at the west and south between 38° 5′ to 38° 28′ north latitude and 48° 10′ to 48° 47′ eastern longitude which is placed the third city with most population in the name of Azerbaijan and capital or centre of Ardabil province at its western side. It is Ardabil province that for superior position from long times was as population centre and had determinative role in a short time of the country history and it, in turn, has created unique capabilities for this region. The mentioned heights collection, their connection and tension give special geographical independence to this plain and also has shaped it as a close pit that only it is opened toward western north i.e Meshginshahr and Mogan plain. The approximate length, width and medium height of this plain are 40, 25, 1350 km respectively in Ardabil city. The area of this plain with oval shape is about 900 km^2. It is found right relation from east with Gilan province through Gardaneh Heran and from west with Azarbaijanshargi through Balikhlochai valley and Gardaneh Saien. It has been in consideration for having ground aquifer. During recent half century, it has been the most important resource for supplying of the urban and rural agriculture, industrial and drinking water. Before two recent decades, the number of deep and semi-deep wells were limited in this plain and for this reason, ingathering or utilizing from ground aquifer of Ardabil plain and population growth in the mentioned regions has been increased the obtained water of aquifer for different uses (the half detailed studies of Ardabil water office, 2009). The great decrease in ground water resources due to use of indesirable method during past years and considerable well numbers in Ardabil plain take us toward attempt. The objective of the persent research is the study of decline and decrease effect of ground water level on the ground waters quality, salinity and alkalinity of wells water in this region .



Map No. 1: Geographical position Ardabil plain's in northwestern Iran and eastern side of the plateau Azerbaijan.

The evolution of tectonic and geology of Ardabil plain's

According to geology plans information of Ardabil plains region and its surrounding areas , it was as a part of Iran palaeozoic platform during the first Era out of water. This condition in the second Era continued till triassic (period). In jurassic (period), the present limits of Anbarans anticline goes to under water which its result has been detrital and seashore depositions shemshak formation (calcareous sandstons and sandy limeston). They are placed on old sediments as discordant. Probably, this discordance is as a result of equivalent event of the former kimmerian (khodabandeh and Amini-Fazl,1997). Following of the equal pressure phase performance with posterior kimmerian, this sedimentary basin comes to up level at the end of Jurassic (period). During the upper Cretaceous (period), two different sedimentary basins are shaped or formed in the region one of them is Astara west basin which is indicative of detrital sediments in a row along with volcanic activity and the other is Namins west basin which is including the sediments often carbonate type and along with less volcanic activity.(Babakhani and Rahimzadeh,1988). During the third Era, the most part of this region is placed under the seas of the Era. But, sea depth is decreased from east o west with time. The oldest depositions of this Era are detrital type as pyroclastic depositions of Eocene about 2000 metres. After shaping of the edge heights of plain due to internal force performance, deep faults are created which formed the eastern slope of Baghrodaghs heights. Also, there are several linear structures in the west direction of plains that we can point to probable fault of Balikhlochai along Balikhlo river. With the appearance of Neogens sedimentary basin in the western south corner of the region, the detrition materials obtained from erosion of the surrounding heights were deposited in it(Babakhani & Rahimzadeh,1988) which increased folding of Miocene depositions and are formed the folds with south -north direction in it. Also, in some cases with the effect of faults performance are formed wells in them that Shorabil lake is its specific sample in the studied limits. So, following of these motions, the present physical figure of Ardabil plain and its near regions are shaped. A close basin has been created with ending of the volcanic activities from palaeogene (period) which is made due to tectonic activities in the pitted regions which its sediments often are mareni-sandstone along with volcanic regions, layers and mid - layers of chalk .Quaternary sediments are including basin alluviums, Ardabil plain deposition , alluvial terraces (on a slope) and porous calcareous rocks which are made in fresh water of the lake. Also, there are some of the volcanic stones of Sabalan at the west part of Ardabil plain which are including Conglomeral, lahar and volcanic ashes.

