Journal of Multidisciplinary Engineering Science Studies (JMESS)
ISSN: 2458-925X
Vol. 2 Issue 10, October - 2016

Evaluation of Mianeh Aquifer hydro geochemical aspects of agriculture, industry and drinking

Gholamreza ahmadzadeh
Department of geology, faculty of basic science, university of Mohaghegh Ardabili, Ardabil, Iran .
Email Adress: gholamrezaahmadzadeh@yahoo.com

***Abstract*— Mianeh plain is one of the Mianeh – Hashtrud study region that located in east part of this region. Mianeh aquifer restricted by Germichai river from North, Aidoghmush and Shahrchai from West and gezeluzan river from South and this aquifer created by sedimentation of these rivers. This region from geologically and structurally aspects located in Alborz – Azarbaijan zone and contain different rock units from Paleozoic to Quaternary age. From climatology aspects this region falls in the semi-arid area on the base of Domartin classification. Water of this aquifer have sodic and classic caloric composition because of effects of geological, climatologically, hydrological and chemical composition of geological formation. From the view point of drinking, industry, and agriculture consumption the water of western region including Hesar village and industrial city and north including Galan Gedar and Sabz villages is in the worst form. The water of aqifer in the recharge region at northern part of the aquifer is somehow acceptable and drinking, industrial, and agriculture usages are possible.**

Keywords—Mianeh, Aquifer, Quality, Agriculture. Industry

I introduction:

Fresh water resources in most countries reduced in the effect of population increase, weather changes, weak management of operation, and increase of probable pollutions. Based on recent estimations, about half of people around the world will have problem in supplying water in the future. So it is necessary that in these countries a stable and fundamental development occur an in the field of improvement and development of water part (management of water supplying) and effective use of underground water resources (demand management).

Our country, Iran, considered as arid and semi-arid regions and in such regions, water is the most limit of agriculture. In these regions, due to the shortage of surface flows and precipitation, high operation is performed from underground water. Nonconformity of technical notes in operation of underground water and very much use of them, drop the level of underground water in several areas [1,2]. The intensity of the drop of water table level and increase of its salinity, in different areas and years, differs due to the amount of nutrition of water table, the amount of use and the thickness of layer of fresh water.

Therefore, consideration of the process of these changes has special importance due to the environment protection and agriculture continuity [3]. Mianeh plain due to the situation of Hydrograph that is presentation of its aquifer and more negative process from underground water is not excluded from this principle and it`s necessary to be controlled in the case of underground water quality. It should be mentioned that the quality of underground water in system depends to the quality of nutritional resources extensively [4].

The limit study of Mianeh-Hashtrud is one of the 11 study limits of second-rate area of great SefidRoud with code of 1303 and has the space of 9234 square kilometers that composed of 8090 square kilometer heights and 154 square kilometers plain.

This study limit, from place situation, restricts to study limit of Sarab and Bostan Abad (of study limits of aquifer area of Uromieh lake), Tarom- KhalKhal from east (limits of aquifer area of SefidRoud), MiandoAb and Saein Ghaleh from west (study limits of aquifer area of Uroumieh lake) and MahNeshan-Angouran from south (study limits of SefidRoud). Study limit of Mianeh-Hastrud consists of Mianeh plain, Turk, Avenliq, Turkmenchay, Hashtrud and Maghamir in which Mianeh plain is located in southeastern part of Tabriz with extent of 60.47 square kilometers and geographical peculiarities (U.T.M) of 735000 to 750000 east and 4135000 to 4150000 north (figure 1).

Study limit of Mianeh-Hashtrud considered as part of Alborz-Azerbaijan geological structure. This region is connected from north to Alborz mountains, south to Zagros mountains and from east to Iran central plateau. Stone parts of this region is related to current and Paleozoic to Cenozoic era. of first builders of first era (Paleozoic), we can indicate to Soltanieh builders, Barrout, Lalon, Mila and Ahak Routeh that in mentioned era generally calcic-dolomite and Maronite-Chile units have settled. During Mesozoic era generally calcic and harmful sediments have settled in study limit. Of builders related to this era are builders

of Shemshak, Delijay and conglomerate-calcic unit of Upper Cretaceous. In early of Cenozoic era generally pyroclastic sediments settled that in direction to quaternary converted to

evaporative-harmful sediments. In Mianeh region, due to the seasonal atmospheric raining that is more than surface saving and penetration speed, surplus of it flows as surface stream or runoff on the ground surface. And it forms different lakes like Aydughmush, Shahar Chay and Qaranqu in this region.

