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Investigation of Water Resources Sustainability in Khansar Township Watersheds

Masoud Nasri
Assistant professor of Ardestan Branch
Islamic Azad University
Ardestan, Iran
Dr.Nasri.m@gmail.com

Ali Najafi
Staff of Natural Resources Department
Isfahan province, Isfahan, Iran
Doralinajafi@yahoo.com

Mansour Shisheforosh
Head Manager of Esfahan Office of Critic Management
Esfahan, Iran

Yousef Moradi
School of Civil Engineering
University of Sains Malaysia (USM)

Abstract

Watersheds are a dynamic system requiring management of its components and resources. Since water plays a major role in water resources management it can effect watershed integrated management. The allocation of water resources in Iran is a challenge due to critical conditions. The Khansar Township is located in the northwest Isfahan province (Iran) in a semiarid climate with an annual precipitation of 303. The Khansar basin belongs to the great basin, Ghomrud. In this study, an investigation of the problems and challenges associated with township water resources conditions was conducted in order to achieve integrated and optimized management with solutions and suggestions on how to provide sustainable water resources management in the township. Results reveal the main problems in the water resources section of the township include: unsuitable management of water resource usage, lack of modern technology, the destruction of Qanat due to a development project, well penetration without licensure, excessive use of groundwater resources, farming patterns that do not adapt to climate conditions, and over consumption of water usage in home, agriculture and industrial sections.

Key Words: watershed integrated management, water resources sustainability, challenges, solutions, Khansar Township

Introduction

Water is a reputable resource that provides life. Therefore, the absence of water leads to the end of life. The increasing population of the world has led to additional pressure for water resources. In ancient times, the Middle East experienced droughts due to its proximity to the drought belt of the earth. As a result, wars occurred in a fight to obtain water. By considering the increasing use of water, problems such as droughts and wars are likely to continue.

Natural resources are the base of production. The transferability and saving of water by use of hydrological cycles is executable. The range of natural resources and base resources include water, air, rocks, soil, and vegetation coverage. Natural resources related threats can affect the quality and quantity of water resources. The increasing population size in previous years; worldwide weather changes; increased pollution in soil, water, air, nuclear, light, and telecommunication divisions; limited rules and bureaucracy; social problems such as poverty, smuggling, and rubbery; low priority of agriculture, environment and natural resources in main plans of country; lack of knowledge by local managers about serious problems like soil erosion, the destruction of jungles and pastures; and similar effective factors have led to a negative destination for natural resources. The main platform for a hydrological cycle will destroy water resources, soil, air, and vegetation coverage of our country in the near future unless we change these processes as soon as possible (Jafari et al, 2008).

In this study, an examination of the status of water resources in the Khansar Township, the existing challenges and problems attributed to water resources and proposals for moving toward the sustainable development of water resources will be presented.

Material and Methods

Geographical location

The Khansar Township which is approximately 95 km^2 in area is located in the northwest Isfahan province (160 km distance from Isfahan) in a mountainous region. The region has a mountain terrain that consists of cold weather with summer temperatures. Precipitation consists of snow in the higher elevations and rain in the lower areas. Due to the elevation of the region, in late autumn and during the winter season, precipitation consists of snow during most seasons. Snow continues to fall until early spring especially in the northern slopes. The important plants of the region pastures are presented in Table 1.

Table 1. Floristic list of main and companion pasture plants of studied region

	Scientific name	Local name	Family
1	Astragalus sp.	Gavan	leguminoseae
2	Bromus sp.	Bromus	Gramineae
3	Scariola Orientalis	Sephidjaaz	compositeae
4	Cosinia Bakhtrica	Karrak	compositeae
5	Gondelia Tourneforti	Kangar	compositeae
6	Euphorbia sp.	Shirsag	Euphorbiaceae
7	Eryngium Billardieri	Zool	Umbelifereae
8	Agropyron sp.	Agropyron	Gramineae

The region has a semiarid climate according to De Martine method and cold semi arid climate according to Amberge method (Power Ministry reports, 2000). The mean annual precipitation is 303 mm and the absolute maximum, absolute minimum, mean maximum, mean minimum, and mean annual temperatures are 37.5°c, 22.5 °c, 8° c, 5.3°c and 12°c, respectively.