Ground water resources of Ardabil plain

Often, Ardabil plains ground water resources are hidden waters between alluvial sediments such as Qt_2 , Qt_1 which form the productive or rich aquifer of the region. Placing of heights such as a circle around the studies range from one side and the existence at alluvial plain as the lowest topography surface at the centre from other side are caused that general placing process of flood ways, ground water canals and rivers be from the heights to centre and north and then to the external side. Of course, increase in the number and amount of the resources discharge show irretrievable stress and tank loss applying during the recent years. Since, the most parts of the ground water in the studied region are supplied through wells, canals and springs. The most use of water resources has caused to ground water level decline and the consequences such as subsidence of ground level and qualitative decline in the region(table1). Also, the unite of geology with different and various lithology are in contact with each other due to the main

faults performance placed at heights and their resulting branch and it is not able to saving of water in the permeable unite with additional potential .

Total yearly discharge	Number all **Resource** water	canals		spring		well		water Resource
		discharge	number	discharge	number	discharge	number	year
284/42	4106	4/20	106	45/2	536	235/02	3464	1380
364/66	2712	1/89	32	3/75	49	341/02	2631	1387

Table (1) : Statistics of the ground waters during (2001- 2008), in Ardebil plain basin.

Hydrography of the plain's unit

In order to studying of the changes in ground water level of Ardabil plain was analyzed the height of water level in about 44 observable wells which monthly changes of ground water level in 44 wells have been drawned during October (1972) to September (2006) in the aquatic 30 years period. It is mentioned that according to the greatest amount of discharge component to supply, seasonal changes aren't observable in the ground waters level within studied wells (figure1).Using hydrography of Ardabil plain with downward movement during 30 years period (from October,1972 to September 2006), the average of yearly decline in the ground water movement level is equal with 1/7 metres. the downward movement or decreasing process of Ardabil plain hydrography wasn't as straight line and has the seasonal changes in ground water level. Almost, according to the downward movement of single hydrography under ground water level of the plain in October month (1972) was equal with 1336/51 meters which is with 9/76 meters decrease, so, it has reached to 1326/75 meters in September month (2006). Therefore, with considering of 5% coefficient and tysn area about 900 Km^2, tank volume changes measured about 540 Mm^2 (half detailed studies of Ardabil water office, 2009).