Existence of evaporating units in different sections of area and chalky layers in Maronite units caused changes in the quality of area water. Also because of establishment of Shahriar dam in this region for developing agriculture, consideration of quality of area water is necessary. Hence determination of quality and type of water of aquifer for human and animal drinking, irrigation and industrial use are the purpose of this research. So from samples of observational wells water that during excavation sampling were done from them and values were analyzed and measured including electric guide (EC), PH, main Anions and Cations, Hardness and arid residual (T.D.S) used in this research and study.

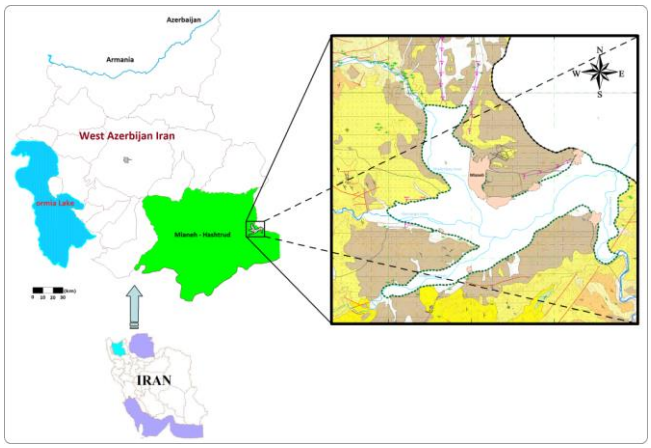

Figure 1: geographical situation of studied area

II materials and approaches:

To consider quality of underground water resources, due to the lack of any qualitative sampling from underground water resource like well, fountain and aqueduct, so the results of chemical analysis of observational wells that sampling were done from them during excavation are used. Table 1 shows chemical analysis of observational wells of Mianeh plain in 1386. In figure 2, situation and number of performed samples are depicted.

Also due to the lack of watery resource in southern parts of plain because of use of surface water resources, information of five points in chemical analysis of Sodium and Potassium ions with flame photo meter device, sulfate with spectrophotometer device, other cations and anions and total dissolved solids, total hardness, general salinity and ratio of sodium absorbent have determined with titration. these measures are done in laboratory of eastern Azerbaijan regional water co. Finally, for determination of water quality for human drinking, we use Shouler chart [5], capability of agriculture use, Wilcox chart (Wilcox, 1995) and the type of area water, Piper combined chart [6].

Table 1: results of full chemical analysis of main elements of observational wells of Mianeh plain

diff	X	Y	Location	Depth	EC	TDS	PH	K	Na	Mg	Ca	Sam Catyons	SO4	Cl	Hco3	CO3	Sam Anyons	Na %	SAR	Hardnes
1	741698	4142982	Honarestan	24	1600	1025	7	0	4	3	8	15.9	4	5	6.7	0	15.9	25	1.6	590
2	738744	4142356	Shahrak	25.5	3420	2219	7	0	17	7	9	34	5	22	6.8	0	34	51	6.1	820
3	738686	4145958	Tazekand	41	1120	824	7	0	2	3	6	11.2	3	1	7	0	11.2	24	1.3	۳۴۲۶
4	744367	4144542	Galangedar	50	5990	3906	7	0	42	7	11	59.8	18	31	11	0	59.9	71	14	870
5	746326	4145455	Sabz	41	4720	3758	7	0	24	16	19	58.6	28	23	8.3	0	58.5	41	5.8	1720
6	740720	4145447	Terminal	24	1890	1136	7	0	4	3	9	16.4	4	5	6.6	0	16	27	1.7	610
7	737261	4143119	Hesar	85	3840	2359	8	0	26	6	6	38.4	5	28	5.4	0	38.4	67	10	630

For determination of quantitative situation of plain, by using seven wells, observation of reference hydrograph of Mianeh aquifer were prepared from Farvardin of water year 83-84 to water year of Shahrivar 87-88. Figure 3 shows aquifer reference hydrograph and average values of monthly average raining of plain from Farvardin of water year 83-84 to Shahrivar watery year 87-88. As it is observed from this figure, balance of underground water of Mianeh aquifer from water year 83-84 to water year of 86-87 has considerable drop descending process that according to hydrograph from Farvardin of water year 83-84 to Shahrivar of 87-88, underground water balance dropped about 4.23 m that shows the reduction of atmospheric precipitation and more operation from aquifer in mentioned water year. It resulted to higher value of discharge rather than nutrition value in the aquifer and negatives underground water balance of the region.

