Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol 2, No.4, 2012
www.iiste.org

Impacts of Agricultural Wastes on Groundwater Pollution in Lipakala Farms, Ondo Southwest Nigeria

Akinro, A. O[1]. Oloruntade, A. J.[2*] and Imoukhuede, O. B.[2]
1.Department of Civil Engineering Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.
2. Department of Agricultural Engineering Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.
*E-mail of corresponding author: johntades1@yahoo.com

Abstract
The impact of Agricultural wastes on ground water pollution was investigated in Lipakala Farms, Ondo Southwest, Nigeria. Physical, chemical and microbial parameters of the water samples of the only water source in the farm were analysed. This was to determine the level of pollution and the suitability of the water source for domestic and animal consumption. Results showed that minute traces of ions were present in water, lead ranges between 0.4 and 0.6mg/l, Nitrate 64 – 65mg/l; pH value of 7.8; Iron, 56.3-57.8mg/l. For the physical characteristics, while temperature ranges between 31.5^{0}c and 33^{0}c, samples were odourless, colourless but tasty with turbidity value of I0NTU and electrical conductivity of 690mho/cm, indicating high presence of salt deposits as a result of the location of precambium basement rock near the farm. The average bacterial count of 4cfu/ml and total coliform count of 10MPN/100N were indication of microbial contamination of the water source. Hence, it is recommended that wells should be located at upland to croplands to prevent inflow through runoff of fertilizers and chemicals from farmlands. Also, modern waste disposal methods should be adopted, phasing out open dumpsites to avoid microbial contamination of well and safeguard public health. In addition, public health enlightment and awareness campaign should be conducted in the farm to sensitize the inhabitants of the farm of the dangers inherent in haphazard waste disposal.
Keywords: Agricultural wastes, Pollution, Well, Microbial contaminants

1. Introduction

Water is one of nature's most important gift to humanity and all living things. The importance of this gift of nature is such that without it man can hardly exist. Not only do we need water to grow our food, generate our power and run our industries, but also we need it as a basic part of our daily lives. Maguvu and Mutengu (2008) emphasized that communities and individuals can exist without many things if the need arises; they can be deprived of comfort, shelter or food for a period, but they cannot be deprived of water and survive for more than a few weeks. Health officials have also emphasized the importance of drinking at least eight glasses of clean water every day to maintain good health (WHO, 1985). Adequate water supply to any community is, therefore, crucial and a determining factor in dictating the healthy condition of such a community.

According to World health Organisation (1993), water covers more than 70% of the earth; but only few percentage of the earth's water is available as a source of drinking. WHO/UNICEF (2006a) noted that an important indicator of risk exposure to water related diseases is access to safe drinking water. "Improved water supply" is defined to include "reasonable access" to protected water resources which include protected springs and dug wells, boreholes, public stand pipes and household connections. Despite the importance of water to human and its inadequate availability in terms of quality accessibility, societies continue to contaminate this precious resource.

The recent efforts at providing foods in adequate proportion in Nigeria have brought about increased agricultural activities which involves the use of agro chemicals and fertilizers. In addition there has been tremendous increase in poultry and livestock farming. Agriculture has been described as the single largest user of fresh water resources, using a global average of 70% of all freshwater supplies (US-EPA, 1993). Yet, FAO (1993a) noted that agriculture, including commercial livestock and poultry farming, is the source of many organic and inorganic pollutants in surface waters and groundwater. It is a cause of pollution through its discharges of pollutants and sediments to the surface and ground waters and through net loss of soil to poor agricultural practices, salinization and water logging of irrigated lands.

