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Groundwater pollution to nitrate and salinity in west of Dez irrigation network, Dezful, Iran

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Abstract: This research aims to map the spatial zoning of 2 quality parameters including EC and NO3 in the groundwater resources around west Dez Irrigation Network and its zoning with GIS for 35 observed selected wells. Also in this paper changes of these parameters during the study period were evaluated (since water year of 2004 to 2013). Comparison of the maps of the spatial zoning of the groundwater depth during the period under study showed that in this region because of the increasing in agricultural activities and overusing of chemical fertilizers, concentrations of the NO3 and EC in groundwater were higher in this period.

Key words: Groundwater; Dez irrigation network; Salinity

1. Introduction

The arid and semi-arid zone such as southwest of Iran is characterized by excessive heat and inadequate, variable precipitation, on the other hand in this region agricultural activities is mechanized and use of chemical fertilizers is high. Nitrate contamination is one of the most widespread groundwater problems worldwide and in the world that affecting drinking water supplies in many agricultural areas. Shahpasand et al. (2004) in a research studied the environmental impacts of urban development on contamination of groundwater nitrate In Gorgan region. Jalali and Kolahchi (2005) examined nitrate concentration in groundwater in Bahar region in Hamadan. The results of the research conducted by Gheisari et al. (2007) in the southeast of Esfahan showed that in some areas nitrate concentration was higher than the international standards. Fekkoul et al. (2011) pollution of groundwater of Triffa plain located in arid and semiarid region in the west to nitrate, salinity and pesticides studied.

The results of this study showed that due to the indiscriminate use of chemical fertilizers in the desert plains of nitrate concentrations in groundwater above and beyond the limit of the global environment. Groundwater pollution, particularly with nitrate (NO3) and salinity, is a global problem in the groundwater source and affect both human and ecosystem health (Choi et al. 2007). In this research Impact of land-use types on nitrate concentration and salinity were studied. Salinity accumulation is another long-term groundwater quality challenge. Salinity accumulation has a history of ending agriculture in arid regions (Hillel 2000). Salahat et al. (2014) in a study 178 groundwater samples were collected and analyzed for salinity and nitrate content. According to desirability function analysis, maximum salinity and nitrate pollution was predicted to be associated with irrigated agriculture lands at shallow aquifers with silty clay loam soils.

2. Methods and materials

Dezful is located in the northeast of Khuzestan Province with warm dry climate and is one of the agricultural production poles in the province. The cultivation area in this town is estimated to be 82000 hectares and about 80% of farming is as irrigation and the rest is as rain fed agriculture. Also, the annual agricultural production in Khuzestan is about 14 million tons and in Dezful it is about 1 million ton (Ministry of agricultural Jihad, 2005). The average annual rainfall in the region is 350 mm by the maximum of 672 mm per year in the water year of 1075-1976 and the minimum of 147 mm in 2007-2008. The area of the Dez river (in this city) catchment is 23250 km2 and originates from the foothills of western Zagros Mountains in Aligoodarz and eastern foothills of Lorestan mountains and Dorood and Boroojerd. The river water quality for agriculture and according to international standards of Will Cox diagram is placed in C2S1 classification and its electrical conductivity (EC) is ranged from 450 to 550 µmhos/cm and its sodium adsorption ratio (SAR) is less than 2 (SAR<2), and the total dissolved substances is fewer than 500 parts per million (TDS< 500).

In this research the samples has been taken from the groundwater (at least 30 wells out of 60 existing wells) in the west of Dez irrigation network and with proper spatial distribution. The research will be

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carried out to investigate the salinity and pollution of groundwater resources with nitrate within Dez irrigation network and its mapping by GIS. Field experiments and preparation of the required maps will be done in GIS environment. Density of the wells network depends on topographic, geological, and hydrological conditions and also the area and expansion of the region under study. Nitrate and EC were measured with spectrophotometer and salinity meter. ArcGIS 9.3 software was used for zone mapping of nitrate and salinity concentration in groundwater in this research.

3. Results

In this paper concentration of EC and nitrate (NO3) was studied, then changes trend of these parameters was examined at the beginning and end of summer in 2004 and 2013 and the diagrams were drawn for the selected wells. Fig. 1 shows scheme of observation wells.

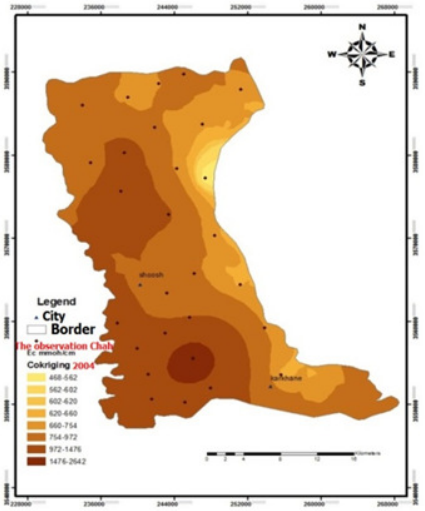

Fig. 2: Spatial zoning of Ec (µmhos/cm) in the summer of 2004

Fig. 2, 3 display the map of Ec changes of groundwater in the west of Dez irrigation network. According to the obtained results, the minimum and maximum Ec in the studied area is 450 and 3010 in 2004, and 500 and 1470 in 2013.