It should be noted that except water year of 85-86 that amount of nutrition is more than discharge in other water years the balance is negative. Also according to figure 3, balance of underground water of Mianeh aquifer in water year of 87-88 shows considerable drop of 1.02 m. it shows high changes of water surface of aquifer in operation season from aquifer of Mianeh plain.

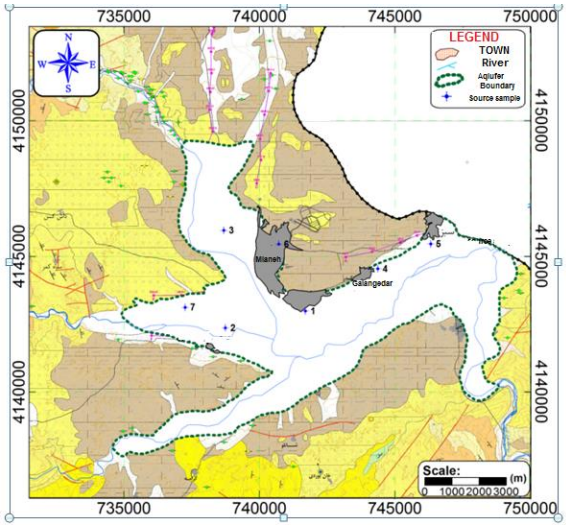

Figure2: location of sampled resources

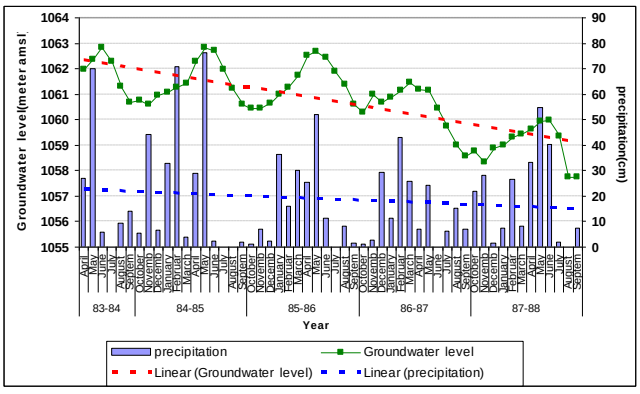

Figure 3: aquifer reference hydrograph and annual raining amount of Mianeh plain from water year of 83-84 to 87-88

Generally, allowed excessive operation from underground water table caused intense drop in underground water level and as a result quality of underground water is reduced. So the quality of underground water of plain aquifer should be considered. Also due to the limitations of using surface water like frequent inaccessibility especially in drought days, improper quality of some of region lakes etc. the need of region to underground water for drinking, industry and agriculture existed more than ever. It should be noted that almost 100 percent of area drinkable water is supplied from underground water resources.

III Results and discussion:

1 water type of aquifer

The amounts of carbonate and bicarbonate in the water are more than other anions because of freshness of water in nutritional places generally. And from water cations, calcium or magnesium amounts are more than other cations of water. Therefore, underground water type in such places is bi-carbonate or carbonate of calcic or magnesium. Water in its flow resolves some parts of ground materials in itself. As a result, by getting away from the nutritional place of aquifer it is added to amount of water salts and anions sulfate is increased. Underground water type, in the end of the flow route of underground water and in external parts of aquifer because of increase of chlorinated salts, it tends to chlorination.

These changes have occurred during motion of water from nutritional regions to depletion areas [7]. It is obvious that the existence of elements like chalk and salt in biological builders around plain and/or in the floor stone of aquifer could be caused sudden changes in chemical complex of aquifer and disrupted general process of changes of water type.

Figure 4 shows piper diagram of observational wells in Mianeh plan, according to it:

Observational wells that are related to northeast regions and north of the plain include areas of green village of Mianeh city are the type of Calcium- Sodium Chloride. In region of Tazeh Kond it is the type of Calcium-Sodium Bicarbonate.

