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Measuring The Amount of Nitrates in Underground Water of Gardiz City, Paktia, Afghanistan

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***Abstract*— Water bodies that are accumulated and stockpiled in water saturated layers of the soil are collectively term as the underground water. These water catches are amongst the most important sources of freshwater and are increasingly used for agricultural, industrial and other purposes. Over extraction and misuse of water has faced these resources with big challenges. The use of fertilizers and manures, and the careless discharge of sewage water have affected underground water and gave root to the increasing levels of nitrates. Gardiz, which is the capital city of Paktia Province, has faced the same destiny of nitrification. The current study has been conducted to know the amount of nitrates in 12 wells and 3 karezes. Clarometer standard method for knowing nitrates amount is used. The results shows that the nitrates content to be in the range of 46.15 to 51.10ppm, which makes up to 20% percent of the total tests. The World Health Organization (WHO) classifies water containing this amount of nitrates as unsafe for drinking. 80% percent of the remaining tests have, luckily, affirmed that the content of nitrates is low, thus water from these sources can be used for drinking. Attempts; however, have to be made to stop nitrification of these resources that is mainly caused by the negligent discharge of manures and sewage water.**

Keywords*— *Underground Water, Nitrate, Chemical Fertilizers and Manures, Abosorbable Wells, Sewage Water

INTRODUCTION

The flow of urban and industrial wastes such as petroleum, radioactive materials, heavy metals etc. to the underground water resources and the over extraction of water from these bodies have resulted in a number of complications [11].

Nitrogenous fertilizers, which play a significant role in plant growth, find their way to the underground water through leaching and soil erosion and contribute to the increasing levels of nitrates in water [12] and [4].

One of the underground water pollutants is Nitrogen. N joins underground water from a number of sources, namely, the use of chemical and organic fertilizers, the negligent discharge of sewage water and manures, and through the natural decomposition of plants. When it rains, the rainwater carries nitrogen down to the water bodies and causes pollution [6].

Since 1970, nitrates are considered as major pollutants of underground water and became a serious issue. Reports from around the world confirm that nitrates in many places have polluted underground water [5].

Gardiz, just like other cities of the country, doesn't have a well-organized canalization; therefore, each family uses their own version of sewage discharge system. On the other hand, the inattentive discharge of manures, household trash and industrial garbage, and the network of open head ditches that carries dirty water to the farmers' fields finally become parts of the underground water and causes nitrate pollution.

To assess the severity of the problem, samples were collected from 15 underground water bodies in Gardiz city. The samples were then taken to the Olive processing factory located in Nangarhar province, where tests for the quantification of nitrate content were conducted.

PROBLEM OF STATEMENTS

The lack of organized canalization and the inattentive discard of household/ industrial garbage have contributed to the pollution of underground water around the world. Gardiz city is also one of the cities that have faced the problem of underground water pollution: therefore, we found it important to assess the situation and report the results for an effective preventive strategy.

OBJECTIVE

The objective of the study is to quantify the amount of nitrates in the underground water resources in Gardiz city.

RESEARCH QUESTIONS

MAJOR QUESTIONS:

How much of the underground water has been polluted with nitrates?

If affected, what is the severity of the problem?

MINOR QUESTIONS:

Is there any solution if the water is unsafe for drinking?

What are the solutions for addressing the problem?

LITERATURE REVIEW

Nitrates are amongst the major pollutants in urban underground water. When the nitrogen of ammonia oxidizes, the resultant compounds are nitrites and nitrates, respectively [10]. N is an important element in plant nutrition. To keep soil rich in nitrogen, nitrogenous or phosphorus fertilizers, either organic or inorganic, have to be applied. In most cases, the amount of fertilizers added to the field is in excess of

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plant's need. When it rains or when the field is irrigated, these fertilizers are washed off the soil and taken into the underground resources. Soil inhabiting bacteria convert nitrogenous fertilizers from one form to another which finally leads the formation of nitrites and nitrates [1].

Water polluted with nitrates causes a health issue called methemoglobinemia. In Gargan, Iran, a study of the underground water has revealed that the amount of nitrates per liter ranges from 3.52 to 145.2mg [9]. In a separate study in Ilam, Iran, 98.33% of the samples collected had lower nitrates but only 1.67% of the samples had higher than normal concentration of nitrates [2].

In Shiraz, Iran, a research revealed that the range of nitrates was from 4 to 72ppm. It also concluded that 60% of the samples had up to 20ppm of nitrate concentration whereas 16% showed that the content of nitrates was higher than considered safe for drinking. The study indicated that urban and household sewage water were the main contributors to the nitrification of underground water [3].

As increases in population will bring more pressure on the usage of underground water resources, governments should make strategies for the sustainable utilization of these resources [7].

