

# Arsenic Occurrence in Drinking Water of I.R of Iran: The Case of Kurdistan Province

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## **Abstract**

*Presence of arsenic in surface water and groundwater resources of many countries in the world has been reported because of dissolution from earth crust. Thousands of peoples suffer from chronic arsenic poisoning due to consumption of polluted water. In Iran like many other countries, geogenic arsenic could affect ground water resources in some area. Kurdistan, a western province of Iran, is facing this problem and arsenic is endemically present in drinking water of rural areas of this province. There is exposure to arsenic in some villages of this area for more than 30 years. As a result, chronic poisoning manifestations such as skin lesions - keratosis, pigmentation - and even amputation due to gangrene are reported in these villages. Measurements have shown arsenic levels in some water resources as high as 1.48 mg/L. In this paper the situation of Kurdistan province has been presented. Results of measurements conducted for arsenic in drinking water, and the future plans aimed at finding the most appropriate solution to providing safe drinking water for the residents of Kurdistan are presented.*

## INTRODUCTION

Arsenic is a naturally occurring element that ranks twentieth in abundance in the earth's crust, fourteenth in the seawater, and twelfth in the human body (Naqvi et al., 1994). Exposure to this substance has many chronic and acute health consequences. It enters the human body through ingestion (water and meals), inhalation, or skin absorption and may be in inorganic and organic forms. Although organic form is more common and higher doses of arsenic enter human body in this form, the inorganic form is more toxic and in fact, the main route of involuntary exposure to arsenic is exposure to this form due to presence of arsenic in drinking water (Elizalde-Gonzalez et al, 2001). In spite of profound health consequences of arsenic in drinking water, it is not routine in laboratories to measure and even test water supplies regarding arsenic in I.R. of Iran. The WHO provisional guideline value for arsenic in drinking water is 10 µg/l (WHO, 1993). However, in Iran, like as many other countries and indeed in all affected developing countries this value is 50 µg/l (ISIR, 1996). According to available reports, in Iran several areas have been affected by natural arsenic contamination. Although government took many initiatives to supply fresh water to villages, as it is not routine to measure the level of arsenic in drinking water, some of these water supplies are polluted and some people are exposed to arsenic. Exploration of polluted water supplies throughout the country is one of the priorities of government and is being conducted now.

## ARSENIC CONTAMINATED AREA: KURDISTAN PROVINCE

Kurdistan province is in west of Iran between 34° 44' to 36° 30' North, and, 45° 31' to 48° 16' East and is in neighborhood to Iraq (fig. 1). Its area is about 1.7 percent of country and has more than 1,300,000 inhabitants. This province is a mountainous region and has two different types of weather: cold weather in high altitude area and temperate weather in valleys and some of western parts. Mean temperature of region is about 12.5°C and annual rainfall is about 500 mm. Sum of flowing water is estimated to be about 7786 million m<sup>3</sup>, of which about 14% is used in the province. Bijar County, an affected region from naturally occurring arsenic, with 580-km<sup>2</sup> area is located on the Northeast of the Kurdistan province and has an average altitude of about 1750m from sea level (NGO, 2001). There are 17 deep wells, 616 dug Wells, 42 springs and 9 subterranean canals in this area (KMPO, 2000). Total annual water consumption of this County for municipal, industry and agriculture uses is

about 30 million m<sup>3</sup>, which is mainly supplied from underground resources. Field studies have shown elevated levels of arsenic concentration in some rural areas of this county. The first cases of chronic arsenic poisoning due to drinking water were diagnosed in 1981. But no scientific and systematic study has been conducted in the region pertaining to prevalence or incidence of such a health consequences. Arsenic concentration of water resources of 18 villages are presented in table 1. As shown in this table, there are some villages with more than 1000µg/l arsenic in their water supplies. Mean concentration of arsenic in these villages is about 290µg/l, six times greater than national standard. Primary investigations have shown that the source of this arsenic is mainly geogenic due to dissolution of arsenic containing compounds in earth's crust. Anthropogenic sources may be important, as mining is one of the industrial activities in the area; but industrial wastewaters or pesticide application have not been identified as source of pollution in the area.



**Figure 1: Location of Kurdistan province in a map of I.R of Iran**

**Table 1: Arsenic concentration of some water sources in rural areas of Kurdistan province exceeding WHO guideline of 10 µg/l**

No. of village	Type of water source	Type of use	As concentration, µg/l <sup>-1</sup> **
1	Spring	Piped for drinking	32
2	Spring	Piped for drinking	10.7
3	Well	Piped for drinking	21
4	Spring	Piped for drinking	187
5	Well Underground canal	Piped for drinking Non drinking	205 206
6	Spring Spring	Piped for drinking Non drinking	11.6 11
7	Spring	Piped for drinking	15.9
8	Spring	Non drinking	28
9	Spring	Non drinking	15
10	Spring	Non drinking	28
11	Spring	Non drinking	45
12	Spring Spring	Piped for drinking Piped for drinking	90 30
13	Spring Spring Spring Spring Spring	Non drinking Piped for drinking Piped for drinking Non drinking Non drinking	1040 210 801 440 470
14	Spring	Ordinarily used for drinking	43
15	Spring	Piped for drinking	23.9
16	Spring Spring Spring	Piped for drinking Ordinarily used for drinking Non drinking	1480 20.8 118
17	Spring	Piped for drinking	422
18	Spring	Non drinking	408

\*Measurements have been conducted in 2001.

\*\* Analysis method: Neutron Activation

## GOVERNMENT ACTIONS

Recognizing and labeling polluted wells and springs, supplying fresh water to polluted area with portable reservoirs and identification of alternative water resources are amongst governmental activities for solving this problem. Indeed, there is a big study for assessment of arsenic in total water supplies of Iran (in primary phases). In the case of Bijaar County because of lack of awareness of full picture of the problem in the area, we are planning to conduct following activities as the main theme of our future studies in the area:

1. Development of arsenic mitigation strategy.
2. Formation of expert committees for situation analysis.
3. Analyzing total water supplies regarding presence of arsenic and other heavy metals.
4. Defining sources and mechanisms of arsenic presence in drinking water.
5. Immediate detection and treatment of arsenicosis patients.
6. Conducting a pilot study for removal of arsenic from drinking water, with special regard to POU technology suitable for rural areas.
7. Education and involvement of local residents in problem solving.

We appreciate any scientific and financial support from international agencies for conducting the above activities and reaching our goal of reduction of exposure to arsenic via drinking water.

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