Observational wells that are related to part of northeast regions and west of the plain and consist of Hesar village, industrial zone and Gelen Gedder village are the type of Sodium-Calcium Chloride.

To consider quantitatively the values of main cations and anions of underground water of Mianeh plain, star diagram also is used (figure 5). These diagrams depicted by help of chemical analysis results of samples of observational wells and showed that type of their water. According to depicted diagrams, type pf water of north regions of plain is calcic-bicarbonate but quality of water of west regions and some parts of northeast regions include gelen geder are chlorination based on the star diagram. To consider changes of water cations and anions of Mianeh aquifer, the map of type of aquifer water is provided by using results of chemical analysis of used water samples (figure 6). This map shows that type of water in north and center parts of aquifer is calcic-bicarbonate. Aquifer water in parts of west, a northeastern part (Gelen geder) and south of aquifer are sodic

chlorinated and in a part of northeastern regions around green village, the type of water is sulfate.

It should be noted that because of lack of underground water resources in southern part of Mianeh plain, it was impossible to sample. So for southern regions, in preparation of map of type, we used information of water surface of rivers of qaranqu and Aidoughmoush that in intersection its type is intensively chloride.

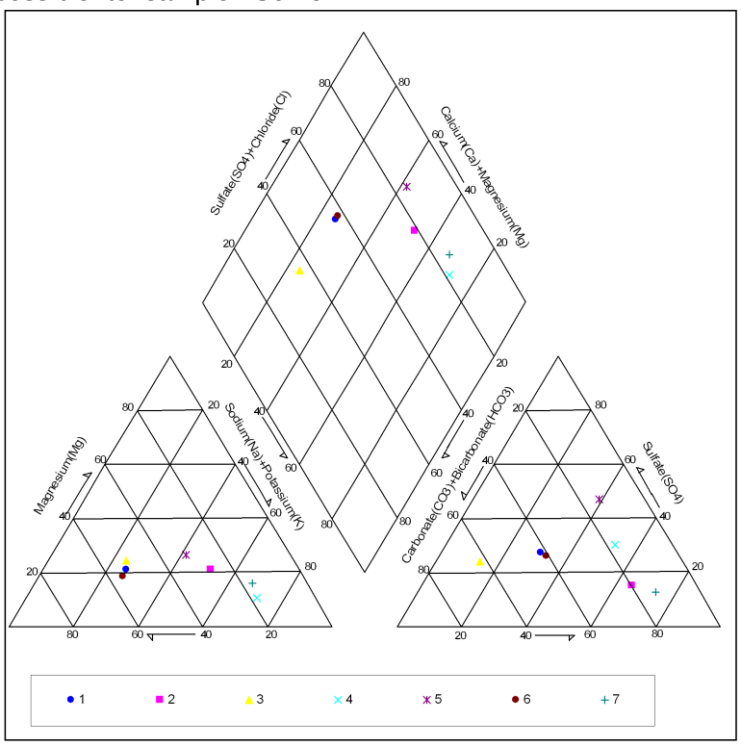

Figure 4: chemical analysis presentation of observational wells of Mianeh plain by using piper diagram

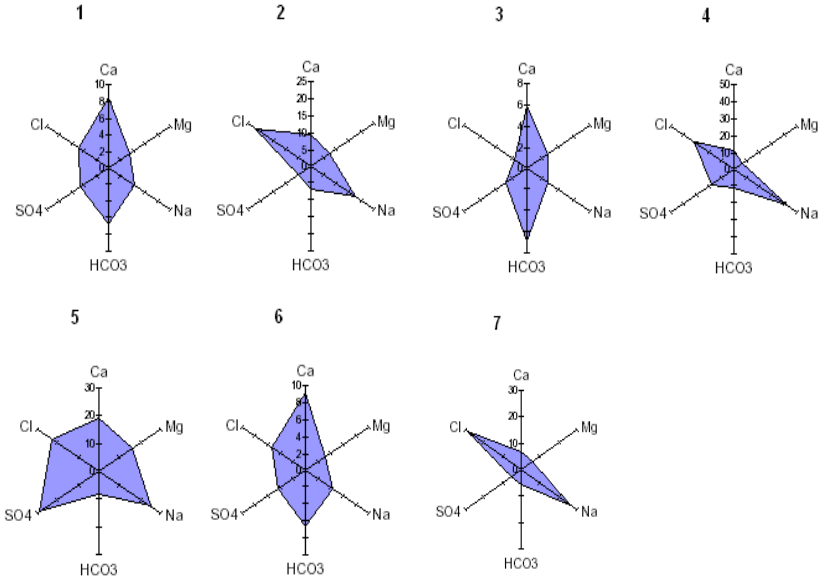

Figure 5: chemical analysis presentation of observational wells of Mianeh plain by star diagram

