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Ground Water Resources Management (Case Study: Khuzestan Province)

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Abstract: Monitoring of water resources operation in Khuzestan Province, southwest Iran, is of high priority due to extent and unique water resources distribution. This paper, therefore, focuses upon determination of authorized and unauthorized uptakes of ground water resources and the water quality assessment including pH and EC values for drinking, agricultural and industrial purposes. The evaluation of ground water resources status and examining the existing drawings of the region, field inspections, statistics and sampling within a one-year period in Shushtar, Safiabad and Shush areas were carried out. The results indicated that across the study region with an area of 15,529 km², 6,000 ground and surface water resources exist while 5246 of which are ground water resources. According to the statistics, from 5246 existing wells, 3893 wells have been drilled legally while 1353 wells have been drilled illegally. From inspected and sampled wells, 154 wells were overused totaling to 214,556,630 m³. The largest water uptakes were found in Mianab with 32 wells and a total capacity of 10,845,384 m³ while the lowest water use occurred in Chananeh with 6 wells amounting to totally 235,980 m³. As per results of sampling, the comparison of mean EC values obtained with standard values revealed that EC values for Abdolkhan, Chananeh, Sorkheh and Dimcheh areas were 2458.3, 2387.8, 2263.8 and 2539 µmhos/cm that exceed the standard values while EC values of other areas were within standard range. Also, based on Schouler classification for agriculture, the obtained EC values are classified as C3 and C4 while pH values were all in allowable ranges. The examination of pH values for agricultural and drinking water showed that all the values obtained, according to Schouler classification, was also acceptable.

Key words: Groundwater resources · Authorized wells · Unauthorized wells · pH · EC · Standard · Schouler classification

INTRODUCTION

Continuation of life depend on essence of water, clean and salubrious water has great important for human. Water sources preservation is necessary for favorite access to this sources. Rainfall reduction declining underwater levels and irregular taking of these limit sources cause for decreasing discharge, Penetrating saltwater into water source and changing water quality. Groundwater are being supplied directly or indirectly by surface waters and rainfalls. Thus, implication of permanent use of these sources is their less takings. In recent years, most countries takings of ground water sources are in excess of the sources supply. Its mean, exploiting and using of water sources which stored in ground water sources during thousands years. By this work groundwater levels will reach to a point that no water will be for exploitation. Ground water levels downfall, mean downstream areas drought and destruction of water wells, kariz and its sources. In 2009 Chine, India and Iran have first to third ranks in excessive draw groundwater sources out [1]. Iran has 6 main watershed and 31 secondary watershed, average range of rainfall at different regions of Iran is between 2000 mm in Talesh until less than 51 mm in Kavir desert. One third of country's 611 Plains face to negative water balance and totally have six milliards cube meters declining in water storage. To prevent this event, Power Ministry has performed water reservoirs balancing project in fourth development program which retrieve 25 % of water reservoirs shortages during every program [2]. Khuzestan province has enjoyed of having rich water sources and soil and always, from old era was observed as industrial and agricultural important pole by statuses and scheme

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designers for development affair. By regard to Khuzestan vast plains and water sources scattering, supervision of these resources is very important. Of water supply methods can mention to groundwater sheet, water well, source, kariz and surface waters. at this study taken water of groundwater sources is being consumed for agricultural applications (greenhouse, green places and agriculture), drinking (drinking and hygiene), industrial (industry, services and Animal husbandry) [3].

MATERIALS AND METHODS

Khuzestan province area is 63213 square kilometers that, sitated at southwest of Iran. Study region with regard to map and table 1, include parts of Khuzestan province which located at 28, 24,31 up to 49,59,32 latitude and 31,42,47, up to 11,18 longitude.

This research is performed during one year and in several sections. at the first by extensive library and internet information about water resources were collected, then basic, maps of water sources were provided via survey organization and Khuzestan province water and power organization. Through statistics of water resources taking methods type mean allowed or unallowed exploitations were recognized were identified follow of it taking value and usage and additional taking of allowed wells were specified, after that studied regions were compared with each other, finally obtained results were presented in graph and table forms. At next section water sampling at under study areas were done monthly, for determining EC, PH and well's depth. Obtained results of EC and PH were compared with favorite and allowed standard values for agricultural and drinking applications and related tables and graphs were prepared. Results were specified by regarding schouler classes for drinking and agricultural waters and the results were classified according with EC and PH and water capability were specified for drinking and agriculture.

