J. Appl. Environ. Biol. Sci., 5(8S)561-566, 2015

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

The water crisis and management of karst groundwater resources in Iran

Peyman Karimi Soltani

The teacher of Education and Training of Qorveh county- Kordestan province-Iran.

Received: March 8, 2015
Accepted: May 10, 2015

ABSTRACT

Water Crisis in the Middle East and especially in Iran has long been raised there because of particular situation of Geography of these areas; but in recent years, it has seriously been under consideration due to turning to groundwater and uncontrolled exploitation of the resources. In this article it has been tried to briefly study the origins of the formation of the water crisis in Iran and then, to consider the major water problems in Iran. Then the distribution of carbonate material in Iran that has a large part of Iran's groundwater called underground karst aquifers has been checked out, and finally, the problems that face Iran karst aquifers were analyzed and recommendations for the management and proper utilization of these valuable resources provided. To achieve the objectives, descriptive - analytical way was used and in the analysis of issues related to the water crisis, existing library resources were used. One of the problems that karstic aquifers face in Iran is the high potential of these aquifers for types of pollution which threat them in many parts of the country particularly around the big cities.

KEYWORDS: water crisis, indiscriminate exploitation, groundwater, karstic aquifers (water tables) water management.

1. INTRODUCTION

Water is one of the most fundamental elements of life. Having safe water as of human needs is known as an essential element and the factor of civilization, so that the communities always respected it and rivers around the world, were of paramount importance and had sanctity with populations living in those areas. No assurance of water, no country can ensure economic and social and political stability and without reduction of atmospheric pollution, water and food security of future generations will be vague and thus maintaining sustainable development will remain only as a striking slogan.Nowadays, the shortage and pollution of water, has put the lives of millions of the inhabitants of the land, especially in poor countries at risk severely. Statistically, 80 percent of world's population have access to only 20 percent of clean and sanitation water supplies. Diseases caused by contaminated water also as the cause of numerous mortality and morbidity in poor countries of the world. Water crisis is an unknown problem that its killing will respectively be far more than the death of infectious diseases of several hundred years ago, and AIDS and all the wars in the world.If the choice is not considered for human, the water crisis, in the future not too distant, will bring up such a disaster that will lead millions of people worldwide into the kill each year. In fact, today we are sitting on the razor sharp edge watching the destruction of our own generation. The generation who seems wiser than the past will not be able to close the way against their destruction[1].

One of the most important problems that humans face today, is the environmental crisis and their increasing needs from the environment and their expectations of it. The expectations now are emerging from the interaction of four major factor:

1. The population increase.
2. Increasing human demands.
3. Technological advances and their impact on the environment.
4. Human behavior in relation to their environment.

The average annual precipitation is about 800 mm in the world. In Iran, The mean rainfall during the last thirty years was only 251 mm and in Yazd province it was only 110 mm with about 60 mm in the city of Yazd, which this amount of rainfall has been reported even less than 10 mm in 2000 and 2001. Bitter and shocking statistics of the central locations of Iran show the importance of preserving the existing water resources largely. So very complex human environment is mixed with carbonate rocks. For example, in the former Yugoslavia (Serbia, Croatia and Bosnia-Herzegovina) in approximately 33% of the land is karst. 40% of land in the former Soviet Union includes the carbonates and other soluble rocks. Iran has the highest percentage of karst after the United States, China and Turkey and karst procreators cover more than 11% of the country [2].

*Corresponding Author: Peyman Karimi Soltani, The teacher of Education and Training of Qorveh county- Kordestan province-Iran. kpeyman1356@gmail.com

In this review article the effort is to briefly examine the problems of waters of Iran and discuss the roots in the gradual formation of the water crisis in the country and then to deal with the problems of karst groundwater aquifers, as one of the main sources of water supply in various sectors of agriculture, industry, drinking.

2. Methodology: The research type is descriptive - analytical and library resources have been used in the analysis of the issues related to the water crisis.

3.RESULTS

3.1. The formation of a Water Crisis in Iran: The problem of shortage of water resources and precipitation is an important and undeniable fact. increase in competition for water, the need of a growing population of the world to feed and increasing water scarcity in many parts of the world, are some important reasons to take a look at that how to manage water in the country. Lack of confidence in the amount of water resources, the serious competition for water from other sectors and increasing demand for food, have severely faced Iran to a water stress. The increase in consumption, weaknesses in the management of water resources, drought, and especially climate change phenomenon are considered as factors in the creation of a crisis situation. In the following, some of these factors will briefly be discussed.