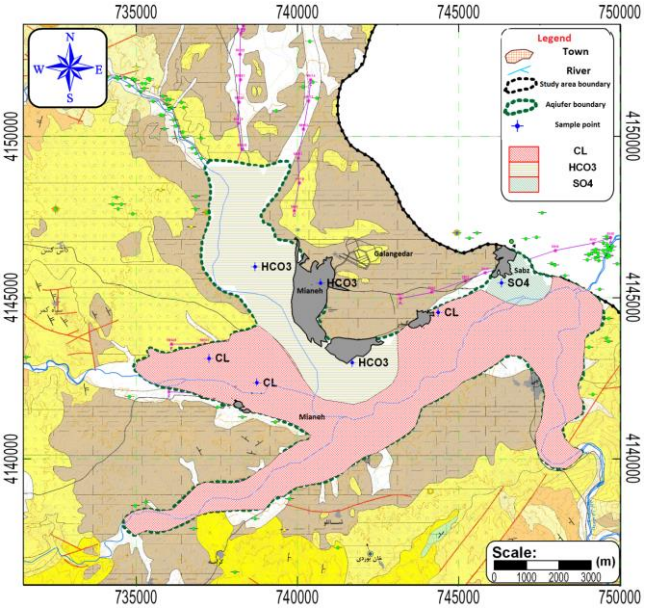

Figure 6: underground water type of aquifer of Mianeh plain

2 classification for drinking consumption

Shouler diagram [5] is especially important due to the logarithm scale, speed, easy of comparison and presentation of several numbers of sample in one diagram and presentation of density of ions (milligram) [6].

Figure 7A shows the diagram of Shouler on the basis of standard of Iran drinkable water for water of observational wells of Mianeh plain. Based on diagram of Shouler, water of aquifer in north regions in which is the place of nutrition of aquifer has acceptable to average limit and water of western regions include Hesar village and industrial zone and northern areas of Gelen geder and green are in improper level.

3 classification for irrigation purposes (agriculture)

The amount of sodium and existing salts in water are the most important quality criterions in classification of water for agriculture [8] because these two factors affect the growth of plant and proportionality degree of water from irrigation and its effect on permeability of soil [9,10]. For example, available sodium in salty water and calcium ion in water replace each other and as a result reduce permeability and aeration of soil and decrease the growth of plant [11]. For this purpose, for classification of water of studied area, we have used Wilcox chart [12] (figure 7 B).

In this diagram, values of electric guide and SAR of performed samples from observational wells are used and results are as follows:

Depicted diagram for sample of water of observational wells indicates that underground water of northern regions of plain like Mianeh environs, Tazekond village is in the C3-S1 type and suitable for agricultural usages. Also underground water of regions of northeast, west and east of aquifer are in types of C4-S4, C4-S3 andC4-S2 which are not suitable for agricultural usages and damage all agricultural lands and products.

Figure 8 is prepared for local consideration of aquifer water from agricultural point of view. As it is observed from the figure,northern parts of aquifer are somehow suitable for agricultural usages (C3-S1 class) and water of other areas of aquifer are not beneficial for agriculture and have high salty risk. These regions consist of villages of Gelen geder, green, Hesar and industrial zone (C4-S4, C4-S3, C4-S2 classes). So in these regions for high operation we can use following products [13]:

a) wheat and barley: it is an industrial product and its water need is compatible highly with water regime of rivers and region raining. Due to the growth season of wheat and barley, water need of them is lower than spring season.

b) cotton: it`s considered as industrial product and tolerates electric guide (EC) about 7700 m/cm in soil environment. So special tolerance of this plant rather than salinity of soil and water is the probability of growth of this plant in this region.

c) alfalfa: it has tolerance of drought short periods and if its cultivation develops, alfalfa will supply high necessity of feed of region farmers.

d) pistachio: due to the climate condition and governing condition on water of soil of region, it also tolerates dry of region and salinity of water and soil. So cultivation of this product is so important from economical point of view.

e). cumin: it is considered as economic product and resists against drought and due to the short growth season, raining regime and discharge of region rivers, this product is also compatible with region condition.

