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# Seasonal Fluctuation of Heavy Metal and Nitrate Pollution in ground water of Farmlands in Talesh, Gilan,Iran

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**ABSTRACT:** There are very few studies evaluating the heavy metals and nitrate contents in their soils and groundwater in the north provinces and cities in Iran although majority of rice, tea and other crops comes from these location. Dangerous contents of Cadmium and Lead could been found in recent years in Mazandaran and Gilan agricultural products due to contaminated source tapped to address population and over fertilization with chemical fertilizers and high rain falling.A descriptive – analytical and cross-sectional study was conducted for determination of Lead and Cadmium as heavy metals and nitrate in 100 samples of ground water and soil of 10 different sites in Talesh in the North of Iran in three consequent months in (winter and spring;summer, 2013). The results revealed that all samples in panjahaft had lead and nitrate contents above maximum level 0.01 mg/L and 50 mg/L which is recommended by WHO (WHO, 2007; US/EPA, 2013) and Lead was present in detectable amounts in all samples while cadmium content in all samples was lower than permissible levels of WHO 0.003 mg/L. In this study, among 100 groundwater samples, 6 samples (with mean Lead content of 0.006 mg/L, about 0.00 mg/L Cadmium content and 26.14 mg/L nitrate content ) in winter were classified in "Excellent" class for drinking, while 53 samples ( mostly in summer season had nitrate content $<$ 50 mg/L , but lead content $>$0.01 mg/Lit) , and 41 samples were in "Poor" class due to had Lead and Nitrate more than permissible levels.

***Keywords*:** Ground Water, Contaminants, Cadmium, Lead, Talesh, Guilan

## INTRODUCTION

Farmland pollution is a complex environmental issue. Harms from it include the visible waste and degradation of the Earth's surface, which makes soil unsuitable for redevelopment or agricultural purposes, and complications in the soil structure, which can influence the chemical properties and biological activities in a particular landform (Cantoria, 2012).

Gilan Province, owing to its rich natural resources, is one of the most populated provinces in Iran (Charkhabi et al., 2007**).** Irrigated agriculture is one of the most well-known causes of groundwater contamination throughout the Gilan state in the north of Iran. According to the provincial statistics in 1998, Rasht City released 1.4 million m3 untreated sewage into the river which is attributed to the increasing urban development (Shirinfekr, 2001). Furthermore, according to a report by Pirasteh and Eimandel in 1997, the annual loading of sediment, nitrogen, and phosphorus to the river were 86,000, 931, 184 metric tons, respectively ( charkhabi et al., 2007). Particularly concern is problems caused by inadequate management of nitrogen compounds (fertilizers) that lead to groundwater pollution by nitrate. Also of concern is the pollution of groundwater by pesticides, salts derived from utilization/evaporation of irrigation water, etc. The magnitude of groundwater pollution associated with irrigated agriculture is dependent on a variety of factors, such as chemicals/materials applied to the land/crops, soil/aquifer characteristics and water management (Lee and Jones-Lee, 2007) . Lead and arsenic can enter the human or animal body through direct or indirect pathways. A direct pathway is the unintentional consumption of lead and arsenic via the drinking of contaminated water or the inhalation and/or ingestion of contaminated soil and dust ( Environmental Impact and Remediation of Residual Lead and Arsenic Pesticides in Soil). Cadmium ,Lead and other heavy metals and some ions such as nitrate and nitrite can pass through the soil and contaminate ground water. Ground water provides drinking water for many rural communities and some cities in the north of Iran. Lead toxicity in humans also affects red blood cells and their stem cells, the kidney, heme biosynthesis, vitamin D metabolism, and the neurobehavioral development of newborns, infants, and children (Carrington and Bolger 1992; Dudka and Miller 1999; Needlemann et al., 1990; Wolz et al., 2003).

One the other hand , increasing nitrate and nitrite contents in food is one of the most important issues that could become a global concern in polluted areas as after industrial evolution. It causes great threaten to human health, environment, plants and animals. Nitrite reacts in stomach with nitrosable compounds to form N-nitraso compounds (Maanen et al., 1998; www.dgroups.org ; www.ead.anl.gov) . The consumption of risk nitrate diet increased the risk of formation of carcinogenic nitrosamine (Maanen et al., 1998) . High levels of nitrate intake were linked with the Non-Hodgkin's lymphoma (World Health Organization, 2007) , bolder cancer (World Health Organization, 2007), pancreatic cancer (Coss. et al., 2003) and stomach cancer (Addiscott and Benjamin, 2004; A G H et al., 2007; www.howtodothings.com; www.positivehealth.com) .The US National Research Council found an association between high nitrate intake and gastric and esophageal cancer (World Health Organization, 2007).

