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A Study on the Effects of Lining Irrigation in the Channel Network on Integrated Water Resources Systems Managements (Case Study; Bar Basin of Iran)

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Abstract. In a new global approach, water has considered economically a special important commodity as basically needs by all sectors. More than 93% of Water resources uses in agricultural section in Iran, that is the greatest water consumer. Challenges around supplies and demands seem to be more important. Bar basin in Nayshabour with proper water potentialities and vast fruit gardens that plays an important role in apples conversion industry. According to some researches, a vast area under cultivation encountered serious water stress in summer because of drought in recent years. Researches revealed that, through integrated management of supplies and demands we can achieve least harm in both surface and groundwater resources.

Keywords: Water supply and demand management, integrated water resources management, Bar basin in Nayshaboor

1. Introduction

In a newly global approach, water has been considered as a socio-economical and initial commodity for human being. Even though the water resources are renewable, but they have limitation too. Considering the World population growth, industrial developments, and improvements in social hygiene and welfare, the renewable resources per capita is tending to decline [1]. Iran with an average of 260mm annual precipitation considers as arid country in the World having limited water resources. Factors such as population growth increase in demands for food, necessary improvements in hygiene and social welfare, industrial developments and ecosystem protection increases the needs of water is apparent in most parts of the country. Expansion of cultivation lands and the high irrigation demands are the main causes of water shortages in water resources. The lack of sound integrated management in supply in one region affects the resources of the other places which bring changes in quality and quantity in other places [2].

By the maximum precipitation as 260mm in Iran inharmonic land distribution that only %1 of the country gains more than 1000mm in a year when more than %28 of the lands has less than100mm annual rainfalls. Evaporation decreases %70 of 415 million cubic meters of precipitations in Iran. An annual rate of 12 milliards cubic meter of water enters to the country through the border lines of neighbor countries. Then total renewable water resources makes 135 milliards cubic meters of which 95 milliards cubic meters of it have been extracted up to the year 1991.Respectively 5.93% and 2% of this amount have been allocated to agriculture, civil and industrial consumptions. In the arid countries that shortage of water has profound mal-effects on agricultural activities to keep the water resources stable, a proper program should be undertaken [3].

At present the management of agricultural water resources has divided into two sections: 1- to supply the resources and 2-to pay to the demands. Limited resources and so many consumers has demanded a profound

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liable management to distribute the resources which includes channel distribution, using the underground waters and a mix of these two and storage of water in reservoirs by using pumps etc. The demand management helps the proper irrigation, changes and organization reforms and encourages the farmers to take part in management of water resources. The main problem in water resources of the country is to keep the balance between the supplies and demands in regard with the time and the place as well. It's more than two decades that the world has come to the solution by using the management of demand rather than supplies. Therefore the scientists have suggested the integrated water management. Integrated management has two main policies and one main goal. The policies are: 1- water should be cared as a socio-economical and environmental commodity.2- the policies and the factors leading the water management should be analyzed in a unique framework. The main purpose of integrated management is a stable and liable and just for development of water resources. So it is relayed on supply and demand management, supervising all the environmental, social and economical aspects of water resources [4].

The integrated water resources management approaches helps to manage and develop water resources in a sustainable and balanced form, taking into accounts social, economic and environmental interests. The integrated approach co-ordinates water resources management and interest groups, by the different scales, from local to international. It emphasizes that involvement in national policy and law making processes, establishes good governance and creating effective institutional and regulatory arrangements as routes to more equitable and sustainable decisions. A range of tools, such as social and environmental assessments, economic instruments, and information and monitoring systems, support this process.

As a whole after all activities performs on quantity and quality of acquired resources to related consumers the suppliers, management of effective functions on consumption and wastage of water are demands this management. In the other words the demand managements are those activities that decreases the demand and making the consumption fruitful and prevents the water resources of contamination or banishments [5]. Out of total of 95 milliard cubic meters of water annually supplied in Iran more than 87 milliard cubic meters are consumed in agricultural affairs to irrigate 7.5 million acres of irrigated cultivation lands, 6.3 million acres of cultivation lands and 1.2 million acres are gardens. The FAO agricultural programmers believe that an acre of cultivated land satisfies the necessary food of 3 person annually. Then for 70 million population of the country the cultivated land notably increases. At present the water consumption %is mainly in the form of basin irrigation with an estimated efficiency of 30% to 40% [6]. The assessments on Dez dam irrigation networks in duration of 9 years revealed that the efficiency of irrigation is less than the 21% in average[7]. In USA the water consumption in duration of 1980 to 1995 has been decreased by16% through promotion affairs by training of the farmers and help of researches [8,9].

