The Mesozoic karst of masses and relationsheep drainage system sensitivity in kharkat-kardeh basin in north of Mashhad (northeast of IRAN)

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Abstract

Karst zones in north of Mashhad provins witch are Mesozoic Karsts, have specific importance in provision of water for the city of Mashhad.

Currently, by utilizing of Live water wells in karst formation of kharkat-kardeh basin (547.10 km^2) and also stored water behind kardeh Dam (about 46km north of Mashhad), part of drinking water of Mashhad.

Will be provided. Hydrologic system of karst has a high sensitivity to pollutants. Thus, various factors including burying of garbage's in singholes and karst shafts, entrance of wast water and sewages to hydrologic system of springs and karst rivers, entrance of wast water containing chemical fertilizers and poisons (pesticides and herbicides), and also environmental hazards resulting from tourism in this region, have caused the pollution of ground water and surface water resources.

The purpose of this paper is recognition of effective factors on pollution of karst areas of kharkat-kardeh Basin, in eastern part of kopeh-Dagh zone. (Northeast of Iran). Five percent of the drinking water of Mashhad in north-west of the city is provided by water resources of karst of kardeh Basin.

In summer, due to increase of concentration of the pollutants and environmental problems, transfer of water from kardeh Dam to Mashhad is blocked and odor and taste of the water change entirely. Because of transfer of pollutants to water reservoir of the dam.

Usage of GIS techniques and Field operations especially in karsts of northern and central parts of the basin, and also execution of several experiments, the effective factors of pollution of the water resources of the karst in the region, have been recognized. Generally, %80 of drinking water which is necessary for rural residents and suburbs of kardeh basin is provided by karst water resources and %20 by the rivers. There fore, the entrance of pollutants to limestone aquifers and karst drainage system in this area can have an direct effect on consumers, health.

Key worlds: *karst zones, limestone aquifers, water resource pollutants, drainage system.*

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Introduction

Karst territories in eastern part of kope-Dagh zone usually are unable to filter water and their filtration coefficient is low. (Eshghi,2004.p94). Because the network of fissures in limestone and dolomite masses is vast and the secondary porosity is high.

Furthermore, the pollutants in hydrologic system of karst are transferred faster than non-karst areas to calcareous aquifers. (Queen land etal, 2004). Currently the drinking water of, %25 of world population is provided from karst water resources (Velayati & Behniafar, 2007) and it is increasing. The size of the karst masses in Khorasan Razavi province is over 17000km^2 which are used as karst water resources in order, to provide drinking water for the cities and suburbs of Khorasan Razavi. (Mashhad and other cities). The karst of koph-Dagh zone are mostly Mesozoic (like karsts of Zagros range) from Jurassic and Triassic.(Servati & oskani, 2004).

Tourism in kharkat-kardeh basin and other pollutants of karst water resources, including permeation of house sewage into rivers, burying of garbages in karst landforms, permeation of wast waters and animal excrement into karst surface water and ground water resources worsen the quality of water reservoir of kardeh Dam.

About %80 percent of the drinking water of rural residents of this basin is provided by springs and karst water resources (Badiei Nameghi, 2002) and is transferred to Mashhad through seven water well in calcareous aquifers and also with water reservoir of kardeh Dam. Never the less, the problem of water pollution has occurred.

Meanwhile, permeation of sewage into surface waters and drinking basin of springs sewage wells in this basin which %65 of them are located in singhols and karst shafts, might occur (Servati & Eshghi, 2005). As a result, karsti fication process has been intensified by the dissolution of calcite and dolomite in Mozdouran (1) and Mozdouran (2) formations:

$$CaCo_3 + H_2Co_3 \rightarrow Ca^{+2} 2HCo^{\overline{3}}$$

$$CaMg(Co_3) + 2H_2Co_3 \rightarrow Ca^{+2} + Mg^2 + 4Co^{\overline{3}}$$

Location of Case study:

Under study area is located in northern part of Mashhad Township and Khorasan Razavi province (northeast of IRAN). Topographically, karst area of kharkat-kardeh Basin is located Hezar Masjed Mountains in eastern part of Kopet-Dagh zone (figure 1). Kharkat-kardeh Basin is 547.10km^2, which about %70 of this basin is karstic (Limestone and dolomite).

Geographical coordinates of this basin is $36^\circ - 37'$ to $36^\circ - 58'$ North latitude and $59^\circ - 26'$ to $59^\circ - 46'$ East longitude.

This basin has six subbasin and the highest point in north of kharkat village is 2900 (m) and the lowest at the exit of kardeh Basin is 1250 meters. (topographic map, Defence Ministry, 2009). The karsts in this area are mountainous and semi-arid regions.