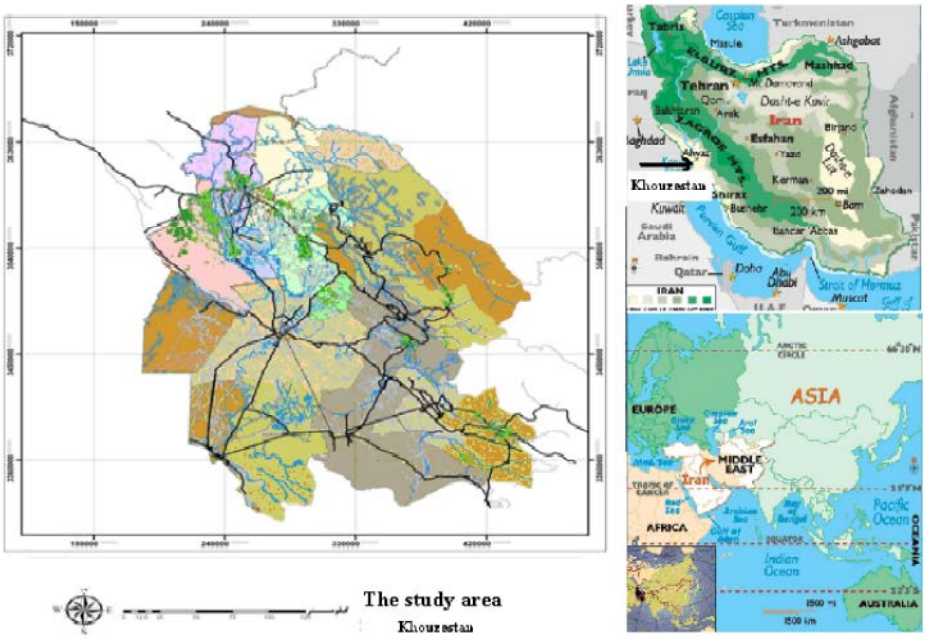

Fig. 1: The study region

Table 1: under study regions specifications for surface and groundwater sources identification

Covered Plains	Water Resources	The approximate area covered *(km²)*
Avan-Chnaneh-Khasraj-Azadaegan plain-esternAbbas plain	1120	3839
Shoosh-Haft tapeh-Abdolkhan-Khovais	650	2036
Andimeshk-Western Dez	650	2600
Eastern Dez-Sabz Ab-Sarbishe	600	3086
Gotvand Aghili-Dimcheh-Shoeybiyeh	730	2302
Miyan ab Shoushtar	1000	867
Kharan plain-North of Ahvaz	1250	790
sum	6000	15520

RESULTS AND DISCUSSION

Part A: According with the well's statistics which showed at table 2 and figure 2, 5246 statistics were taken, 3893 rings were dug with permission and 1353 rings were dug without permission. maximum allowed wells were on Dezfoul-Andimeshk region with 893 rings and minimum relate to Dimcheh plain with 137 digging Wells's rings. Also, maximum unpermitted digging wells related to Gotvand-aghili region with 576 well's rings and minimum statistics related to Shoosh-Haft tapeh region with 44 well's rings.

As showed at table and figure number 3, allowed wells have 21455630 cube meters additional taking which, of these numbers, maximum refers to Miyan ab with 32 ring wells and 108453384 cube meters additional taking and minimum refers to Chananeh with 6 ring wells and 235980 cube meters additional taking.

Also, by studying depth of water wells based on figure 4, maximum average of depth relates to Sorkheh Shoosh plain with 95.5 meters and minimum depth relates to Miyan ab plain with 10.93 meters depth.

Part B: Sampling has performed monthly and for every sample EC and PH were measured and after sampling results average appointment, obtained numbers were compared with Iranian approved standards, which presented at table number 4:

Based on graph number 5 which is explanatory of obtained EC from studied regions comparing with Iranian approved standard for allowed values and favorite for agricultural uses show that regions of Abdolkhan, Chananeh, Sorkheh and Dimcheh have (2458.3, 2387.8, 2263 and 2539) microzimens EC With respect, the mentioned regions are more than allowed standard and other regions waters have EC allowed standard.