4 classification from industrial consumption point of view:

Specifications of types of water that used in industry are different based on the kind of industry. For example, the clearest physically and chemically water is necessary for pharmacy and paper-making industries while in cases like mineral industries the matter considered fewer [11]. In industrial usages of

water, hardness level and its reactional environment are critical [14].

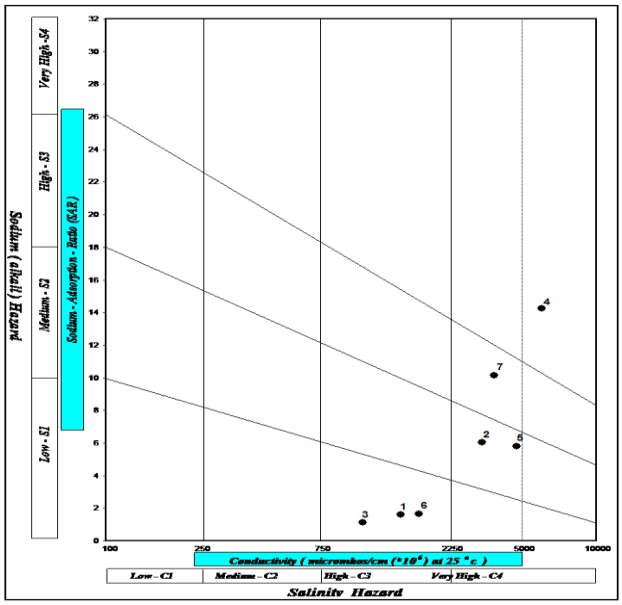

Figure 7: presentation of chemical analysis of observational wells of Mianeh plain by A: Shouler diagram B: Wilcox diagram

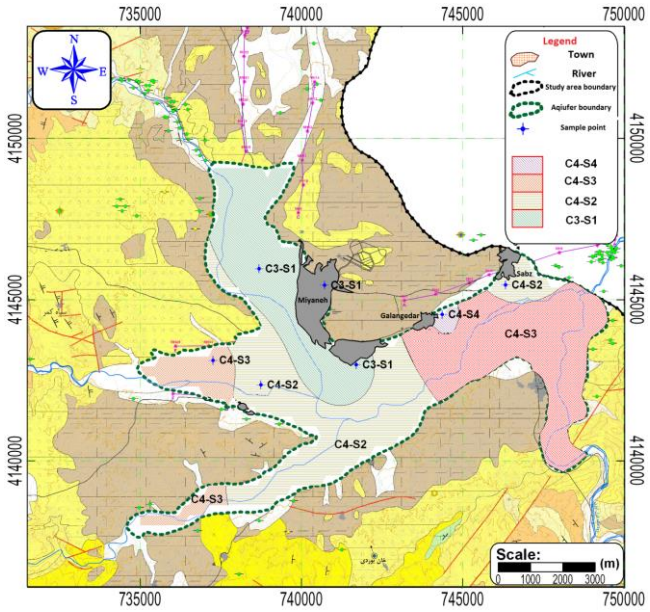

Figure 8: location consideration of water of Mianeh from agricultural point of view

5 effective factors in increase of salts of regional water of Mianeh

Combination and density of existing salts in water are the result of the effect of different factors. These factors are as following:

a) geological factors

By coming down of rain water and formation of surface water, at first dissolved salt is low in this water. But its contact with sediments and different stones increase its salts (Moghimi, 1385:75). Maronite, Chile, evaporative and sandstone builders have high development in almost all regions of area especially western, southern and central parts. So major of water passes from these builders and finally pour to rivers of Ajichay, Ayidoghamoush, qaranqu and Ghazal.