3.1.1. Increasing population and increasing migration from rural to urban areas: Population explosion phenomenon has also occurred in Iran as well as most places of the world. In 1921, the population of Iran has been less than 10 million people that has increased to more than 75 million people in 2010 today. Also more than 80 percent of Iran's population was rural and 20 percent was just urban in the year 1921. Developing immigration policy from villages to cities during Pahlavi, the villages gradually emptied and towns were full of immigrants, living often on the fringes of cities. This Process gradually evolved to 50 percent urban and 50 percent rural until 1979 and finally in 2010, this has reached to nearly 30 percent rural and 70 percent urban.

3.1.2. Climate change: Climate change is now one of the most important environmental challenges globally so that temperature rise, melting of polar ice, rising global open water level and climate changes on the threshold are ahead of its consequences. Drought is a phenomenon that has surrounded many Middle Eastern countries, especially Iran for about 20 years.

3.1.3. Wrong policies in the agricultural sector: The fact, at the moment, is that the wrong policies in the agricultural sector is the root of many problems related to water and especially water table level drop of groundwater, in plains of the country. Exportation of indigested licenses for drilling deep and semi-deep wells in many regions of the country, is one of the wrong practices. In Qorveh and Dehgolan with 4,500 square kilometers of area, there are nearly 6,000 deep and semi-deep wells, which have had consequences as 100 meters drop of water table or even more in some locations of Qorveh and many dry wells of the city of Chahar Dooley.

3.2. The problems of water in Iran: In general, water problems in Iran can be divided into four categories:

3.2.1.Low rainfall: Iran is located at the semi-arid and arid part of the world geographically; the average precipitation in Iran is about 250 millimeter, while the global average is about 850 mm, which is more than three times the amount of precipitation in Iran. In such a way that the information and statistics show, in 6% of eastern and central range of the country the annual rainfall has been less than 50 mm and in 45% of southern, eastern and central regions nationally less than 200 mm and in 40 percent of the country between 200 and 500 mm and in 8 percent of northern and mountainous strand of west of the country between 500 and 1000 mm and finally in one percent of the northwestern coast of the Caspian Sea it has been higher than 1200 mm [3].

3.2.2. High evaporation: Iran placed at 25 to 40 degrees north latitude and crossing arid and semi -arid belt of the northern hemisphere over the center of the country, has lots of the water by the rainfall evaporated and out of reach.

3.2.3. Inadequate rainfall season: Unfortunately, while the most rainfall in autumn and winter, most of water in need in our country, as well as most countries in the world, whether in agriculture or in drink, is in the spring and summer.

3.2.4. Poor distribution of rainfall: Precipitation in our country does not fall in the same way. In the sense that the difference between the rainiest part of the country (a station in the West of Caspian sea and around the port of Anzali) with more than 2000 mm annual rainfall and lowest rainfall part of the country (Loot Desert) with

about 100 mm of rainfall per year, is about 20 times. The highest amount of rainfall of the country falls in the catchment area of the Caspian Sea with an area of about 11 percent (19% of the total rainfall in the country). With regard to the rest of the rainy regions over country, it concludes that 52 percent of rain and snow annually downfalls only in about 25% of the total country surface. Based on this, 27 percent of the total of the maker downfalls is falling on 4% of the total area of the country.

3.3. The distribution of karst in Iran: Calcareous and dolomite formations of the country is special for series of the Zagros Mountains in the West and Southwest and Alborz Mountains in the north and some heights of central mountains so that we can say it has occupied relatively large areas across the country[4].

3.3.1. Karst creators in the region of Zagros: Karst unevenness are developed and active in the West and Southwest areas of the Zagros Mountains, so that they have occupied over 350,000 square kilometers in this area. Many of karst formations outcrop in the Zagros region. Carbonate rocks related to Mesozoic and Paleozoic period are in the northern part of the Zagros and in the provinces of Chahar Mahal Bakhtiari, south and northwest of Isfahan, north east of the province Kohgiluyeh Boyer Ahmad and northern parts of the Fars province. So they are not fully mature and developed in terms of karst reserves and side effects; while young karsts related to Cenozoic era are observed in the southern part of the Zagros[2].