According with below table and for schouler classification base on EC for agriculture, Sorkheh, Chananeh and Abdolkhan regions are classified in C4 class and other regions are set in C3 class.

Based on graph number 6 which is explanatory of obtained EC from studied regions comparing with Iranian approved standard for allowed values and favorite for drinking uses show that all regions have numbers

Table 2: Allowed and not allowed water wells

Areas	Authorized Wells	Unauthorized Wells	Total Wells Drilled
Sorkhe Shosh plain	235	108	343
Chananeh plain	243	168	411
Abdolkhan-Khovays	159	83	242
Shosh-Haft tapeh plain	749	44	793
Dezfoul-Andimeshk plain	893	339	1232
Dimcheh plain	137	92	229
Gotvand aghili plain	171	576	747
Miyan Ab plain	546	208	754
Kharan plain-North of Ahvaz	355	140	495
SUM	3893	1353	5246

Table 3: Allowed wells with additional taking

Areas	Number of wells authorized overdraft	Volume of overdraft
Gotvand aghili plain	16	2604023
Miyan Ab plain	32	10845384
Dimcheh plain	2	258552
Sorkhe Shosh plain	6	1007964
Chananeh plain	6	235980
Shosh-Haft tapeh plain	1	241920
Abdolkhan-Khovays	8	462708
Dezfoul-Andimeshk plain	83	5799099
SUM	154	21455630

Table 4: EC and PH average values obtained from water wells

EC standard Allowed limit for agriculture	EC standard Favorite limit for agriculture	EC standard Allowed limit for drinking	EC standard Favorite limit for drinking	PH standard Allowed limit for agriculture	PH standard Favorite limit for agriculture	PH standard Allowed limit for drinking	PH standard Favorite limit for drinking
2000	500	2000	1500	8	7	6.6-9.2	7-8.5

✝Standard favorite limit: maximum value which less than it cause for decrease quality and water is proper only for drinking

✝Maximum allowed standard: maximum value of salts density in water which its continuously drinking has not dangerous for healthy of a person (75 kilograms) with 2.5 liters daily consuming.

Table 5: EC and PH standard values for drinking and agriculture

Areas	average well depth	EC Average for drinking	EC average for agriculture	EC Average for industry	PH average for drinking	PH average for agriculture	PH average for industry
Sorkhe Shosh plain	95/5	750	2263	840	8	7/15	7/3
Chananeh plain	62/86	5155	2387/8	2750	7/8	7/6	8/7
Abdolkhan-Khovays	68/41	1568	2458/3	5352	7/8	7/7	7/4
Shosh-Haft tapeh	41/7	894	1496	1224	7/9	7/6	7/9
Dezfoul-Andimeshk	74/9	866	785/36	641/18	7/9	7/5	8
Deymcheh plain	31	2287	2539	1563	7/5	7/82	7/8
Gotvand aghili plain	51/25	1300	1570	1292	8/07	7/63	7/9
Miyan Ab plain	10.93	1720	1879/2	1883	7/7	7/6	7/7

Table 6: Water classification for agriculture base on EC

Quality from risk for soil view	class	EC (µmhos/cm)
low	C_1	250-100
medium	C_2	750-250
high	C_3	2250-750
Very much	C_4	2250<

Table 7: Water classification base on schouler theory

Waters classification for drinking	PH
Drinkability (good)	7.3
Drinkability (acceptable)	7.8
Improper	9
Bad	10
Usable in urgent conditions	11
Undrinkable	>11

between favorite limit and allowed limit, except Chananeh and Dimcheh regions with 5155 and 2287 µmhos/cm, these regions' EC were more than allowed standard.

Graph number 7 which is explaining that average obtained PH from studied regions comparing with Iranian approved standard for allowed values and favorite for agricultural uses show that all regions have numbers between favorite limit and allowed limit and no region's PH to exceed from PH standard limit.

Also base on Schouler classification for drinking relying on PH (table number 7) all regions are being set in class 2 mean that, all regions have drinkability.