Due to the fact that in evaporative builders, Maronite and Chile the amount of sodium ion (Na) with capability of breakup and displacement (2.5 %) and Chlorine with capability of breakup and displacement (100 %) as Chlorine sodium are very high [14]. Therefore, the existence of this lithology caused increase of sodium and chlorine ions, so water of this region are the kinds of Chlorine and sodic. Also existence of evaporative minerals in evaporative, Maronite and Chile units of region caused increase in the amount of dissolved solid materials.

b) climate factor and geographical situation

Geographical situation and climate condition have high impact on the quality of water resources [11]. Water of arid and semi-arid regions have higher amount of salts [11]. Inappropriateness of climate situation of Mianeh region like low raining, high temperature and intense of evaporation rise degree of density of salts so due to the semi-arid region, conditions are ready for increase of density of salts.

c) Hydrology factor:

Quality of water resources of nutritional region changed after passing from different stones and sediments to depletion region [11]. Whatever passed distance is more, water attracts higher salts because of contact with sediments. On the other hand, grading sediments down of plain is usually finer and speed of water motion became slower and caused that time of water contact with sediments increased. As a result, the amount of dissolved materials in water also increased. For this reason, in Mianeh region because of vast area and long distance of rivers that especially because of locating general part of area in Maineh plain which caused shrinking of seeds and increase of time of river water contact with area sediments, water of region generally has higher salts.

Results:

According to performed studies in Mianeh region, low raining and high thermal level caused that studied area considered as semi-arid regions. Quality of underground water of aquifer of Mianeh is affected totally by Shahrchay, qaranqu and Aydughamoush rivers. Quality of underground water in flow route of rivers from source to Mianeh plain that is in fact the point of intersection of rivers and exit form study area, decreases with the effect of passing point of rivers and damages. This case is obvious in rivers of qaranqu and aydughamoush but quality of underground water of Sharhchay is beneficial and its reason may be lack of any harmful formations of water quality in its flow route from source. Suitable quality of underground water of Shahrchay valley affects quality of aydoughamoush and qaranqu valleys water and also qualitative process of entrance water from western and southwestern sections and caused

improvement of underground water quality of all area in middle parts of plain. In the following, underground water flow pours to eastern regions (depletion areas) and underground water quality decreased.

In areas that water is not proper for drinking, industry and agriculture, we can grow resistant and halophytes like wheat and barley, pistachio, cumin, alfalfa and cotton in this region. Also it is suggested that to consider qualitative changes of underground water in long-term period, some resources of underground water selected as water resources of qualitative witness and sampling were performed from them annually and their chemical analysis results considered to monitor the qualitative changes of it due to the increasing operation of underground water resources in mentioned plain.

References:

[1] Adesuyi, J. O. Internatinal aquifer system in arid zones-managing non-renewable resources, Pre-proceeding, Tripoli, Libya, 1999. P: 20-40.

[2] Charalambous, C. N. Water management under drought conditions, Desalination, 2001.138: p. 3-6.

[3] Zinck, J. A., And Farshad, A. 1995. Issues of sustainability and sustainable land management, Can, J. Soil Sci, Vol. 75, pp. 404-412.

[4] Nash, H., and McCall, G. J. H. Groundwater Quality. Chapman & Hall, London, 1994. 203 pp.

[5] Schoeller, H. Les eaux souterraines. Masson & Cie. Paris, 1962. 642 pp.

[6] Sedagat M. Land and water research. Payame Noor University Publication. 2003. 368pp.

[7] Freeze, R. A., and Cheery, J. A. Groundwater. Prentice-Hall, Inc.,Englewood Cliffs, N. J. 1979. 07632,U.S.A., 604 pp.

[8] Alizadeh A. principles applied hydrology. Seventh edition. Godse Razavi publication. 2004. p: 776.

[9] Dazy, J., Drogue, C., Harmanidis, P., And Darlet, C. The inflows on chemical composition of groundwater in small island: The example of the Cyclades,(Greece), Environ. 1997,Vol. 31, pp. 133-141.

[10] Neilson-Welch, L., Saline water intrusion from Fraser River estuary: A hydrogeological investigation using field chemical data and a density-dependent groundwater flow model: M.S Thesis, Univ. of British Columbia. 1999.

[11] Mogimi H. Hidrogeochemistry. Payame Noor University Publication. 2005.Pp:213.

[12] Wilcox, L. W. Classification and use of irrigation water, U.S.Department, Agri.Circular, 1995. 969 p.

[13] Pursoltani M, Harami R. Hydrological study of Sangerd plain at Sabzevar. Journal of applied Geology. 2007. No 2. p 11-18.

[14] Kardovani P. Water research. Nashre gomes publication. 1992.Pp:286.