3.3.2. Karst formations in Central Iran zone: Karst roughness does have not so much development in the central region of Iran due to rainfall reduction. What can be seen of karst phenomena today, is related to the more humid climate of the past. In addition, because of igneous young veins influence in limestone as well as the effect of the orogeny forces, there has been created large changes in karst areas that the studies by Ministry of Energy, for example, in the central mountains can be reminded. Drilling operations in the limestone mass of south mountains of Finn in Kashan area has shown that they hit the water in a depth of 117 meters and continued drilling operations up to 160 meters[4].

3.3.3.Karst formations in the Alborz mountains range: Karst roughness is seen plentifully in the northern highlands of Albrz, so that the landscape of these unevenness can be viewed from as far as the Kopet Dagh of north of Khorasan to Astara. According research by Department of Natural Resources in the Kheyrud forest Kenar, karst phenomena has a great development because of hard and pressed limestone mass building of the second period. However, such a roughness of lime can also be seen in the regions of Deylaman and Syahgal.

3.3.4. East Iran: In eastern Iran, Balochistan, limestone formation located in southwestern Khash, is worthy of the extent so that Hamoon Chah-e- Gavi and Tagour are placed on it that perhaps these two pits could also be considered part of karst pits; and due to the limes extent there, future studies may be able to discover karst water resources in this dry region of the country[5].

3.4. The management of karst aquifers underground: Primarily limestone karst regions beside the great value and importance in various fields of biological, hydrological, mineralogical, science, culture, recreation, etc., have problems associated with stability or subsiding lime lands, as well as particular hydrological problems such as the following:

1. Their special talent in the development of pollution;
2. High permeability and cause problems during the construction of the dams;
3. Flooding when the closure and landslides in underground ducts;

Unfortunately, we are facing with many problems in the karst areas of the country. Due to indiscriminate harvesting of karst aquifers, many of these areas are Sinking and subsidence and some craters are also created in most of them. For the importance the underground karst aquifers in arid and semi-arid regions such as Iran and poverty of surface currents in these areas, they are somehow considered the most important water supply in various sectors of agriculture, industry, drinking and therefore, in the following, the issues and problems related to the management of these areas in relation to the water crisis in Iran will be discussed.

3.4.1.Indiscriminate extraction of underground water: many problems and issues related to unemployment and economic problems, smuggling and insecurity and regional sinking of land and a substantial drop in the groundwater level are of the consequences of uncontrolled exploitation of the groundwater aquifers in plain Rafsanjan (Mortazavi et al, 2014). Map of underground aquifers crisis of the world published by NASA, has displayed in Figure 1. As certified in the figure Iran is at the highest level in the world's groundwater depletion (purple).

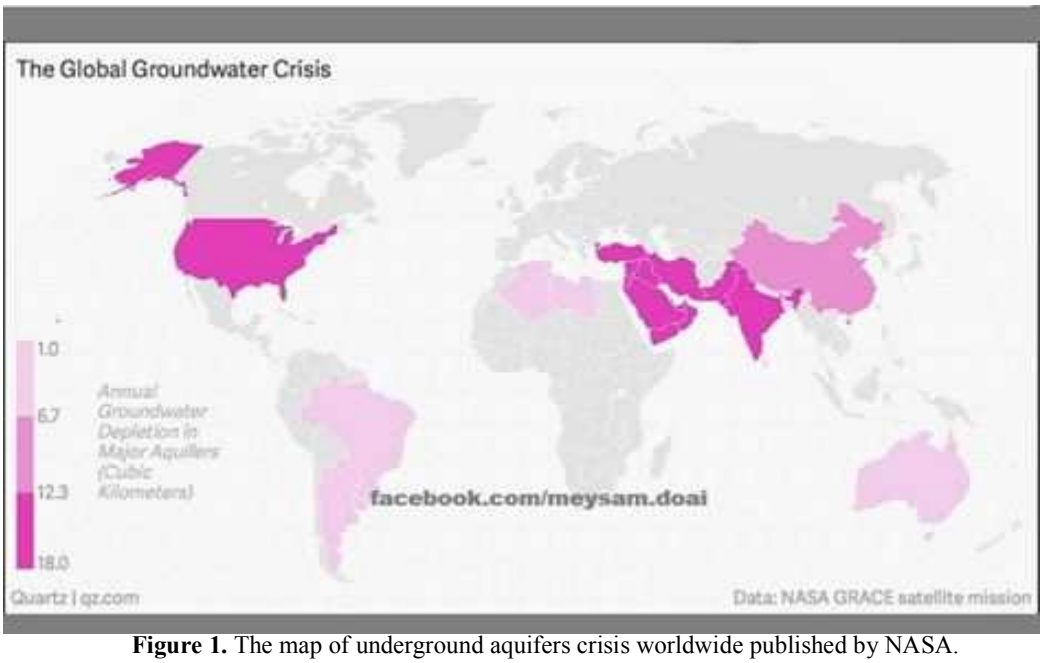

Figure 1. The map of underground aquifers crisis worldwide published by NASA.