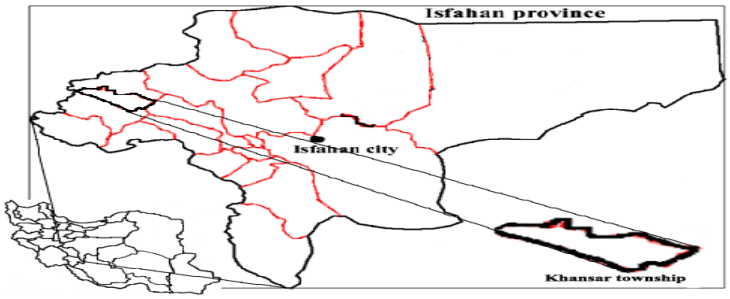

Figure 1. Township location in country and province

Study method

Some of the natural restrictions and low areas of the region have made obvious properties prefer a higher slope. Low precipitation, soil depth, and environment recycling in many divisions of the township have led to limitations in making and enriching ground water aquifers. There is a high rate of tourism because of attractions such as Golestan Kooh and Sarcheshmeh Park. The limited number of fertile lands for agriculture is a limitation that affects civil affairs and development plans. Otherwise, irreversible damages will be occurred in sensitive areas of the region. One of the negative effects of some constructional projects is damage to water resources by affecting ground water flow and also the existence of erosion and sedimentation and water resources pollution.

In the next section of the paper, the status of water resources in the region is explained, followed by challenges and damages relative to the region.

A) Current status of water resources

1. Surface water like rivers and streams: there are no permanent surface waters and sometimes seasonal stream flow in arid rivers and flood canals.
2. Ground waters like springs, qanats, and wells: the main part of the regions' water supply is from extant wells, springs, and qanats. The most important

spring of township is the Sarcheshmeh spring. Some properties of the regions' qanats are presented in Table 2.

Table 2. Some properties of khansar Qantas

	Division	Village	Name	Well numbers	Depth of main well(m)	Length (m)	Average discharge (lit/sec)
1	Koohsaar	Rahmatabad	Gharieh	80	20	1800	17
2	Koohsaar	Rahmatabad	Edar	25	15	300	9
3	Koohsaar	Rahmatabad	Mianlai	20	19	300	13
4	Poshtkooh	Veest	Lasman	28	18	1200	13.5
5	Poshtkooh	Veest	Badam	63	31	2300	17
6	Poshtkooh	Veest	Jomazeh	76	29	2500	21
7	Cheshmehsaar	Dooshkharrat	Shaahshara	75	46	1500	19
8	Cheshmehsaar	Dooshkharrat	Haghi	65	40	1400	17
9	Cheshmehsaar	Laaijand	Sofla	12	25	600	18
10	Cheshmehsaar	Sangsefid	Baghkal	28	35	1200	35

3. Dams and water reservoirs: some small and big embankment dams have been constructed by the government which is very different in area and water content. The only dam constructed for drinking water is Baghkal dam which is not completed yet. The dam is located in southern section (2km) of khansar city (50° 30' E; 33° 12' N) and was constructed on the khansar River (one of Ghomrood regions). Saving the water of Baghkal (one of Ghomrood origins) and supplying drinking water to the city has been the main goal of this construction.
4. Water resources: there is a running project on transferring water from Dez river origins to khansar city.

B) Problems, challenges, and damages to extant water resources

I. ***Bad management, limitation and damages caused by humans***

1- Lack of modern technology in using water resources (modern irrigation, covering canals, isolating water canals, isolating water reservoirs, qanats strengthening, and preventing water leaking from pipes).
2- Qanat destruction by construction projects and lack of dredging and repairing qanat.
3- Digging unauthorized wells.
4- Digging wells with unauthorized depths and annual sub soiling.
5- Extra discharging ground water resources via wells.
6- Lack of sufficient attention to appropriate cultivation patterns according to climatic and ecological conditions.
7- Extra uses of water in houses, industry and agriculture.
8- Old water distributing system.
9- Using water in both drinking and agriculture-landscaping use.
10- Lack of sewage recycling system.
11- Development of irrigated agricultural lands more than ecological capacities.
12- Non real price of water in different use divisions.
13- Pollution of extant water resources (houses, industry, agriculture).