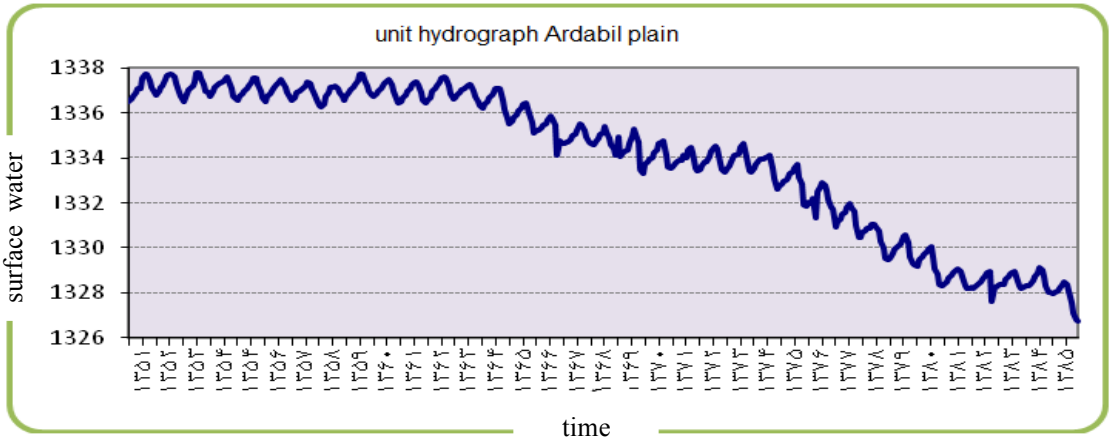


Figure 1 : unit thirty years hydrograph water table Ardabil plain **.**

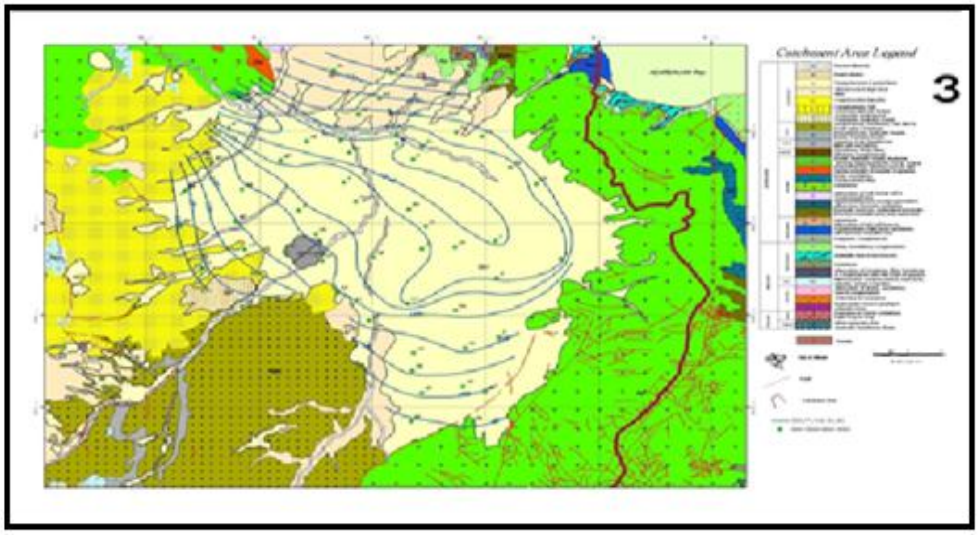
Ground waters qualitative studies

In order to the qualitative studies of Ardabil plains ground water, first of all, from about 44 wells with suitable intervals which are shown in figure (2) conducted sampling method. In table (2), analyzing results as sample from wells water have been shown which performed in June (2008) the parameters such as T, EC, PH were measured in place and after transfering of the samples to Lab, the ions $HCO3^-$, CL^-, Ca^{2+}, Mg^{2+}, to titration method, Na^+, K^+ ions with flame photometer and $SO4^{2-}$ with Turbid meter were determined. With statistical studying which performed over the chemical variables with the mentioned results in table (3). PH average of water is about 7/4 and it is

in the limits of the neutral waters. From acidity point, PH in the drinking water should not be less than 6/5 or more than 9/2. PH range or limit in 7 to 8/5 is desirable for drinking water (Alizadeh, 1999). Bicarbonate ion among anions has the greatest value about 5/1 M EQ /L^{-1} sodium (Na) and potassium (k) among cations show the greatest value about 6/9 M EQ /L^{-1}. Also, the salinity amount is introducer of the ground waters with 1200 MS/cm according to electric conduction .Which shows the remained day amount about 616 mg/l. Studying of the ground waters chemical compounds have near relation with dissolution of materials in the ground water. there are chloride sodium in 100 samples and calcium bicarbonate in 30% of samples. Also, total stiffness of the ground waters between 105 - 1175 mg/L in terms of calcium carbonate is changeable. According to total stiffness allowed limit is 500 mg/L.In practical, the waters with stiffness more than 200 arent desirable (Alizadeh,1999 & Todd David keith, 2005). There are all types and facies in the ground waters region with considering of the performed studies, but, bicarbonate type with sodic facies are included the greatest number about 60% the rest of type and fascies are sodic sulfate, manzic bicarbonate, calsic bicarbonate and choloro sodic, respectively.

Average	min	max	Variable
7.4	5.32	8.28	PH
5.1	2.1	11.3	Hco_3^- (me/l)
4.1	0.1	22	$SO4^{2-}$ (me/l)
3.5	0.3	15.5	CL^- (me/l)
3	0.6	10.4	Ca++ (me/l)
2.3	0.6	13.1	Mg^{++} (me/l)
6.9	0.6	20.2	$Na^+ + k^+$
1200	256	4390	EC
616	129	2 200	TDS (me/l)

Table 3 : Average and range of chemical variables



Map No. 2: Location of sampling points for chemical analysis (Babazade,1387)

