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Investigating of the Most Important Reasons of Consumed Exploiting of Groundwater's Sources, Ardakanplain Case Study, Yazd, Iran

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ABSTRACT

Droughty areas formed about 1/3 of earth's surface. The rate of rainfall in these areas is low and rate of evaporation is high that it sometimes arrives to 40 times more than rainfall.

With this situation, droughty areas are in difficulty of water sources. Since surface waters are not trustable in these areas (because of low and irregular rainfall), human has tried to turn to sources of groundwater that has less environmental changes.

Yazd- Ardakan plain is one of the areas that has groundwater tension and actually has faced to dropping of groundwater's level and land settlement. According to negative conclusions and consequences of land settlement and vital importance of groundwater reservoirs in droughty areas, in this article, it's been tried to do research and explore in this field and do analyze about effective factors of this field. Since agriculture has most consuming water volume, in this article, the basis of work was stayed on studying of agricultural activities, moreover developing of industry and population and some of performed plans in area were mentioned too.

Obtained conclusions show that excavating of numerous wells through the revolution occurrence that there wasn't accurate observe on excavating wells and also policies of government are main factors of increasing of cultivated surface and as result of that, increasing of exploiting from reservoir. Also agricultural activities especially traditional agriculture is main factor of losses and wasted water because of their low efficiency. Developing of industry and population are couple of effective factors of increasing consuming water.

Keywords: *Dropping of groundwater's level, Reservoir nutrition, Traditional agriculture, Developing of industry and population, Yazd Ardakan plain.*

INTRODUCTION

Droughty areas formed approximately 33% of earth's dries (Arar et al. 1997) lack of rainfall and high rate of evaporation and transpiration are two important factors in sensitively and fragility of ecologic environment in this area. All of organisms such as human and animal and vegetation are in environment that has minimum potential and producing capacity. Then any strategy for management and any kind of exploiting in this areas should be by considering of some indicators that will be resulted maximum efficiency beside minimum of waste products and destruction. Because in the case of ecologic environment exiting from natural state its return is too difficult and has extraordinary costs.

Yazd-Ardakan plain is one of the areas that faced to intensive dropping of groundwater's level. This problem becomes more acute when more than 70 percent of population of province

and approximately 98 percent of Yazd province's industries are located in this area. Also this area stayed on after Herat and Marvast that is agricultural pole Yazd province, from the agricultural point of view.Jahani has gotten result by doing some calculates that in duration of years 1971 to 1996 approximately 30 million people were added to urban population and 9.3 million were added to rural population. Also picking up water for different consumes since 1971 to 1996 became 2 times more. Table 1 illustrates this and also illustrate reduction of water capitation in years 1966 to 2021.

Table1: Capitation changes of renewable water sources

Capitation of water in cube meter for each person in year	Year
7000	1966
2160	1996
1300	2021

Since that agriculture in this area like other areas has the most extracted water (based on done investigations in Iran, agriculture 93%, drink and health 7.4%, industry and mine 2.7% and aquatics 2.9% assigned to themselves from extraction water of different sources) (Jahani, 1993) then in this research, basis of work is study of agricultural activities.

In this field Khosravi has done investigation about role of promote in raising of watering efficiency. Through his researches that he has done in Zarghan's station (located in Fars province) it's determined that wheat, barley and corn in order need 8853, 7960 & 8870 cube meter of water in hectare by cycle of 10, 11 & 8 days in spring and 9, 9& 15 number of watering. With field studies and done researches from farmers in Darab, Khafrak and Marvdasht areas, the rate of using water for watering was estimated. Results showed that only for corn watering, gave water to farm was 12600 cube meter in hectare while needed water for that is 8870 cube meter in hectare, that's mean something about 3730 cube meter of waste water (Khosravi, 19991).