One of negative effects of construction projects is "pollution." As Miller (2003) references the national Academy of Science (1969) pollution is defined as all unfavorable changes in physical, chemical, and biological properties of air, water, or earth which are threatening health, living and activities of human or other organisms.

14- Lack of scientific management in designing and execution of construction projects.

Richardson et al. (2005) believed that protecting the environment during construction projects is very important. In order to overcome problems in river engineering it is non avoidable to have sufficient knowledge of engineering and some knowledge of hydrology, hydraulic, erosion and sedimentation, river mechanic, soil mechanic, buildings engineering, economy, environment and related topics. We can prevent many damages to natural resources, water, and soil or minimize the losses and also reconstruct the region rapidly after construction projects. Two construction projects in this region (Baaghkol dam and khansar - Daamaneh road) have caused many damages in this region which have destroyed water resources especially from an erosion-sedimentation pollution aspect (Table 3).

Table 3. Physical destruction of natural resources of khansar region due to construction projects

<table>
<tr><td>Baghkal dam</td><td colspan="4">Ring way of khansar - Daamaneh road</td></tr>
<tr><td rowspan="10">Total destruction area including the place of reservoir; roads; mines of rock, clay, and sand; movement of heavy machines; workers stations; workshop; and … was estimated about 100 hectares</td><td colspan="4">Total estimated destruction area including road place and ring way place: branch roads, excavation places, movement of heavy machines; workers stations; workshop; and…</td></tr>
<tr><td>-</td><td>Pasture name</td><td>Pasture area (ha)</td><td>Destruction area(ha)</td></tr>
<tr><td>1</td><td>Teedjan</td><td>4879</td><td>8.24</td></tr>
<tr><td>2</td><td>Baba sultan</td><td>477.3</td><td>12.5</td></tr>
<tr><td>3</td><td>Horestaaneh</td><td>671.15</td><td>13</td></tr>
<tr><td>4</td><td>Suneghan</td><td>400</td><td>12</td></tr>
<tr><td>5</td><td>Janga+Arsur</td><td>550</td><td>65</td></tr>
<tr><td>6</td><td>Keedeh and cheshmeh veng</td><td>250</td><td>34.34</td></tr>
<tr><td>7</td><td>Sang sefid</td><td>2750</td><td>62</td></tr>
<tr><td>8</td><td>Ghaleh Babamohammad</td><td>550</td><td>14</td></tr>
<tr><td>9</td><td>Doosh kharrat</td><td>6348</td><td>28.89</td></tr>
</table>

-	-	Total	16875.45	250
Total destruction area of these projects is 350 hectares.				

Considering the preceding data, it is obvious that pastures which are the main producer of surface waters and ground waters have been damaged by bad management of these two projects. The destruction will occur in water resources for the township with a multiyear delay.

15- Soil erosion in the watershed.

According to a study by Gavrilovic et al (2008) in Serbia-Yugoslavia, we can ascribe many floods, eroding flows, building damages, and landslides to the destruction of pastures and their vegetation coverage and soils. Various researchers have shown that soil erosion caused empires to collapse and affect civilizations such as the Mesopotamia civilization. The improper methods of land use (like indiscriminate cutting of trees, excessive grazing, indiscriminate development of dry lands, plowing in the slope (Refaahi, 1999), road construction in erosion susceptible areas, excavation and embankment along waterways and slopes and firing native pastures that is compatible and high resistant unfavorable environmental factors) amplifies soil erosion.

16- Inadequate attention to water management.

17- Weak rules or bad execution of extant rules in water division: water must be known as a national capital not personal. It has been proven many times that people were not cooperating with the management organizations (like water organization and agriculture organization).