Study of the ground waters quality from agriculture and drinking point of view

The existence of sodium and ground waters salinity risk (sodium absorption ratio and electric conduction ability) studied for evaluating of the waters from agriculture point of view which has the main role in the agriculture soils context changing, early fading and interruption in the plants growth (sedagat,1352). Their typical chemical analysis results were divided based on wilcoxs diagram from irrigation ability(figure2). According to the diagram about 29/1 % , 37/5 % , 25 % , 4/2 % of samples belong to S1C2, S1C3, S2C3, S2C4 and s3c3 classes respectively(Babazadeh, 2007). Generally, Ardabil ground waters haven't any limitation from agriculture point in a small area of the north - east part of this plain. But, it is medium in the half - east part and a small area of the western slopes and it is undesirable in the southern slopes which to middle - wards of the plain becomes good and in medium level. In order to studying of the waters from drinking uses, the typical chemical analysis results of the waters transfered on sholer Berkalf diagram (figure 3). In this diagram, the ground waters were distinguished to six classes or groups including good, acceptable, medium, unsuitable, full undesirable and not drinking which the ground waters of the half- east and half west of the plain are in the good level from the drinking capability and also their wrest situation were seen in the southern slopes. The rest points except for a limit region in the central part of the plain have desirable waters .

Conclusion and suggestions:

According to statistical researches of the water resources (2008), discharge volume through 2631 used wells (about 1579 deep well and 1052 half deep) is about 221/02 million meter cubic . In the following of the resulting volume from the water resources, there is constant decline in the ground water level instead of the seasonal supplied due to precipitations, flood flow and also returning of the agriculture water. It has been calculated based on 30 years period evalution (plain hydrography) and found that the decline amount is about 1/75 meters yearly. So, the tank loss is measured about 540 MMCUBIC. Also, with decline of the ground waters level is decreased from bicarbonate type and is increased to T- cholore amount . Therefore, the waters salt value in the direction of the ground waters flow toward to natural discharge and drainage places is increased, But, the salinity value is low and medium . For this reason, almost the ground water quality throughout of Ardabil plain even in the external regions is good relatively. In general, with considering of the plain lithology and supply or drainage and discharge of the water table, the best points for utilizing from water are eastern regions of Ardabil plain. In order to maintaining of the water table and avoiding of the bad and un stuitable quantitative and qualitative situation should be substituted utilizing management with the present management. In this case, are suggested suitable cultivation patterns with low need ecological conditions and also conducting of the irrigation methods with.

Table 2: Results of analysis of water samples from deep wells Bkhanh Ardabil 44 June 1387