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Methology:

Due to deterioration of quality of water in the springs and rivers, especially water reservoirs of kardeh Dam in the dry seasons of the years and also increase of children diseases (diarrhea, stomach infection), it was decided to make a relation between karst hydrologic system and entrance of the pollutants (garbages and waste matters) through field operations and water experiments. Research tools included: topography, geology, land use, distribution of rural area, and pedology, layers which were prepared in GIS. Moreover, the relation between recognition of pollutants of karst water resources and other pollutants which enter the reservoir of dam were studied and assessed by aerial photographs and field operations.

Tracking test were executed by colored materials in three of the basin and in karst area in order to link the penetrative wells to the springs basin. The results were prepared in the from of maps called type of water pollutants.

The relation between the entrances of pollutant with karst landforms:

The pollutants enter hydrologic system of karst through karst landform. (Ford and Williams, 1998). According to table (1) which was prepared by surveying karst domains in kharkat-kardeh basin, there are three limestone-dolomite formations.

A. Mozduran (1), (contains layered limestone and dolomite).

B. Mozduran (2), (contains massive limestone and dolomite, related to upper Jurassic and Early cretaceous) (Iranian Geology organization, 2009).

C. Chamanbid formation (contains thin-layered limestone with marl interlayer related to lower Jurassic).

Totally, karst area over %50 of the basin most of the karst features are located in Mozduran (1) and (2) formations (table, 1). As shown in figure 2, the size of karst formations of Mozduran (1) and (2) in the basin is more than other formations.

Table (1), Geological formations of kharkat-kardeh basin in koppet-Dagh zone

Formation	Name	Lithology	Area (%)
Mozduran (1)	Mz_1	Linear limestone	21.69
Mozduran (2)	Mz_2	Block limestone, dolomite	32.80
Chamanbid	Jch	Limestone, marl	26.51
Shorijeh	ksh	Conglomerate, sandstone, and linear limestone	10.5
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others	---		85
Total			100

Karst features including linear and vacuolated karens, funnel-shaped (Aven) and singholes, karst shafts, caverns and polygenic features, are chiefly formed in these two formations.

Karst do lines and sing holes, especially limestone shafts are suitable places for burying garbage and wast matters.

According to the fields survey of the shaft limestone in close proximity to the Aāl village and three sinkhole limestone dolinite in Balghoor village revealed that according to the table (2), various rubbish materials as remainders of plastic materials, nutrous rubbish and pile of carpet wearing were buried into this karst landforms.

Throwing away rubbish and trash by tourists around kardeh dam and route of basin upstream rivers, have intensified water pollution risk. Raining infiltration and snow melting have caves decomposing and deterioration of trash in shafts of karst and with penetrating runoff into karst hydrologic system is one of the important sources of water pollution, ferrous oxide especially oxidation of metallic materials (a Tin cans).

Table 2: important kinds of karst land forms in relation with drainage system of karst zonation in kardeh*

Raw	*Karst landforms*	*Relating with drainage system of karst*
1	Linear karren and diffuses solution	Drainage of defuses currents in hydrologic system
2	Rinnen karren (hole and hive)	Related Epi-karst Endo-karst (danger of latex transmit ion)
3	Solution and collapsing do lines	Transmitter of domestic animal dropping and latex in drainage basin of cave streams
4	Caves	Place of trashes and metallic oxides danger risk
5	Karst shafts and breakages	Human pollutant transmitter, latex and detergent
6	Small sinkholes	Gathering place of manure or domestic animal watering place

** The source: field studies and tracking experiments of kardeh to kharkat village (2009).*

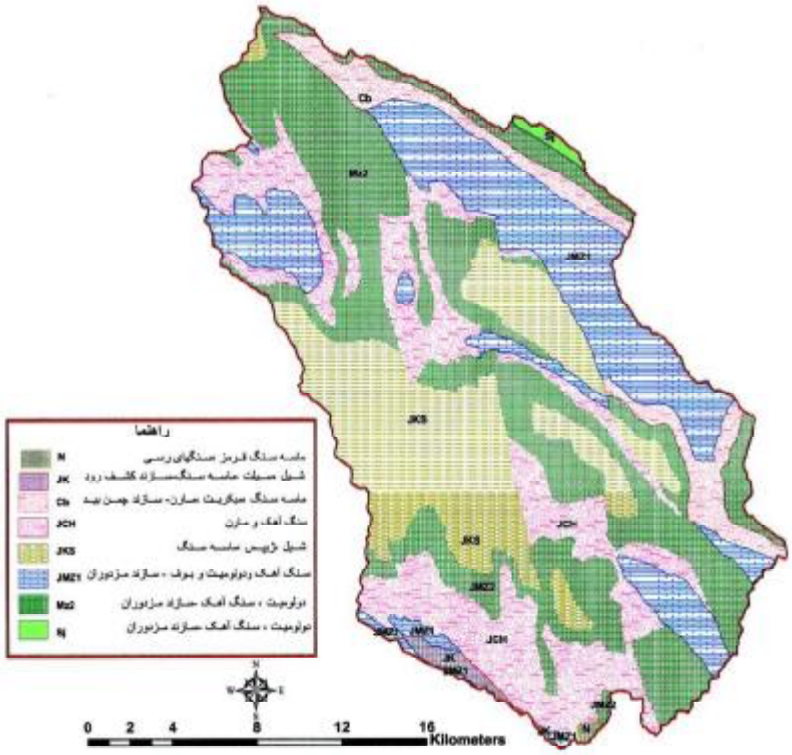

Figure (2). Geologic Map of kharkat-kardeh basin

Various pollutants in karst zonations of basin:

Considering mountainous region and having very karst landform and shapes especially in upstream villages of basin. Tourism has developed to a great extent during last decade. Also the presence of native and nonnative nomadic tribes on the way of main river, basin of karst spring and also a sewer infiltrator.