The current water resources model studied were mainly focus on the irrigation system of the agricultural. Dynamics of system and Integrated Water Resources Management used to study Yellow River in China [10], water for irrigation in Spain [11], water resources in Canada [12, 13, 14],and in Singapore and water balance in Mono Lake, California [15]. Considering the global norms, consumed water for important agricultural supplies is even too high. [16].

Considering the aforesaid, integrated management on water resources as well as the lands is very important. The Bar region in Nayshabour needs more water supply due to drought and its vast land areas under cultivation which results in severe water tensions especially in the hot summer season. On the other hand the Bar River as the main supply for the gardens is one of the main branches of Bar dam laying to the down site of dam and feeding even the of Nayshabour plain watershed which has encountered annually 95 centimeters water losses of ground water. The purpose of this study was to provide a solution to the resolving the problem of water stress by the least damage to Bar dam that enters the flows to subsurface aquifer of Nayshabour. These results, indicates that the effect of demand and supply management of water resources on river flow and groundwater flow in watershed basin.

2. Materials and Methods

The region of this study is located in Khorasan-e-Razavi province at the vicinities of Bar city a suburb of Nayshabour in 36.29. 23 North. and 58.42.55 East. The Bar river originates from Binalood mountains in North West of Nayshabour in the slops of a 2750meters high of mountain called Dal Khan in the north of

Bar city which is one of the originates of Kal-e-Shoor river in Nayshabour too. Bar river irrigates the Bar and Aryeh, damenjan and Chaharbagh and mingles lands by a stream from the east side's ,called Taqan. Then passing Khanlegh village it downwards extends of the plain[17].

The most important stream which enters the Bar River is Taqan that originates from Binalood mountains then passes through the south of Bar city and east of Taqan to Derakht-e-Jouz village and enters about 10 km in Chaharbagh. The river flows permanently at its upper parts and in spring time together with the floods ends at the Bar river and finding its way to Kal-e-Shoor in Nayshabour. There is an active hydrometer station in Taqan village since the year 1348.The rivers watershed keeps its vastness up to the station in 102 square Km with an average slope of 7.5% and by the annual capacity of about 18 million cubic meters with the good quality of water , same as Bar river, which is suitable both for agriculture and drinking purposes(Fig. 1).

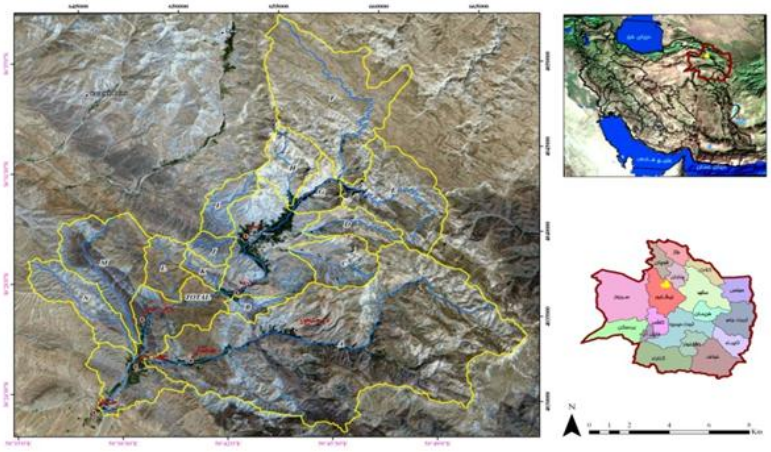

Fig. 1: Case study Map – Khorasan-e-Razavi, Iran

The main activities in these areas are mostly fruit gardens with specially apple trees. The only provided water system for the gardens is Bar River which tends to be seized greatly at the summer seasons and is limited to the springs seasons. When there is no profound system of distribution, it makes the upper gardens to benefited more and yet those at the down sides suffer the lack of irrigation water greatly. To keep the gardens not to barren some wells not so deep drilled at the river bed (Fig. 2) and pumping the water by some light discharge rate irrigation, undertaken to save the gardens. This attempt dries the riverbed in the lower located villages like Ariyeh and Damenjan.