Ca	Mg	Na	K	HCO3	SO 4	CL	TDS mg/l	EC	PH	%SAR	Number place	UTM y	UTM x	number
1.4	1	2.77	0.04	3.3	1.2	0.9	267	532	7.12	2.5287	pirami	4231640	272947	1
1.3	0.9	1.8		3	0.7	0.6	208	415	7.3	1.7162	Aghblagh mustafakhan	4238492	283397	2
1.3	0.9	2.16	0.04	3.2	1	0.5	228	455	7.38	2.0595	mrny	4236266	284677	3
1.3	1	2.1		3.7	0.1	0.8	225	449	7.48	1.9583	tpraqlv	4231220	276532	4
1.3	1.1	3.4		3.3	2.1	0.9	306	608	7.12	2.9583	yvnjalv	4234783	286004	5
2.8	1.5	7.29	0.11	3.9	4.2	3.9	594	1185	7.23	4.9717	ButcherTph	4236094	269965	6
3.3	1.6	14.02	0.08	5.3	7.6	6.4	960	1915	7.23	8.957	Sakhslv	4249662	272480	7
1.4	1	1.6		3.4		0.9	208	414	7.56	1.46.6	arkhazlv	4238317	278720	8
4	2.3	5.64	0.06	6.1	3.7	2.4	605	1211	7.29	3.1778	Aqchhknd	4249387	264080	9
5.3	3.6	14.02	0.08	5.4	10. 1	7.7	1160	2310	7.44	6.6461	anzabbala	4249387	266655	10
3	3.3	16.29	0.11	5.7	9.6	7.6	1128	2280	7.42	9.1784	yznBad	4253994	268276	11
3.8	2.6	10.12	0.08	5.1	5	6.7	840	1670	7.43	5.6573	dvltAbad	4251088	265711	12
3.8	1.4	8.7	0.1	5.6	5.1	3.5	706	1408	7.03	5.3955	anzabBala	4244719	264568	13
3.6	1.6	6.5	0.25	5.8	3.1	2.8	584	1165	7.5	4.0311	Shykhklkhvran	4221474	262662	14
1	0.7	2.1		3.7		0.4	200	397	7.83	2.2778	Chabrlvh	4220817	281236	15
3.9	2.1	5.3	0.1	6	3	2.6	577	1151	6.89	3.06	Samyan	4250287	259399	16
1.3	0.9	3.26	0.04	3.8	1.5	1	285	568	7.77	3.1083	qrhHsnlv	4236917	277219	17
2.11	0.9	8.04	0.06	5.8	0.6	5	565	1125	6.6	6.5537	Myrzarhmylv	4239518	277025	18
1	1.1		2.6	0.5	0.5	0.5	177	352	7.66	1.0258	qrhchnaq	4244214	283417	19
1.2	0.6	2.96	0.04	3.7	0.4	1	250	497	7.7	3.1201	Mhmvdbad	4237200	287401	20
2.1	1.3	3.84	0.06	4.4	2	1.2	375	748	7.65	2.9451	pthkhvr	4244214	280316	21
3.1	2.4	4.06	0.04	5.5	2.7	1.7	489	975	7.26	2.4483	Svla	4251400	279650	22
2.4	3.1	2.06		3.4	2.6	1.9	390	777	7.69	1.2422	Khankennedy	4251160	277225	23
1.3	0.6	2.7		3.6	0.9	0.3	239	477	7.61	2.7701	Krgan	4220470	279156	24
8.5	6.2	15.76	0.51	5.2	15. 2	11. 3	1560	3140	7.53	5.8242	gvrdal	4225118	268505	25
1.2	1.4	1.3		3.4		0.6	202	401	7.15	1.1402	Khlylbad	4226300	278342	26
1.5	1.7	4.62	0.08	4.9	1.5	1.8	404	801	7.72	3.6524	Nvshher	4219272	274058	27
2.5	1.7	3.96	0.04	4.8	1.7	1.9	417	831	7.23	2.7327	Nvjhdh	4248653	275131	28
1.4	1.4	3.1		3.9		2.3	306	609	7.84	2.62	gly	4245420	282570	29
2.8	2	10.12	0.08	8.7	0.6	6	759	1512	6.03	6.5324	Vyladrh	4226721	243887	30
3.2	4.1	11.39	0.11	5.8	7.7	5.6	952	898	7.87	5.9618	Sltanbad	4241776	268830	31
5.1	2.4	6.29	0.11	11.3	0.8	2.1	702	1400	6.65	3.2481	Nvran	4235446	254667	32

0.8	1.8	4.96	0.04	4.2	2.1	1.5	386	770	8.28	4.3502	Grhlar	4240808	272403	33
1.5	1.6	10.8		4		0.5	204	406	8.17	6.23	Shhryvr	4246242	254320	34
4	3.8	12.78	0.12	5.7	9.8	6.4	1110	2180	7.47	6.4714	kvzhtbzrg	4222397	269132	35
0.6	1.2	0.6		2.1		0.4	129	256	7.75	0.6325	doyael	4222875	281846	36
3.3	2.4	8.4	0.1	10	3	1.5	717	1432	6.77	4.9757	AaraloYBige	4224735	274360	37
10.4	13.1	17.7	2.5	5.3	22	15.5	2200	4390	7.16	5.1636	kmyabad	4229660	269065	38
1.2	1.6	1.4		3.3	0.2	1	221	440	7.86	1.1832	Shyk khalifalu	4237770	280824	39
1.6	1.8	5.44	0.06	5.4	0.9	2.9	452	901	8.14	4.1723	Lands East south Ardabil	4234800	275294	40
1.3	1.5	0.8		2.9	0.2	0.7	186	371	8.08	0.6761	AbyBigelow	4241134	286420	41
4.1	3.1	10.89	0.11	5.5	6.3	6.7	922	1838	7.12	5.7395	Nyar	4236150	266600	42
2.8	1.1	3.36	0.04	5	0.9	1.7	374	745	7.8	2.4061	Grijan	4245591	257143	43
1.5	0.6	2.1		3.5	0.1	0.7	211	421	8.04	2.0494	Grh Hill	4236723	279250	44