Wells in 13 village of basin and township of kardeh are among the main karst hydrologic system disasters. We can totally classify potential pollutants of karst water resources as followers:

1) Transfer of sewage and effluents by karst shapes and landforms into rivers and limestone aquifers, totally 547.1 square kilometer of basin extent, There are 620 sewer infiltrator well rings in rural areas 65% of there wells are places in sink holes and karst diffuses that become of soil loss and sedimentation material are not any water filtration Rural areas effluents divertly inter The main river or diffuse and karst breakage.

2) The bury of trash in karst sinkholes and throwing rubbish in rivers suburbs and kardeh reservoir dam by tourists and basin rural these rubbishes and consist of fruit peel and vegetables, plastic and disposable materials, metallic material, glass bit, food stuffs remains and charcoal.

3) Enter of polluted flows with fertilizer and chemical poisons from forming and garden into the main river as usually dam lake.

Traditional cultivating ways and the lack appropriate agricultural management on the one hand and mountainous region on the other hand, bring about manure and chemical, fertilizer's entrance from terraces alluvial of river suburb to words of kardeh dam reservoir and karst aquifer.

4) Transmission of detergents by rural into karst drainage basin especially in kardeh branch toward kowshk-abād (southwest of basin). Detergents from of washer and detergent from powders remain longtime in rivers and aquifers (craw ford 2002, p.196).

According to investigations that we recon ducted on year 2008, the average of detergents entered in rivers of kardeh to Marreshk route were the movement of 956 liters liquid detergent and 1155kg. Detergent powders considering that lack of natural filtration in karst area, is serious danger of water pollution and environmental hazard in Lang-term.

5) Domestic animal wasts that spread in the river route by nomadic tribes' domestic animal passage Dr Gather around of spring manifestation. Domestic animal wasts have vital role in deteriorating water quality especially water of spring and river.

Traditional livestock breeding is one of the main environmental problems in karst areas and has influenced region ecology (cupver 2003, p.311).

Considering the tracking experiments in various karst springs in route of Aāl to Balghoor revealed that many of pollutant materials as animal dropping and detergents can inter hydrologic system of karst and main river via sink holes and karst diffuses.

The cave stream number of karst masses in many areas of basin as Aāl and kharkat have very much movement.

The paper , shows different kinds of potential pollutants for karst water resources in the studied area. This is a result of field researches, tracking trial effect and result of extracting question ires as well that concerned to detergents usage. It reveals main problems of basin as the factors that threaten karst water resources.

Conclusion and suggesting:

A portion of drinking water of Mashad is provided by karst aquifers and kardeh dam reservoir in 45km north of this region. Transfer of pollutants in karst mountainous basin of kardeh to karst drainage system especially in kardeh downstream river has brought up many environmental problems related to the deteriorated water quality. Also %80 of consumption water of basin residents is provided by springs and karst water resources. This problem can create deceases resulting from water pollution especially in late of spring and summer seasons.

Deterioration of water quality in summer season prevents transition of water from dam reservoir towards Mashad. Conclusively, this inters more pressure on another underground of city region. Therefore, short-term and Long-term strategy of karst aquifer water resources management in country and regional level as well is essential now days, there is no policy making related to the karst water resources management from an environmental hazard and sanitary issues.

Karst aquifers have special importance in coastal borders of Queshm an Kish islands addition to interval part of country. This part needs a conscious management in the case of pollutants control with its hydrologic system. Legislation in the field of karst water resources protection on the country level will play a vital role in this case. We are in need of controllable laws in the karst zonations management and protection point of view, especially in the mountainous karsts (Zagross, Alborz, Kopt-Dogh and central IRAN) a number of controllable important working methods in this case as follows:

A: Planning in the field tourists control entrance in the place of dam lake and environments of karst wells.

B: Setting up dustbins to collect trash gathering and to prevent throwing rubbish in sinkholes or rubbish burring.

C: Gathering of rural sewag by septic especially in the surrounding of rivers and karst spring route.

D: Prevention of domestic animal wasts in springs drainage basin place or karst sinkholes.

E: Non-transition of detergents into the river route, dam lake and springs drainage basin.

F: Setting up of warning boards in order in form pollutant risk of karst aquifer.

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