METHOD AND MATERIALS

As show by the coordinates in figure 1, this study was conducted on 15 different underground water bodies in Gardiz city. Samples were collected from these resources and were then taken to the olive processing factory in Nangarhar Province for the quantification of nitrate contents. Each sample was tested three times and the average was taken as a final output. Nomenclature used for different resources are shown in Table 1.

RESULT AND DISCUSSIONS

Nitrates are produced from a number of sources such as natural and artificial fertilizers and sewage water. It first pollutes surface soil and then leaks down to underground Water. If the concentration of nitrates does not exceed 45 ppm, it will not cause any health issues; however, if the concentration increases over the range, the water becomes unsafe for drinking [8].
The samples are taken from Baladah, Kochi khil, Mamri, Karmashi, Khwaja Hasun, Malikhil, salokhil, Arjal Khil, Ahingaran, Shakarkhil, Sursang, Sadiq Kala, Baba Abdullah, and Dogha Abad. The wells and canal weirs used in this study are used for drinking purposes. The GPS coordinates shown in table 2 are taken from these sources. Geographic locations of all the studied resources are shouwn in Table 2.

Table 1: Nomenclature of the Resources

Named	Resource	Named	Resource
A	Salokhil masque's well	I	Shaker khil village's general well
B	Water supply department 's storage (kariz)	J	Karmashi village near Mirzaman house 's well
C	Abadul hai High school's well	K	Shaikhan village abo bakar sadiq's well
D	Salokhil's village Weir	L	Karmashi village relative firan's well
E	Paktia University, near political Science faculty 's well	M	Sursang village's near Quba Masque well
F	Abdullah kalah village's general well	N	Ahangaran village's general well
G	Malik khil village's general well	O	Baladah village Khial Gul market's well
H	Fir bagh said ahmad home 's well		

Table 2: Cordinates of studied Resources

Name of the location	longitudes (E)	latitudes (N)	elevation (e)
A	69°13′35.9″	33°36′39.7″	2340
B	69°13′27.3″	33°36′17.6″	2325
C	69°13′14.7″	33°36′07.5″	2320
D	69°13′33.6″	33°36′44.6″	2343
E	69°14′01.8″	33°38′03.7″	2387
F	69°12′28.5″	33°34′57.3″	2390
G	69°13′42.1″	33°35′20.2″	2396
H	69°12′55.8″	33°35′40.4″	2305
I	69°12′32.6″	33°35′08.8″	2393
J	69°14′15.5″	33°36′10.3″	2306
K	69°13′02.5″	33°35′22.7″	2397
L	69°14′04.5″	33°36′58.7″	2358
M	69°14′19.8″	33°35′50.7″	2313
N	69°13′53.9″	33°35′43.5″	2306
O	69°16′46.8″	33°37′59.3″	2347

The following maps show the location of wells and weirs in Gardiz city, the map of Gardiz city, and the map of Paktia Province.

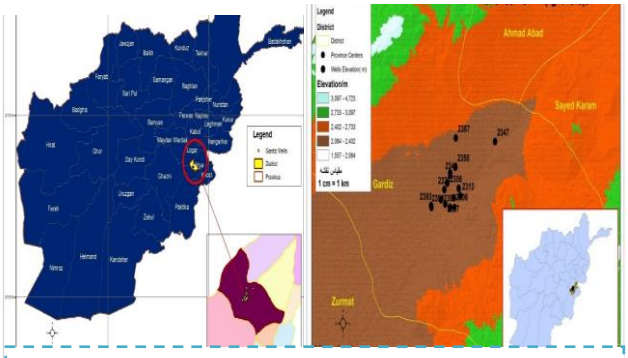

Fig1. Tested water of Gardiz city wells and weirs (karizes)

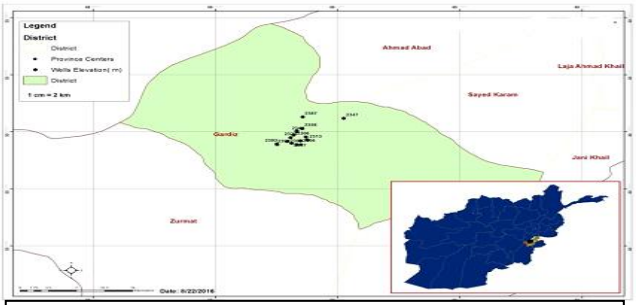

Fig 2: Topographic mapping of the points (water bodies) that were used in this study.

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MEASURING NITRATES IN WATER:

The following procedures are used for the quantification of nitrates in water.

1. Prepare a solution of potassium nitrate. To do so, 0.185gr of potassium nitrate is dissolved in one liter distilled water. However, we prepared a solution of 250ml with the same concentration.
2. Three test tubes are prepared. Fill one with distilled water and name it as a Blank Test. The second tube is filled with 10ml of KNO_3 solution and labeled as a Standard Test. The last tube is filled with sampled water and labeled as Sample Test.
3. Mix KNO_3 regent with the Standard and Sample solutions. Leave it for 10 minutes and measure it with calorie meter.