There are very few published studies evaluating the heavy metals and nitrate contents in their soils and groundwater in the North provinces and cities in Iran although majority of rice, tea and other crops comes from these location. Dangerous contents of Cadmium and Lead could been found in recent years in Mazandaran and Gilan agricultural products due to contaminated source tapped to address population and over fertilization with chemical fertilizers and high rain falling (Zaaouli et al., 2010; ziarati et al., 2013a; ziarati et al., 2013b) .

In view of the importance of the role of excessive heavy metals and nitrate in health status of the human body, the present study was initiated to investigate the levels of contamination with heavy metals and nitrate in the groundwater of farmlands of Talesh in Gilan province and then determine and evaluation of seasonal fluctuation in these hazardous materials in the studied samples.

## MATERIALS AND METHODS

### *Sampling method*

A descriptive – analytical and cross-sectional study was conducted for determination of Lead and Cadmium as heavy metals and nitrate in 100 samples of ground water and soil of 10 different sites in Talesh in the North of Iran in three consequent months in winter and spring and summer 2013.

### *Study Area*

Talesh is situated 140 km north-west of Rasht, on the south-west coast of the Caspian Sea. Talesh township, covering an area of 2373 square kilometers, ¼ of surface area of Gilan in 37° 43′ 50″ N, 48° 57′ 13″ E northern latitude, all studied sites are demonstrated in figure 1. The capital of the county is Talesh City. At the 2006 census, the county's population was 179,499, in 42,949 families (Census of the Islamic Republic of Iran, 2006. The county is subdivided into four districts: the Central District, Asalem District, Haviq District, and Kargan Rud District. The county has five cities: Hashtpar, Lisar, Asalem, Chubar, and Haviq. Talesh is a key center of production for a large number of high value rice , vegetables and fruit crops. In this research all the groundwater samples collected from Talesh- Asalem county in five different region by local names: pirharat, Klasra, Lacho, Kharjegil, Panjahaft.

Cadmiumand Lead as heavy metals and nitrate in100 samples of ground water and the chemical characteristics of soil from 10 different sites in Talesh in the North of Iran was determined in three consequent months in winter and spring and summer 2013. Talesh is situated 140 km north-west of Rasht, on the south-west coast of the Caspian Sea. Talesh township, covering an area of 2373 square kilometers, ¼ of surface area of Gilan in 37° 43′ 50″ N, 48° 57′ 13″ E northern latitude, all studied sites are demonstrated in figure 1. The capital of the county is Talesh City. At the 2006 census, the county's population was 179,499, in 42,949 families (Census of the

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***Nitrate determination***

Concentrations of nitrate in 100 samples of ground water of 10 different sites from Asalem- Talesh in Gilan province in three consequent seasons (winter, spring and summer,) in 2013, according to Iranian standard method (2347) were studied by spectroscopy method. The results were compared to Iranian standards and World Health Organization (WHO). The World Health Organization (WHO) and the European Community (EC), maximum contaminant level (MCL) of nitrate is given to be 50 mg/L.

***Lead and Cadmium Determination***

100 samples were collected and stored in clean acid-washed polyethylene bottles, following the sampling routines set for water quality studies (APHA, 1985). After collection and delivery to the Pharmaceutical Research laboratory in Islamic Azad University, the water samples were acidified with HNO3 to a pH <2. Prior to the chemical analysis, water samples were filtered through a Whatman glass microfibre filter (GF/C). The concentration of Cadmium and Lead were measured in the samples by Atomic Absorption Spectrometry technique. The samples were analyzed by Flame Emission Spectrophotometer Model AA-6200 (Shimadzu, Japan) using an air-acetylene flame for heavy metals: Pb and Cd, using at least five standard solutions for each metal and determination of potassium content was followed by FDA Elemental analysis ( FDA/ ORA LABORATORY MANUAL, 2013).

***Statistical Method***

Seasonal differences on the basis of the cite of ground water were determined by student t-test. Seasonal changes were calculated by one way Anova and for analysis of the role of multiple factors univariate analysis was used by SPSS 17.Probability values of <0.05 were considered significant.

## RESULTS AND DISCUSSION

The results were determined as mean ± SD of three replicates in each test. Chemical characteristics of the soil profile in specified seasons are shown in the table 1. Data is averages of the 50 profiles.