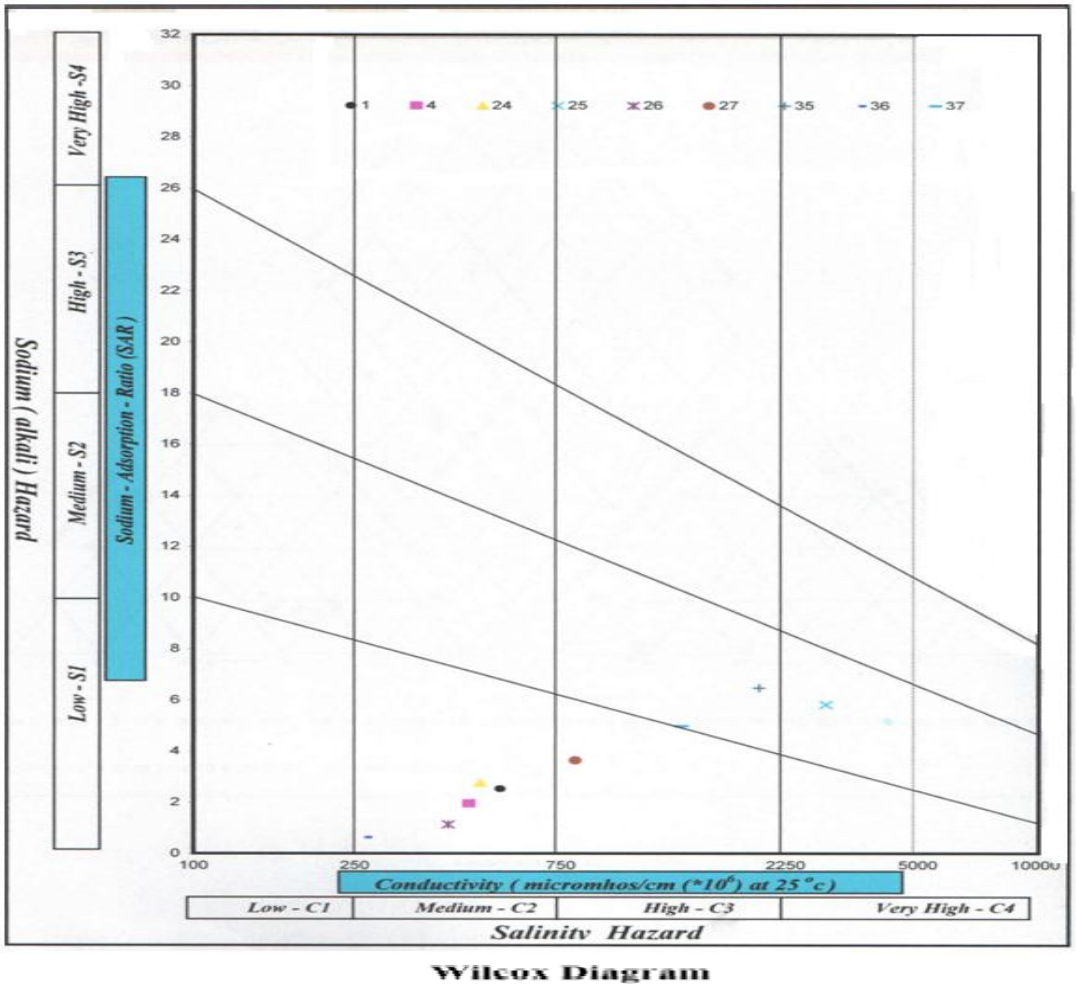


Figure 2 : Diagram of Ardabil plain categories of drinking water and agriculture (Figure WILCOX)