Fig. 4 shows trend of EC in groundwater at west of Dezful. In general, trend of these results shows that in this period concentration of the electrical conductivity of water is greater.

Fig. 5 displays the map of NO3 changes of groundwater in the west of Dez irrigation network. According to the obtained results, the minimum and maximum NO3 in the studied area is 450 and 3010 in 2004, and 500 and 1470 in 2013. Results indicate that concentration of nitrate in these periods (from 2004 to 2013) increased via agricultural activities such as overuse consumption of chemical fertilizers.

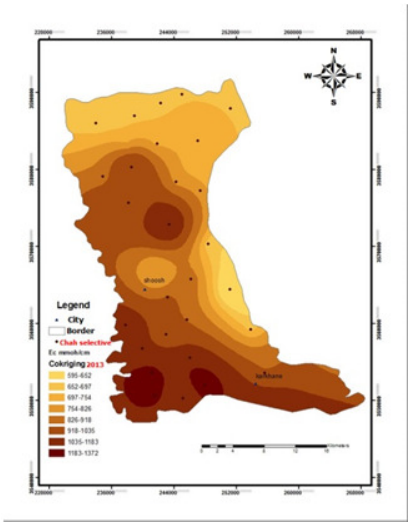

Fig. 3: Spatial zoning of Ec (µmhos/cm) in the summer of 2013

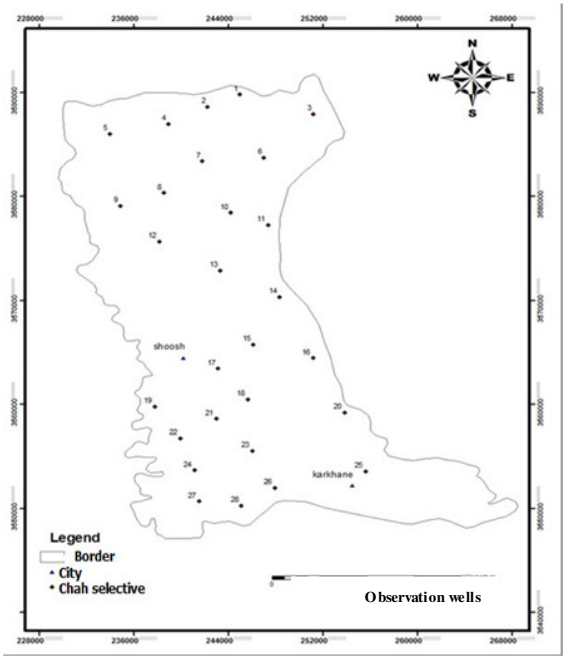

Fig. 1: Map of observation wells

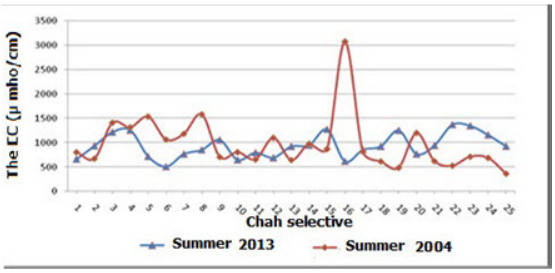

Fig.4: Changes of EC at the beginning and end of statistical period

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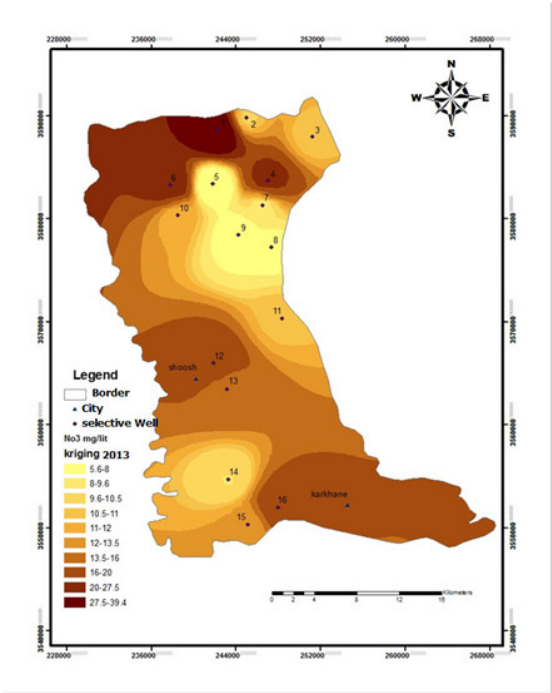

Fig. 5: Spatial zoning of NO3 (mEq/L) in the summer of 2013

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