Fig. 2: An exhibition of collecting water from the river bed and delivery to the gardens

In this study the areas of region was divided first into different hydrological parts. Then considering the surface and underneath amount of water, by a different managerial scenario were presented for both supplies and demands. At the supplies managerial section, totally 9 reservoirs were proposed when at the demands section actions such as linings of channels were studied. Using the Vensim software,[18] analyses were

made on the managerial scenario and its effects on the entered amount of water into the Bar dam which is responsible for irrigation of the region(Fig. 3).

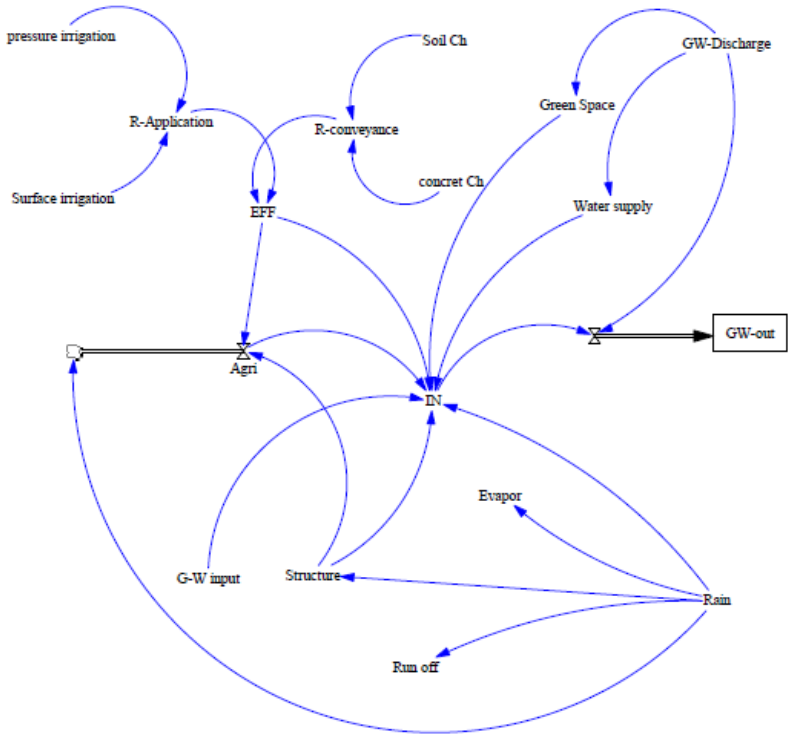

Fig. 3: Defining of variables of water distribution in Bar city using Vensim software

3. Results and Discussion

All of the managerial water consumption scenarios are to be studied. There are about 1070 acres of lands bearing fruit gardens in Bar region. Regarding the lack of water at the summer time the farmers began to dig wells in the river bed. As investigated the total consumed water in the region was 105 million cubic meters. Digging well supplies only 2.27 million cubic meters annually. But by undertaking the proposed actions the stress changes from 1.838 million cubic meters to1.160 million cubic meters. This causes an increase of 2.52 million cubic meters that resulted in more water supply and thus making the surplus water to sink into the underneath layers.

The absence of reservoirs in proper places the proposed actions however fails to compensate the requested supply completely. Therefore if here the distribution be undertaken through concrete channels the surface and underneath supply will differ greatly. We will continue to study such a scenario too.

Bar City by totally 57550 Channels of which 10% is concreted with 90% output and the rest are natural clay channels with an efficiency of 70%. By only lining of these channels (40285 meters) and without any reservoirs construction water tension will be decreased by 1.82 to 0.73 million cubic meters. The discharge waters from Bar region is 1.18 million cubic meters and the underground water of Arayeh area will tend to decrease so that all the wells will be dried up. The total water underneath which enters the Nayshabour plain (in Khanlogh area) will be 9.08 million cubic meters annually. Lining of all 100% of channels makes underneath water sizes, that pumps' illegally and the supply will decreased to 0.44 million cubic meters annually. It has been assumed that the upper region in Bar city is able to supply water from ground the same as present time for ever, but this will not happens since with any decrease in recharge waters the groundwater supply will decreased too. If it be possible to increase the water in Arayeh region the farmers will close their illegal wells consumption. Study revealed that with lining all the channels a great decrease in water consumption yeilds.

To solve the problem, totally 8 regions was supervised and it was decided some small reservoirs construction. By doing this and with reservation of 0.6569 million cubic meters of water even though all the

channels can be used as they are today a decrease of 1.16 million cubic meters will be at hand. By 100% channels lining (28775 meters) the lack of water reaches to 0.39 million cubic meters and yet the underneath water flows to downward villages as well. This will helps the new recourses to remain unchanged and consumption decreases even at the down side regions.