18- Not considering professional performance of water resources and hydrological cycle: studying total effective factors of a watershed and their interaction with each other or the environment.

The interaction and yield of ecosystem components, in place of studying only human activities is an introduction to identifying watershed and nature actions. A comprehensive and systemic approach is important. All activities of humans, managements, plans, and human life are related firmly to the interaction between biotic-abiotic factors of watershed. A lack of knowledge will lead to soil erosion, destroying or bad use of resources and environment destruction plus many problems in nature. On the other hand, watershed management plans will be defeated or will be done in low levels (Haadiani, 2005). For example and by no sufficient patience to watershed sight, Baghkal dam has been built and rights of lowland regions have been ignored. Meanwhile by neglecting overland flows of Khansar River due to this construction, Golpaayegan plain will be evolved with hygienic problems of garbage, and wild life destruction in river beds and sides and also more crises in ground water resources of the Golpaayegan plain.

II. ***Natural limitations and problems in water resources category***

1- High slope: the area has high lands which cause fast drainage of runoffs and accelerate the soil erosion process.

2- Limited precipitation: The Khansar Township is known as an arid or semiarid place with 303 mm annual precipitation.

3- Inappropriate precipitation regime of the region.

Iran with 1648105 km2 and 75 million people and average rainfall about 250 mm/year (Masoudian and Kaaviani, 2008) is one of the most arid regions in the world. Precipitation is one of the basic factors of water resources existence in Iran but distribution of it is very inharmonious from place or time aspects. As a result, water resources are not uniformly distributed. Maintenance and management of resources depends on both receiving rain and rain variability. While the spatial variation of precipitation in Iran is very high, specifically in years

with less rain (Missourian and Kaaviani, 2008). In the study region, these differences are high, too.

4- Low depth of soil and alluvium: lack of deep soils, plus limiting agriculture, increases irrigation times. Low depth of alluvium in this region reduces penetration and saving ground waters.

III. *Soil and its importance from the viewpoint of natural sciences*

Soil can be known as a natural phenomenon consisting of organic/inorganic matters which are forming in the outer surface of earth. This forming is the result of many permanent processes which is known as a dynamic phenomenon. The importance of soil has various dimensions from a scientific perspective which can be summarized as plant nourishing resource; natural phytoremediant; producer of three green house gases: CO2, N2O and CH4; an open system; the only bed for plant growth; and a geomorphologic control. Dokochaov, the Russian soil scientist mentioned five important factors for soil making: climate, bedrock, topography, living things activities, and time. These factors play the main role in soil creating. Depending on the dominancy of each factor, evolutionary processes can be changed. In fact, soil nature is a function of five factors in which one of them can be fixed and the others are its variables (Raamesht and Sayf, 2005).

1- High temperature and winds cause increase evapotranspiration in the region.

2- Expansion of geological impermeable formations: main part of khansar lands is consisted from schist-crysit rock units which have low permeability and water saving coefficient.

Results and Discussion

Considering the challenges and opportunities of water resources in Khansar, the main challenges of this division is related to natural factors like limited rainfall, existence of impermeable geological formation, lack of aquifers and the high slope of lands. Geological formations have a wide range of diversity and expansion. Therefore, as the mother rock of soils, they can affect depth, texture, structure, fertility and the other physical and chemical soil properties. Our management can not affect soil properties for a long time and wide area but the benefits of water leaching in alkaline soils, adding lime or sands to some heavy soils, adding manure or the other actions to improve soil properties cannot be ignored. Topographic specifics of the region like slope, direction and height cannot be changed on a big scale and is not economical even on a small scale. The limitations in this factor have caused serious problems in water resources development. Human management cannot eliminate these factors even by using modern technology. We can only reduce the negative effects of these factors by using adaption techniques like land leveling for keeping water and soil; contour cultivation; limited use of extant aquifers; performing watershed management in sub watersheds of the township for soil and water saving; reducing erodibility of hill slopes, valley walls, and flood canal walls. By considering the weather condition and semi arid climate of the region will help determine the appropriate patterns for cultivating agricultural-horticultural crops, especially cultivating extreme cold and water deficiency tolerant varieties. Human factors have been effective in large scales concerning water challenges in the region despite the improvement patterns of cultivation by farmers and related organizations; inadequate training about sowing and the better use of water; not observing elements of correct plough and non scientific soil preparation on hill slopes; insufficient budget in water transferring canals, qanat, and spring divisions; starting construction