Fig 3. Photos shows the prosec of blank test and simpl test

4. Turn on the calorie meter 10 minutes before the measurement.
5. Put the Blank Test in calorie meter. Set the Transmission (T %) to 100% and Absorption (abs) to 0%.
6. Put Standard test in the calorie meter. The amount of absorbed light will appear in the Abs_{stan} Tab.
7. Remove the Standard Test and place the sample test in the calorie meter and read it in the Abs_{sam} Tab.

8. Now calculate the amount of nitrates using the following formula and shown in Figure 4.

$$Q_{Nitrat} = \frac{Abs_{Sam}}{Abs_{Stan}} 100 \text{ , ppm.} \qquad (1)$$

With regard to the formulation of (1) formula, the first black tast tube placed in the colro meter, T% was hurned and Abs was zero. The standard test was then placed in the chloro meter and the absorption rate of 0.13nm was created. In this way three samples were extracted from each source of water and after extracting in chlorometer, the absorption rate was brought and after making it in (1) formulas. After the average rate of Nitrat are showen in Fig 5.

Fig 4. Photos shows the zero value of calorie meter

You will see that there is no light absorption in the Blank Test whereas the absorption of the Standard Test is (0.13nm) and shown in the Absorption Fig 5. Three independent tests were conducted for the sampled water and the average was used as a final output Fig 5.

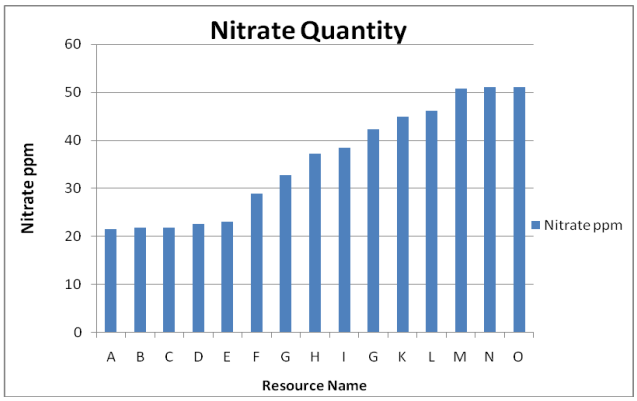

Fig 5. Quantity of Nitrates in Different Resources

Looking at the figure 5, we can see that the highest amount of nitrates in Gardiz city is with the range of 46.15 - 51.10ppm which makes up to 20% of the tests. According to the standards of WHO, these waters are not suitable for drinking. The remaining 80% of tests show lower amount of nitrates which means they are safe for drinking, however, care has to be taken in the future to avoid further nitrification.

Nearly all people dwelling in Gardiz city consume water for drinking purposes directly from wells and weirs. We selected 15 sources of drinking water for this study and sampled them. 80% of the test showed that the nitrate level is lower than those causing health issues. Water tests from karmashi, Baladah, firano village, Sursang, and Ahingaran reveal higher amounts of nitrates which are not safe for drinking. Our observation indicated the existence of garbage collections, the stockpiles of animal manures and sewage wells near the water sources. As water is pulled down by the gravitational force, it carries the dissolved nitrates and other pollutants to the underground water resources

CONCLUSION

The amount of nitrates in karmashi, firano weir (Kariz), Sursang, Ahingaran and Baladah is 46.15, 50.77, 51.10, and 51.10ppm, respectively. Water containing these amounts of nitrates is considered unsafe for drinking. A number of pollutants have contributed to the increasing levels of nitrates in these waters, but the main sources of problem were sewage wells and the negligent discharge of animal manures.

SUGGESTIONS

1. Due to higher amounts of nitrates, water in Baladah, Ahingaran, and Sursang must not be used for drinking purposes. If there is no any alternative option, then mix some clean water with the underground water to dilute the concentration of nitrates.
2. Gardiz Municipality and Water Distributing Department have to work with the people to safely discharge household garbage and animal matures. Also, they have to conduct seminars and workshops for the people and let them know of the consequences.
3. The Water Distributing and Canalization department, which has access to clean water storage, has to extent tap water network to Ahingaran, Balada, and Sursang

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as they did in Itifaq mena, so the problem of nitrates can be addressed; however, great attention has to be paid for the conservation of natural environment in the long run.

AUTHORS PROFILE

Mr. Fazalurahman haqyar was born in 1972 in Paktia city, Afghanistan. He received his Master degree in Hydraulic and hydraulics structure (Engineering) from Poly technic University, Kabul, Afghanistan in 2015. He has been working as academic member and assistant Professor since 2004 at Paktia University, Engineering faculty, civil Department, Afghanistan.

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