Table 1: Usage of managerial scenario in water consumption (percentage of channel linings in Bar region) and its effects on ground water recourses and water problems.

proposed factors not fulfilled condition of today				proposed factors fulfilled		
% of channel lining	Annual consumed water	lack of water in Bar	Underground output	Annual consued water	Underground output	lack of water in Bar
100	1052	-0.18	0.64	11.17	0	0.78
%70	1052	-0.73	1.18	11.17	0	1.36
%50	1052	-1.09	1.54	11.17	-0.39	1.75
%10	1052	-1.82	2.27	11.17	-1.16	2.52

Accepting the variables (more than 10%) and to ban the farmers of extend their gardens will fulfill the proposed linings and reservoirs and puts an end to the water crises in the region.

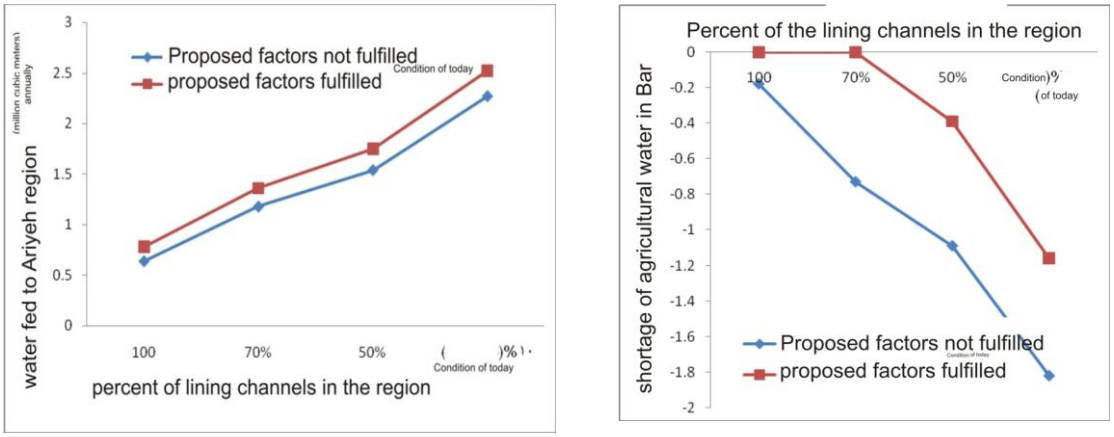

Fig. 4: Decreased underground supply waters and the decreased consumption of the main supply waters when the irrigation channels be lined

Table 1 and Fig. 4. shows that with the fulfillment of the proposed actions and at the same time lining of the channels in Bar by 70 % (40285 meters)and totally 1.36 million cubic meters of regional ground waters enters Ariyeh village which compensates the lack of water there at the end of summer when the water recourses decreases. The project yields 9.26 million cubic meters of water to enter at the down side into the watershed of Nayshabour.

In fact the small reservoir projects in Bar apart from the consumption management scenarios cannot decrease water tensions seriously and it should be undertaken as well. Since the reservoirs capacities is negligible compared to the annually streamed discharge water which feeds the Bar dam(0.6569 to 43)million cubic meters, such actions has nothing to do with the water feeding to the dam and lining of the channels can also preserve the ground water in Nayshabour watershed to decrease and no any water tensions continues in the region. The Fig. 5 Shows the location and farming lands for scenarios

Fig. 5: Location and farming lands of scenarios.

4. Conclusion

In this article we tried to state the importance of supply and demand management and its effects on surface and ground waters. The result showed that by lining of the channels the ground waters tend to decrease which in turn to causes of penetration of salty waters from the west region in Nayshabour watershed and to the central part of the plain. We should admit here that any changes in nature results in environmental tensions as well and it is impotency in decision makings, replies the needs of the residents as well as preserving the ecosystems. Study showed that the proposed changes are unavoidable because of the fact that such changes cannot solve the problems if not being along with the profound system of demand management.

The scenario of lining the channels caused a deduction of1.56 million cubic meters of water into the Nayshabour watershed in Khanlogh village ,however its acceptable in regard of the fact that the aforesaid amount is nothing corresponding to (920 million cubic meters water supplied in Nayshabour plain) and waters entering the Bar dam (0.6569 to 43 million cubic meters). A few of the artificial dams needs to be constructed at the down sites to block the winter's floods and compensate the losses.

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