projects without consulting water, soil and natural resource experts; destroying water resources and ground drainage canals and also qanats and springs (i.e. Keedeh qanat by Baghkal dam project) and destroying natural path of ground drainages by ring way of khansar - Daamaneh plus transferring tones of soil and erosion sedimentation in lower lands.

Water resources pollution has increased in the last ten years due to excessive use of chemical fertilizers and poisons by farmers in the region. On the other hand, industrial development in the region and sewage from these units has caused pollution of soil and water resources. Construction projects heighten soil erosion and the amount of sedimentation, increasing soluble matters. To stop pollution with the limited water resources that are available is very important because in many regions of the country the main problem is not only limited resources but also poor quality and pollution of the limited resources.

Proposals

Water is undoubtedly a main part of development all over the world. In Iran because of its location in the drought belt-water importance is very high. Therefore, civilization, existence and development of populations are directly related to the accessibility of water. Considering the extant limitations in resources, the necessity of saving water in order to supply economic and political security is obvious and must be performed by all direct and indirect users of water resources, and above all, by the highest managers of the country. To promote better usage and control the negative effects of water resources in the Khansar Township, the following proposals are notable:

1- Better training on the use of water resources to all user groups including farmers, household consumers and industry and services sectors, managers, and students.

2- Accurate records of all surface and ground water resources with physicochemical properties (i.e. discharge amount, EC, TDS, and SAR) to create better plans to offset the challenges.

3- Adequate budget for applying modern technology in use of water, like changing traditional irrigation, covering canals, and repairing distribution network.

4- Forcing industrial units to filtrate their sewages and hygienic disposal of wastes to reduce soil and water polluting resources.

5- Forcing contractors and consultants to obey natural resources rules for saving basic sources of soil and water and performing pollution decreasing actions in projects.

6- More control on using aquifers especially in Dooshkharrat and Golsaar regions.

7- Expanding watershed management actions especially in origins of khansar, Khompeech, and Laayjand rivers and also in high lands of main qanats like Sangsefid qanat, Khompeech qanat, Kahrat qanat, Baadam qanat, Vaadasht qanat.

8- Increase in water price in various divisions to reach real price and reducing non essential uses.

9- Separating drinking water from the other uses.

10- Writing health manual of region watersheds considering various climatic, geological, topographical properties to scientific dynamic planning proportional to ecological possibilities.

References

Gavrilovic, Z., Stefanovic, M., Milovanovic, I., Cotric, J., and Milojevic, M. (2008). *Torrent classification-base of rational management of erosive regions*, XXIVth conference of the Danubian countries, IOP conf. series: Earth and Environmental Science 4(2008) 012039, IOP publishing.

Haadiani, M.O., (2005). *Physiography and Topography of Watersheds*. Mabaas press.

Jafari, M., Nasri, M., and Tavili, A., (2009). *Land and Soil Degradation*. Tehran university press.

Massoudian, S.A. and Kaaviani, M.R., (2008). *Iran Climatology*. Isfahan University pres.

Miller, G.T., (2003). *Living in Environment*. Translated by M. Makhdoum. Tehran U press.

Power Ministry reports, (2000). *Studies of Baghkal dam, basic information, weather report*. Tamavan Consulting Corporation.

Raamesht, M.H. and Sayf, A., (2005). *Soils Geographic*. Isfahan University press.

Refaahi, H., (1999). *Water Erosion and Controlling It*. Tehran University press.

Richardson, S., Karaka, M., and Stevens. (2005). *Effects of Road Making on Rivers Margins*. Translated by A. Salavatidezfooli and M. Mohsenisaravi. Gorgan Agriculture University press.