Henry believes water consumption in watering has low efficiency than industry because of different reasons (Henry, 1872)

Chit whereas his research in Myanmar, understood a tip that farm to farm watering makes out of reach the huge amount of water and in the other hand causes to their non-uniform distribution that as result causes to water lacking in cases of dehydration. Therefore, many lands don't receive water or receive very low amount of water and water arrives to furthest point of land too late. (Chit, 1992)

Bergstom presented a general formation to definite and measure of economic value of groundwater. He believes for deciding and policing about groundwater, all aspects of work should be considered. He presented a general formation also for evaluating of policy benefits about groundwater. Usage of this formation will be useful for strengthen policies, developing and completing estimated benefits, avoid from twice presented problems and eliminating repeated evaluation of groundwater's sources. (Bergstom et al. 1996)

Level of economy development, climate and population are factors that make different pattern of water consumption in different countries. (Arar et al. 1997)

James offers that controlling of surface water and groundwater's deterioration progress should be done. This operation had two targets. One of them is saving of economic development and another one is natural environment protection. Economic developing has been construed despite the existing of water in present and for future and protecting of natural environment to prevent of existed flows discharging. (James et al. 1992)

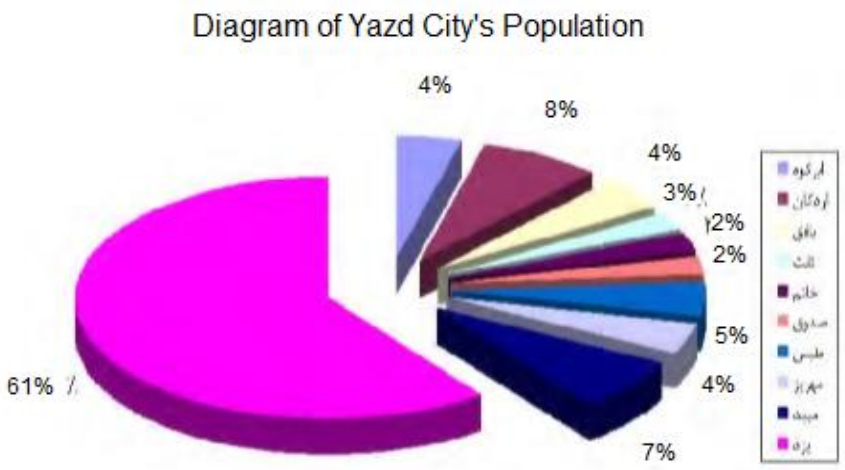
In case of groundwater's dropping, Tashakori has done investigation about condition of groundwater in Ghasemabad plain and he has estimate the rate of dropping water's level approximately 6 meters. He considered growing population, rate of income, type of employment, number of livestock, type of products, weakness in related rules and them perform, as main factors of extra exploiting from groundwater and he has investigated about them. (Tashakori, 1998)

Eventually, Shahidi Hamedani by studying that he has done in Ghahavan plain in Hamedan, he resulted that plan of under cultivate surface increasing needs to provide required water for watering and credits and loans that were provided for farmers by agricultural bank, cause to extract deep wells in area and as result, wide surface of lands were cultivated and cause to extra exploiting of groundwater and make area to desert. (ShahidiHamedani, 1999)

MATERIALS AND METHODS

Area of study

Yazd-Ardakan watershed with 10741 km^2 area and it's formed by Ardakan, Meybod, Taft, Sad dough and Yazd cities. Figure (1) that is done by an estimate in 2001, it obtains 659551 people of province's population. (Figure 2)



This area was formed by seven under areas such as Miankouh, Poshtkouh, Ghahraj, Nadoushan, Khezrabad, East of Ardakan and Yazd-Yardakan. Yazd city is faced to lack of water sources by millimeters of average rainfall. This area is one of complete and distinctive tablelands of Iran center tableland which approximately contains any type of geomorphology units of an erosive and complemented zone in droughty and dry area.

In this research by performing library studies and done social researches in scrolling way have been done with determining society and statistical sample. In library researches, following items have been analyzed and decomposed:

Study of demography and social features of zone, investigate and research about industry and process of industrialization of zone, investigate sources and done studies about water sources and obtaining information about them, investigate of done studies about agriculture's situation.

In social researches by choosing statistical samples of agricultural wells, obtaining following information have been tried: type of agricultural products that cultivate in the area, asking farmers about is agriculture affordable or not, calculating products in surface unit for major owners and minor owners, estimating of consumption water's volume in surface unit to produce product by emphasizing on wheat and alfalfa that have the most surface of under cultivate, investigate of effects of every parameters on each other and determine of freedom or lack of their freedom. For example, investigating of effect of education's rate on production etc. determining that is there any relation between them or not?