The amount of this harvest out of the groundwater is between 12 and 18 kilometers cubic. To be able to have a clearer understanding of this number it is converted to cubic meters. Between 12 and 18 billion cubic meters of underground aquifers is harvested, in Iran. If we extrapolate the same 12 billion, this amount approximately becomes 66 times the Karaj Dam (capacity of Karaj Dam is 183 million cubic meters). But as seen in the map, the United States of America do not harvest anything less than us either. But the management style is quite different.

From the total of 95 billion cubic meters of water obtained annually in Iran, more than 87 billion cubic meters is consumed in agriculture for irrigation of 7 million 500 thousand hectares of the area under irrigation including 6 million and 300 thousand hectares of arable land and one million and 200 thousand hectares of gardens. Agricultural planners (FAO) believe that providing food for three people per year, requires one hectare of agricultural land. So for the country's current population of 70 million, the area under irrigation should significantly increase. At the moment, the efficiency of watering that mostly is in the form of flooding irrigation is estimated between 30 to 40 percent. In America with the implementation of extension methods and agricultural extension and research they could decrease 16 percent of the amount of water consumption per hectare during 1980 to 1995 AD. The use of water for irrigation of the important agricultural crops is very high compared to global scales. Current pricing of agriculture water is not based on volume of water Consumption; therefore it should be to ensure the price in agriculture based on the volume of water in order to increase irrigation efficiency and water consumption management in agriculture.

Another problem, is the excessive consumption of drinking water in villages and cities. Every person in Iran consumes 142 cubic meters of purified and plumbing water on average per year, while this figure is 108 and 105 cubic meters in high water countries such as Austria and Belgium. In cities of Iran, in all cases where there is a need for water, such as car washing, irrigation and as such, they use sanitary and plumbing water harvested mainly from underground water spending a lot of cost.

The concept of figurative water is regarded as one of the important issues in water resources management. In Iran, even though, the success of the domestic production of cereals has been impressive, this process cannot be kept but due to increased limitations of water resources. Moreover, dehydration in the future primarily will be due to unplanned use and not due to lack of water. The water used in the production of goods, is called figurative water, part of which has been kept in the product. Low water countries can use the water needed to produce water-intensive products, such as food, in other parts by importing them. This trade occurs by considering the respective advantage of the countries exporting food production. Thus, the country acts to export food which have better condition in producing goods compared to the importer countries in terms of Resources and factors of production. Imports of food products in Iran does not take place with the aim of virtual water trade yet. In the event that by taking advantage of new patterns to assess the status of the country in terms of comparative advantage in agricultural production and food import and export policies change in accordance

with the principles of food security, you can invest the benefits of it in other sectors, and cope with water crisis in countries affected by drought.
Rainwater harvesting is one of the most significant and the most appropriate management techniques to deal with dehydration. Revival traditional practices that often prevailed in many central parts of the country for centuries can be useful in this regard. Rainwater harvesting, is done with different interests and motivations that its main aim is to optimize the management of rain water utilization based on requirements and consumption.

3.4.2. Contamination of underground karst aquifers: One of the most important karst hydrology issues is related to groundwater pollution in these areas. As it was said in the debate before the dissolution agent in carbonate rocks and other soluble rocks causes development of cracks and crevices, caves and other pits and troughs. These effects form a system of underground channels for water transition in the basement.
Waters infiltrated into the ground through abundant cracks and gaps and Ponor and vessels (which are regarded as places of the absorption of limestone plateaus) and as well as surface rivers and streams that disappear in such areas compose karst limestone aquifers. Groundwater in these areas flow easily and join into underground without passing through the filter aquifers under the effect of gravity force. Refining level of the polluted water in these areas is very little or lack of it because of the loss of soil layer and as well the presence of karst landscapes (cracks and solution holes and cave rivers); in addition, contaminants transfer faster in the karst hydraulic system than non-karst areas and reach limestone aquifer in a short time. The attenuation capacity of karst areas is limited to reduce environmental impact of pollutants for the following reasons:
1.Tack of significant levels of absorption, ion exchange or destruction of pollutants by microorganisms.