Table 1. chemical characteristics of the soil profile at the studied area farmlands

| Soil Texture | % Clay | % Silt | % Sand | % O.C | pH of Paste | Ecx $10^3$ | Depth ( cm) | Location of samples | Code |
|---|---|---|---|---|---|---|---|---|---|
| C= CL | 40 | 31 | 29 | 0.58 | 6.83 | 0.61 | 0-35 | Panjahaft | 309 |
| SL | 12 | 23 | 65 | 0.72 | 7.06 | 0.68 | 0-35 | Kharjegil | 310 |
| L | 26 | 31 | 43 | 1.37 | 5.91 | 0.63 | 0-35 | Lacho | 311 |
| SL | 14 | 27 | 59 | 0.58 | 5.55 | 0.45 | 0-35 | Pirharat | 314 |
| L | 20 | 33 | 47 | 1.51 | 5.88 | 0.36 | 0-35 | Klasra | 315 |

The results in figure 2 and figure 3 revealed that all samples in panjahaft had lead and nitrate contents above maximum level 0.01 mg/L and 50 mg/L which is recommended by WHO (WHO, 2007; US/EPA, 2013) and Lead was present in detectable amounts in all samples while cadmium content in all samples was lower than permissible levels of WHO 0.003 mg/L ( WHO 2007; US/EPA 2013; ISIRI) . The amount of Lead in the ground water samples was significant in the different seasons (p<0.01).

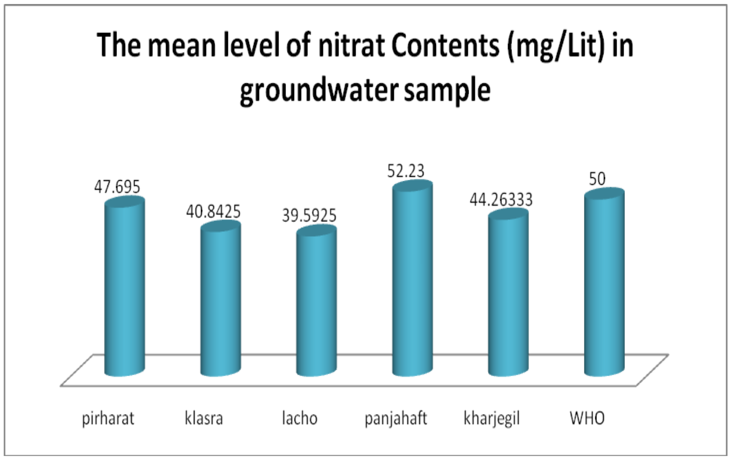


Figure 2. The Mean level of Nitrate contents (mg/L) in 100 groundwater samples, Talesh - Iran ,three seasons of 2013

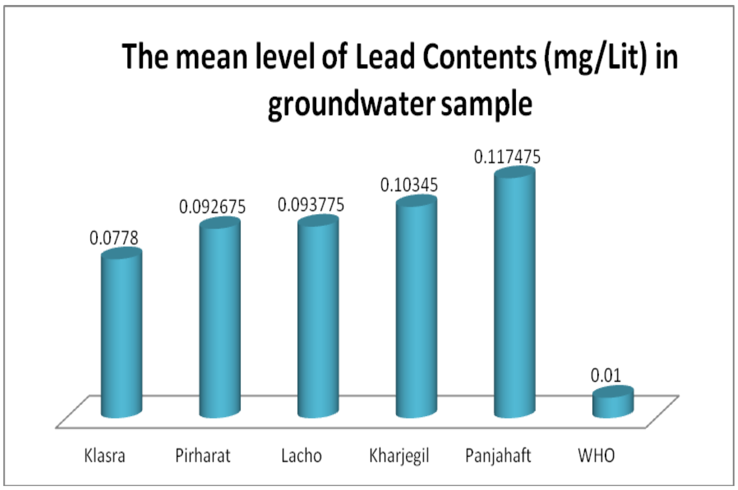


Figure 3. The Mean level of Lead contents (mg/L) in 100 groundwater samples, Talesh - Iran ,three seasons of 2013

The average rainfall of the study area in 2013 has been reported as 1667 mm in spring, 1250 mm in summer, 1720 mm in winter. Seasonal differences in Lead content were significant ($p<0.01$) (higher in summer) which probably related to the rainfall. A highly significant, positive correlation was found between nitrate contents of the winter and spring groundwater samples , compared to summer ones.