To make work easier and using of computer for decomposing and analyzing data, the answers were encoded. That's way, about questions of package (multiple choice) determined a number to each answer (code). According to abilities of EXCEL software, it was used and encoded data were put in computer.

Eventually a comprehensive table by Mother Name was obtained that all the answers were coded and were registered in it. By using of this table, some agreement tables were extracted.

After extracting agreement tables by using SPSS software, Chi-Square test was used for investigating of freedom or lack of freedom between couple of parameters in table. Note that formula of this test is as follows:

$$X^2 = \sum (q_i - e_i)^{2/e_i}$$

q_i: Observed abundance

e_i: Expected observe

In cases that expected abundance is less than 5, correction is used too:

$$X^2 = (\text{corrected}) = \sum ([q_i - e_i] - 0.5)^{2/e_i}$$

To compare major owner and minor owner first Variance test and then t test was done:

$$t = (\bar{X} - \bar{y}) - (\mu_x - \mu_y) / \sqrt{(s^2_x / n_x) + (s^2_y / n_y)}$$

Also about open questions, by using of farmers' answers some results were obtained and their point of views were analyzed and decomposed.

CONCLUSIONS AND DISCUSSION

26 percent of population of area are younger than 50-year-old farmers and 74 percent are older than 50-year-old farmers. In case of rate of education, approximately half of farmers are illiterate and near 1/3 of them are literate and only 24 percent of them have noticeable education (than two previous groups). According to age and education of farmers, it's understood that farmers are farming in method of their ancestors unaware that it's a features of traditional agriculture whereas they don't have noticeable information about modern methods of watering and if these systems were observed in some areas, there were only some people who have done this by encouraging of some engineers or promoters. Based on don studies in almost 25 to 30 years ago, the water condition was announced critical, then it can have proved that almost 40 to 50 years ago that extracting wells were started, some years pass (10 years) to announce area critical. Helps of government has role to extract 29 percent of wells and 71 percent of wells didn't receive help from government. In one hand help of government has role in improving economic power of farmers and its results is more welfare of farmers and if dominated condition on area and exploiting from that is considered, these helps would be effective in extracting wells and are considered as one of the main factors of dropping water's surface. In the other hand because economic power of farmers improved and if well didn't need floor breaker, farmer agree to pay cost.

This result is with the result that Sahidi Hamedani obtained from Ghahanvand plain study. Then entering of technology and also government's help can be main reasons of extra exploiting in groundwater's sources.

In statistical investigation, relation of wells property situation and government's help is passed by doing Chi-Square consider zero (consider freedom) test and it shows two parameters are independent from each other. Therefore, statistically, government's helps in extracting new wells weren't effective in exploiting.

In statistical investigating, consumption water's volume of major owners and minor owners was determined in unit that average of their consuming were equal but it should be attended that consumption water's volume of minor owners is more than major owners that it's because of transfer water's wasting.Therefore, the result of this study is same with Mr. Chit's quote. That's mean the volume of water wasting in minor owner is more that it causes to water depletion in times of water lacking which can be one of the reasons of extra exploiting from groundwater that should be noticed in zonal planning.

Table2: Observed abundance between type of ownership and water wasting

X^2	Sum	Major owner	Minor owner	Ownership / Water wasting
$0.07^{N.s}$	42	10	32	Minor owner
	37	5	22	Major owner
	21	4	17	No different
	90	19	71	Sum

In surface, 5% doesn't have meaning.

According to extracted data from questionnaire of irrigated water's volume through a season by farmers for wheat product was different from 1555.2 to 8160 cube meters in hectare that definitely the rate production is different too.

In next step, under cultivate surface of several products and extra water that entered to area were considered and were determined which only about wheat and in Yazd-Ardakan limited area, approximately 2.43 million cube meters' extra water from require water was entered to farm which is a noticeable number. This result conformsthe result that Khosravi obtained from his studying in Zarghan station located in Fars province. It shows that one of the most important reason of extra exploiting from water sources in country is lack of knowledge of farmers in water requirement of different products that it causes to waste huge part of water.