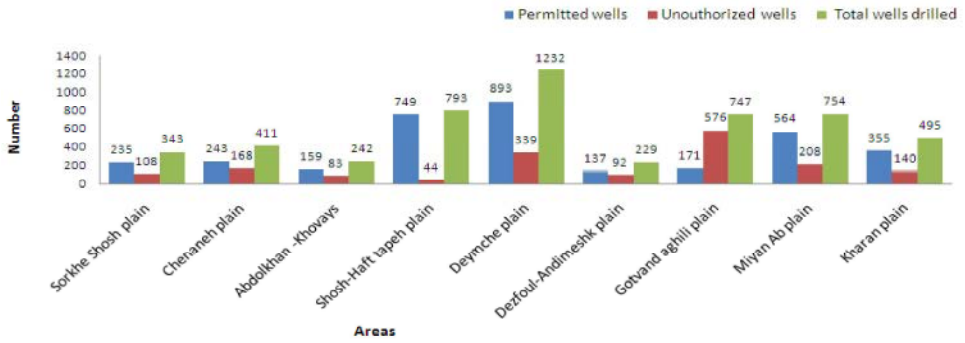

Fig. 2: Taking statistics of groundwater sources (wells)

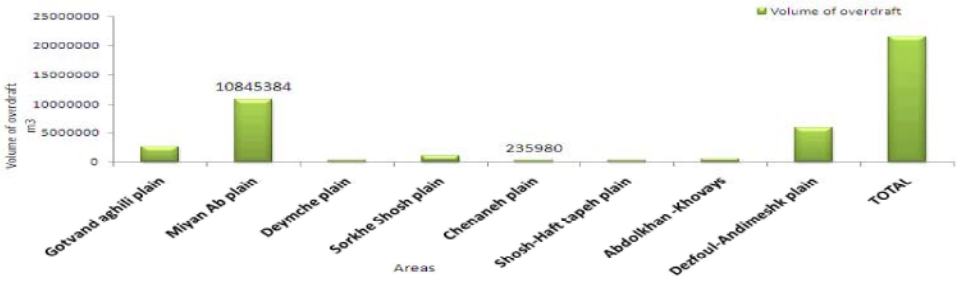

Fig. 3: Allowed wells with additional taking

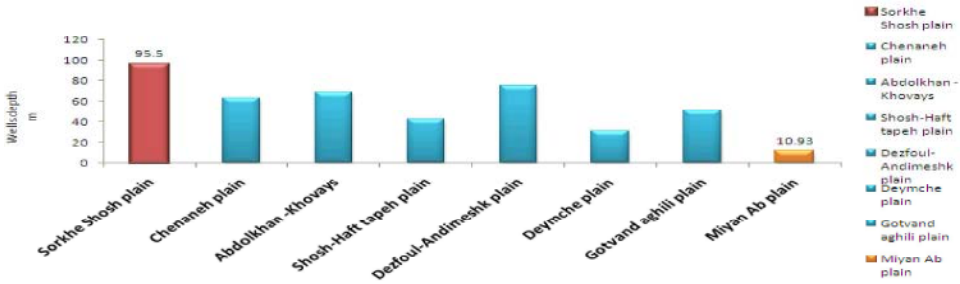

Fig. 4: Digging wells average depth

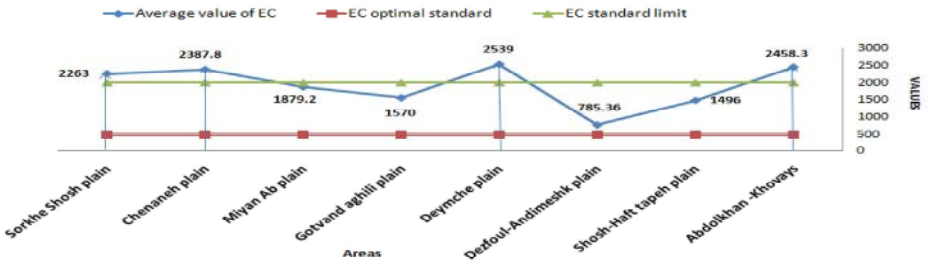

Fig. 5: Comparing average EC with standard for agriculture

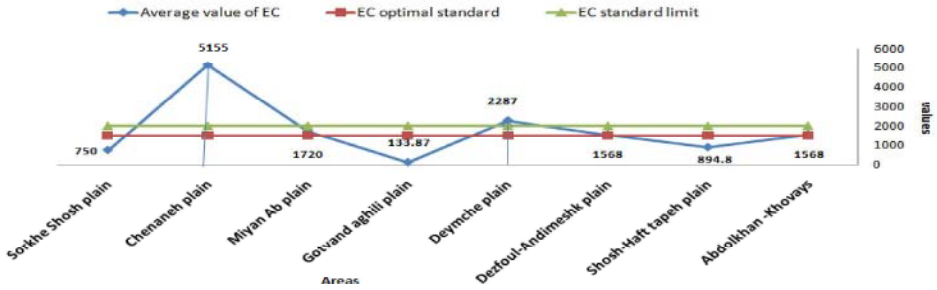

Fig. 6: Comparing average EC with standard for drinking

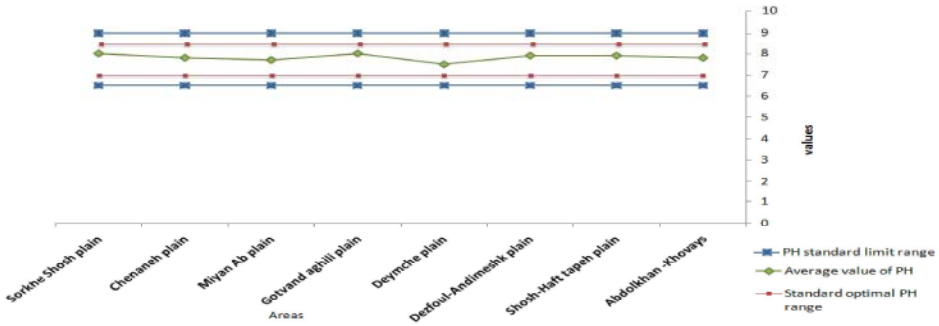

Fig. 7: Comparing average PH with standard for agriculture

CONCLUSIONS

Results of under study regions show that takings of ground water sources are being performed with and without allowed. Base on obtained statistics in the regions totally 5246 wells were dug which 3893 of them are allowed and other, 1353 wells are not allowed. By examining of allowed takings, specified that allowed wells have additional takings equivalent to 21455630 cube meters. maximum taking relates to Miyan ab with 10845384 cube meters and minimum taking relates to Chananeh with 235980 cube meters. Comparing sampling results with EC standard show that all under study regions have drinking allowed limit standard, but Dimcheh and Chananeh with

2287 and 5155 microzimens values and EC study shows that regions of Abdolkhan, Chananeh, Sorkheh and Dimchehh have takings more than allowed standard limit with (2458.3, 2387.8, 2263 and 2539) microzimens EC additional takings, in order. Other regions have allowed EC. From PH view all regions set into allowed standard range, both drinking and agriculture. According with Schouler water classification for EC Sorkheh, Chananeh and Abdolkhan plains are classified in C4 class and other regions are classified in C3 class. Also, in Schouler classification for drinking base on PH, all regions are being set in class 2, implying that, all regions are being set in drinkability category (acceptable).

Recommendations: Water is human being common treasure it shall be offered to next generations, so for optimum exploitation and management of this resource recommendations are being presented as below:

- prevention of groundwater sources destruction, preservation, revival and optimum exploitation of the sources on sustainable development path.
- applying water consuming pattern proper with climate for agriculture, industry and drinking Sections.
- identification of hygienic and environmental restrictions for drinking water sources.
- The compiling risk management methods for opposing against drought and flood.
- fairness distribution of water and codification country's water comprehensive law.
- valuation environmental effects of important development water projects to decrease negative effects on environment.
- establishing management comprehensive system for entire water cycle base on sustainable development principals and preparing land on country's watershed.
- productivity improvement and attend to water economical, security and political values for Collecting, resenting and consuming water.
- increasing water storing along with decreasing natural and unnatural losses in country.
- codification comprehensive program for propriety at dam's projects implementation, Water preservation, water gathering and irrigation and drainage systems.

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