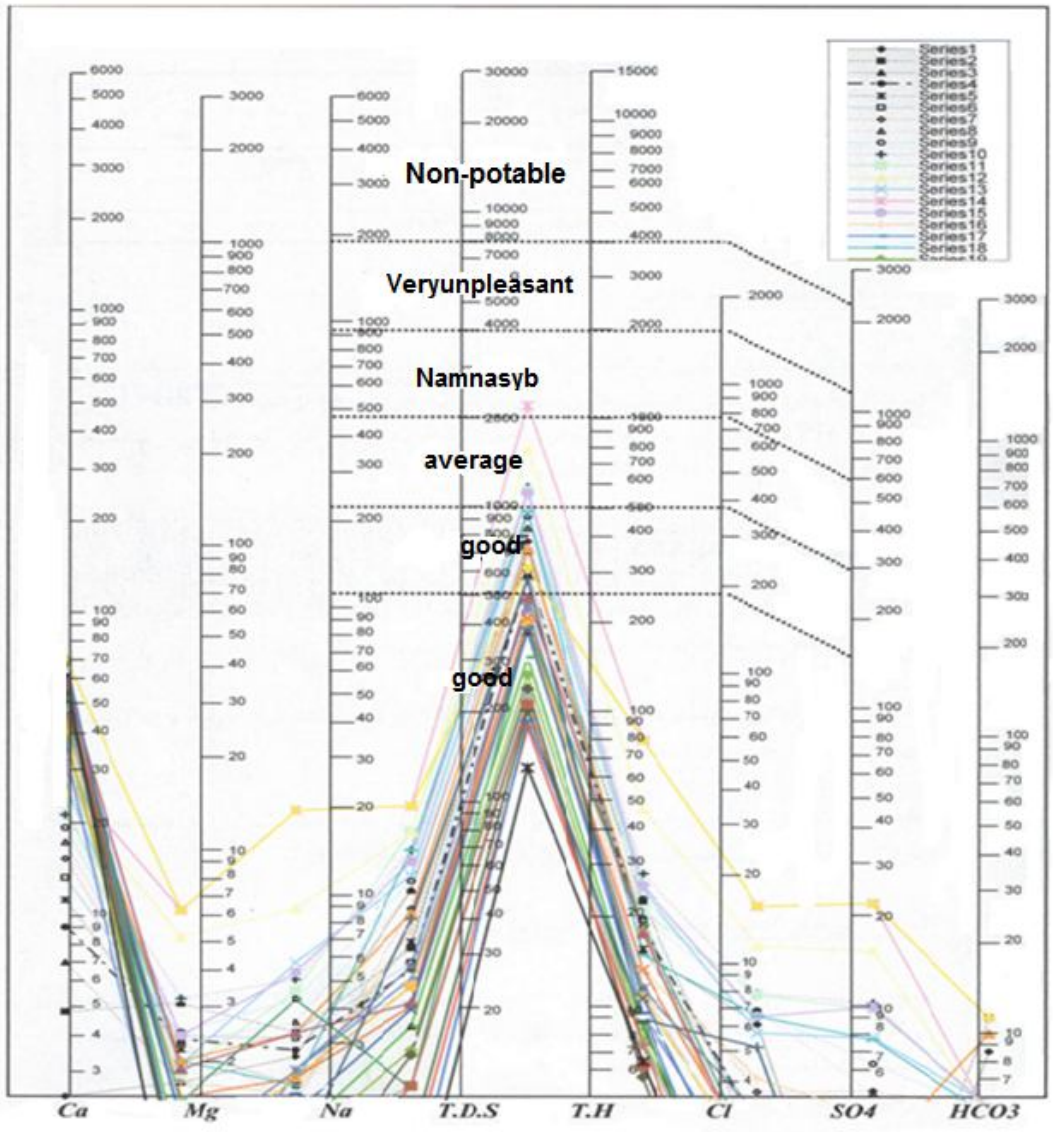


Figure 3: Graph logarithmic division of Ardebil plain drinking water (Figure Schuler)

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