If efficiency of water transferring is considered too, it's observed what huge amount of water's volume is going to out of reach by different ways such as evaporation, penetration and different reasons. To estimate this amount, if it's considered that total consumption water in agriculture part is approximately 413.4 million

cube meters and efficiency of water transferring is 48 percent, it's observed that about 215 million cube meters of that are going out of reach by different ways. If previous wastes added, rate of extra picking from groundwater is about 1.2 times more (188 million cube meters).

According to Henry's beliefs that water consumption in irrigating has less efficiency than industry and according to the result that was obtained from this study about rather too much water wasting in agriculture part than industry, is requiring necessity of attention to sources' potential of water in area to choose type of land usage. Thing that hasn't been considered in zonal planning of Yazd-Ardakan plain.

Another problem which is noticed in this research is that Milshbar company has 5 rings of well and most land of this company is under cultivate of alfalfa. Produced alfalfa is used in constructed husbandries. Politic of this company is preparing whole consumption dairy of Ardakan city (in other mean Yazd province) while farmers of this area beside farming, are doinghusbandry and preparing huge part of consumption dairy and according to that water require of alfalfa is more than other cultivated agricultural products in area, it can be resulted that constructing these plans is how wrong and put double pressure on water sources.

Among others actions that were done in Ardakan city, is desertification plan. This plan was done by Natural Resources Administration and by cooperating of farmers. In the way that it's allowed to farmers to do 2% pistachios beside A triplex doing. Among these plans is assignment of 8000-hectare land with 3 rings well for desertification.

This question is asked that is A triplex doing (that experts are discussing about that recently and question its cultivating) and so-called correcting desert by using of groundwatermore important that water sources and are picking water, a triplex and pistachios cultivating reasonable with critical situation of groundwater?

According to above contents and the frame that Bergstom has presented about definition and economic value measurement of groundwater, this issue should be noticed that for deciding and politicking about groundwater, whole aspects of work should be considered such as economic and vital value of water and it should be considered according to water resources of area for its using in different parts such as A triplex doing and alfalfa cultivating.

Meanwhile the social studies, municipal and urban developing problems are observed clearly too. This order is observed especially surround the Yazd city and especially Ardakan city. That's way, Ardakan's population has been increased impressively and published statistics from Iran Statistic Center is corroborant of that.

Table3: Growing of Ardakan city population through the several past decade

	Sum			Urban			Rural		
	Sum	Man	Woman	Sum	Man	Woman	Sum	Man	Woman
Population(1986)	99676	51799	4788	61984	32338	29646	37702	19461	18241
Population(1996)	61802	32391	29411	44398	22976	21422	17404	9415	7989
Population(2006)	73292	40548	32744	59248	31041	28207	14044	9507	4537

CONCLUSION

This research has tried to investigate and research about agriculture meanwhile population and industry have been considered too. It seems, the most important reason of groundwater's level dropping in area of study is extracting too many wells. Resulted water of these wells, is used for agriculture, industry, drink and health. After extracting wells that has direct role in extra picking water from groundwater, agricultural activities are the most important factors that have indirect role. Lack of knowledge of farmers from plants' water requirement is one another of important factors and it's noteworthy. As it's observed, only wheat receive 2.2 million cube meter in a year and about other products, it is same too. Therefore, forming teaching promotion duration for farmers seems necessary.

Agricultural joint stock companies have more production rate than major owners and miner owners meanwhile they use water by more efficiency.

Population growing is one another of factors that cause to increase water consumption in drink and health part. Natural growing of population and immigration are two main factors of urban population growing especially in Yazd and Ardakan cities that it-self is a factor in increasing of exploiting from groundwater.

Industry development is another categorytoo that has dual role. In one hand industry causes to attract population and in the other hand, population growing requires more water. Constructing alloy steel of Yazd factory and Yazd steel factory and Cement factory are some industries which have extraordinary consuming of water meanwhile have much role in attracting population.

Cultivated agricultural products in area is varied and different. Some of them such as wheat, barley and pistachio don't have much water requirement while have high income for agriculture and in compare with other products, pests and diseases aren't effective on them but kitchen garden products like melon, watermelon and green cucumber have much water requirement while they are effected by pests and diseases easily and don't have much price. So changing pattern of cultivate is necessary.

Performing governmental plan such as Atriplex doing plan in side of Siahkouh Desert (Afzal well) is one of the important factors in using of groundwater. According to width of area, function of performing this plan is one of the noticeable factors in exploiting groundwater.

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