In figures 4 and 5, the mean level of lead and nitrate contents were compared during different seasons. The most of samples in summer had high level of Lead and the lowest level of Nitrate , on the contract in winter the highest level of Nitrate and the lowest level of Lead were repoerted.

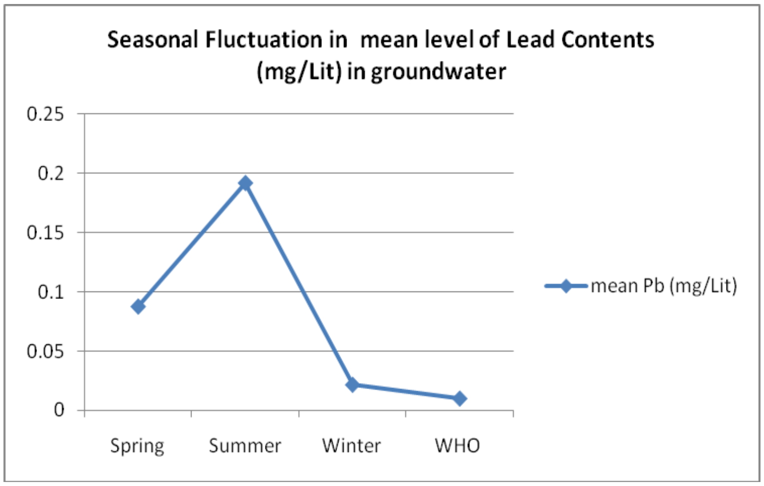


Figure 4. The Seasonal fluctuation of Lead contents of 100 groundwater samples studied , Talesh-Iran , three different seasons 2013

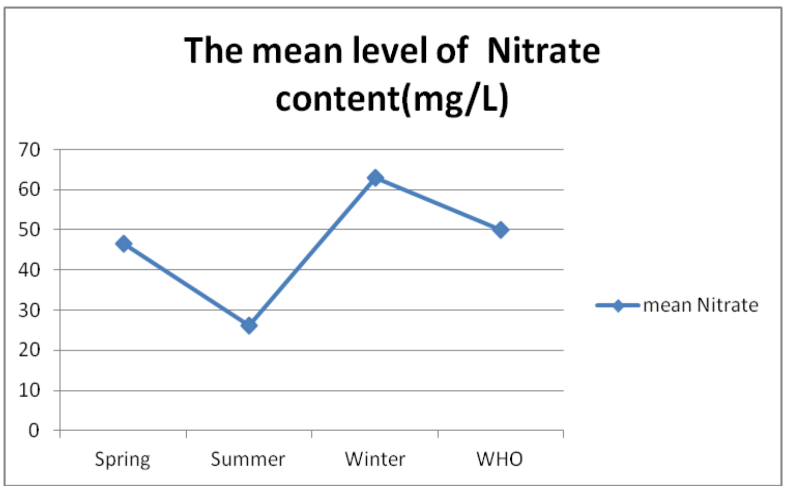


Figure 5. The Seasonal fluctuation of Nitrate contents of 100 groundwater samples studied ,Talesh-Iran , three different seasons 2013

## CONCLUSION

In this study, among 100 groundwater samples, 6 samples (with mean Lead content of 0.006 /Lit , about 0.00 mg/LCadmium content and 26.14 mg/Lnitrate content ) in winter were classified in “Excellent” class for drinking, while 53 samples ( mostly in summer season had nitrate content $<$ 50 mg/Lbut lead content $>$0.01 mg/Lit) , and 41 samples were in “Poor” class due to had Lead and Nitrate more than permissible levels.

Most of the examined ground water collected in Talesh in present study is polluted and Lead concentrations are higher than WHO guidelines, EPA standards and ISIRI (Iranian drinking water Standards :NO. 6694) and probably have public health problem by their consumption and constantly determination of heavy metals should be measured by responsible organizations.

We suggest that some projects should be done to improve the operational efficiency and financial sustainability of provincial groundwater , due to improve water distribution systems, irrigation water for crop and rice yields and including metering, sanitary sewers and a wastewater treatment plant in Guilan province. Public Health and Environmental Department in Gilan and other provinces should be established due to detecting contaminant contents in groundwater . The infected hand pumps and tube wells, which were being used for domestic usages in the Lead / Nitrate contaminated areas, have been identified and put into hold for further usages **.**Heavy metal and nitrate removal plants, based on various treatment technologies to treat contaminated groundwater, have been installed in many farmlands and sites and put into operation to provide potable water where there were no access of other sources of potable water supply **.**

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