2.The rapid penetration of polluted runoff into underground aquifers

3. The presence or absence of thin soil cover, which allows the rapid transit of pollutants.

4. Governing regime of turbulent flow[6].

Karst aquifers contamination transfers by various mechanisms and is dependent on the physical and chemical characteristics of the pollutants.

Factors affecting the karst water pollution can be categorized as follows:

1. The transfer of pollutants (wastewater and sewage) into karst hydrological system.

2. The waste buried in stone-pits and gaps in karst rock.

3. Drain water contaminated with fertilizers and pesticides from agricultural lands and Gardens

4. Transfer of detergents and chemical contaminants into karst drainage basin and aquifer.

5. Waste and manure-contaminated waste water on the path of the rivers[7].

Some of the important management strategies of karst areas to prevent the pollution are:
1. Geo-morphological and hydrological study and research in karst areas in order to exactly detect them and evaluate their degree of development.

2. The control of land use in karst areas which their water resources are used for drinking in cities or in rural areas. For example, deforestation in areas of karst and diversion of water channels, mining, agriculture, or any substantial change in the structure of the earth should be done based on the principles of land management.

3- Waste collection and prohibition of burying them in stone-pits or karst gaps, since burying waste in the karst drainage system path could easily analyze sand with rain water and be conducted into the aquifers pollute it because of the sensitivity of karst drainage system is very high.

4-planning protection of mountain karst where there are nomadic or rural livestock pass. The establishment of livestock in the springs or their drainage basin or along the rivers of karst areas can be risky because of the accumulation of excreta and manure.

5. Management of throwing waste and any pollutants by visitors and tourists who enter by tours to view areas of karst (caves, mountains, springs and other karst landscapes) [8].

4.DISCUSSION AND CONCLUSION

The term karst is a collection of geological processes and phenomena of rocks dissolution and becomes obvious by formation of the dehiscence, destruction and degradation of buildings and the condition of the rocks, creation of a special type of water circulation regime, and the specific type of the region's topography and finally the special regime of drainage. Karst areas often have a great deal of ground water aquifers in the underground cavities, pores and slots and vast spaces and cavernous.

Large parts Iran is covered by limestone and carbonate rocks and due to the geographical location of Iran on the arid and semi-arid belt of the world, the importance of these rocks in terms of reserves of underground water tables in them becomes several times. This kind of rocks along with their many advantages, mainly are facing with the problems as well, which unfortunately most of these problems have emerged due to lack of proper planning in this field in our country.

Water crisis has always threatened our country and our neighboring countries, but this threat and problems caused by it have been very serious since a few years and the lack of surface water due to climate change has led to the large influx towards groundwater especially karstic aquifers in most parts of the country plains and places for use in agricultural and drinking water supply for cities and villages. Severe vulnerability of karst aquifers has doubled the problems caused by indiscriminate exploitation of these aquifers, and if no management is taken correctly and principally in this field, its consequences will affect all economic and social aspects of our society.

REFERENCES

1. Rahimi, H.,The water crisis: Global unknown problem, Peyk-e-Nour Magazine,2003.1(2).
2. Afrasiabian, A.,The importance of research of karst water resources in Iran, Proceedings of the Second International Conference on Water in karst formations2008, Kermanshah- Tehran, Iran.p.131-143.
3. Mohammadi, M.,to Analyze the effects of global warming on water resources and Iran soil, the Second National Congress of the soil and water issues of the country1996, Tehran, Iran.p.27-35.
4. Haririan, M., Iran geomorphology Generalities1990, Islamic Azad University Press.p.63.
5. Asghari Moghaddam, M.R., Principles of geomorphology2004, Sara.p. 257.
6. Jjalilvand, R.and Laila,N.H., Environmental pollution of groundwater of karst areas and ways to protect karst areas,the fourth Specialized Conference of Environmental Engineering2010,Tehran, Iran.p.1-10.
7. Eshghi, A.Emission factors influencing karst, Journal of Literature and Human Sciences, Shahid Chamran University, Ahvaz, 2005.1.
8. Eshghi, A., Servati, M.R., Potential pollution factors of karst water resources in the basin of Karde (the north of Mashhad city), Geography and Development Magazine,2003.1(2).