In this part of the world where waste disposal generally and agricultural waste disposal constitute a great challenge, the effects of uncontrolled waste disposal system on water bodies may be calamitous. Donlagic et al. (2007) stated that conventional agriculture is the major polluter of an environment, especially if the chemicals are used without control. Agricultural development is closely related to the development of fertilizers. Due to its chemical composition and raw materials, fertilizers can be polluters of water and soil. Uncontrolled application of fertilizers without the knowledge of soil characteristics increases the risks of pollution. In the areas of intensified agriculture water streams are endangered, and pollution with heavy metals, nitrates, phosphates, pesticides and polycyclic aromatic hydrocarbons becomes the reality. Nitrates especially present great danger and are intensive polluters of underground water streams. Apart from pollution from fertilizers, animal wastes are high in oxygen demanding materials, nitrogen, and phosphorus, and they often harbour pathogenic organisms. In addition to wastes from commercial feeders which are disposed of on lands, animal dungs and faeces which are also carelessly disposed, all constitute threat to natural waters through run off and leaching. The main purpose of this work, therefore, is to investigate the impacts of agricultural waste on groundwater in the study area, Lipakala Farm Nigeria Limited, located at Ondo, Southwest Nigeria.

2. Materials and Method

2.1 Description of the Study Area

The study area is Lipakala Farm Nigeria Limited, Ondo southwestern Nigeria. It is located within the humid region of Nigeria on Latitude of 70141N and Longitude 50 081E. Apart from a human population of about 1500 consisting of both skilled and unskilled labaours, the farm also provides abode for livestock animals such as pigs, goats, sheep and about 500,000 poultry birds of various types (layers, broilers etc). The farm is important to the people of the area as a result of the vital role it plays in terms of animal production. Aside from its hatchery which supplies most of the chicks that are raised by many poultry farmers in the area, it also boasts of a feed mill where varieties of livestock feeds are produced, amongst other activities.

2.2 Collection of Water Samples

Sample collection was done according to WHO recommendations in guideline for drinking water quality (WHO, 1993). Two samples of water were collected from the main water well that supply the farm. The two samples were collected (sample 1 at 6am and sample 2 at 6pm on 28 August 2010), in sterilized bottles. To ensure that no organisms were admitted into the bottle other than that which already exists in the water sample, the containers used to draw the water was also sterilized on the site using cotton wool damped with ethanol and in flames. Samples were securely covered, labeled and stored in a refrigerator for less than 24 hours. The duration of storage ensured that organisms present survived. Upon the successful collection and storage of the samples collected, laboratory analysis to evaluate certain physical, chemical and microbial parameters were carried out based on internationally accepted standard to determine the quality of samples. Physical parameters determined include colour, odour, taste and turbidity while E-coli and Coliforn count were determined for microbial analysis. In addition, such chemical parameters as, pH, potassium, sodium, calcium, chlorine, total dissolved solids, turbidity, alkalinity, sulphur, manganese, magnesium iron, dissolved oxygen, electrical conductivity, phosphorus and hardness were determined.

3. Results and Discussion

Before the actual discussion of the results, it is important to put in proper perspective the various factors surrounding the well which serves as the sole source of water in the farm and from which samples were collected. Although the well was lined and covered, fetching of water was being done by the inhabitants of the farm using various types of water drawers, many of which were not hygienically kept. Also, the well was located downstream to a central animal waste dump and farmland which makes it very receptive to both surface runoff and base flow from polluted sources. Furthermore, the rate of water withdrawal was very high making the well to be highly disturbed every day. Although, there is high rate of siltation, the well is regularly desilted so that it can continue to serve the inhabitants of the farm.

3.1 Physical Analysis of Samples

The results of physical analysis shown in Table 1 indicate that although the water samples were odourless and colourless, they were however not tasteless. The sweet taste may have occurred as a result of the high salinity of the well water and the presence of certain microorganisms some of which may be harmful to human and livestock animals. In addition, the turbidity value of 10NTU obtained for the two samples was higher than the WHO recommended unit of 5NTU. High turbidity level according to Adekunle, et al. (2007) normally arise from the reduction of transparency due to the presence of particulate matters such as clay, silt, finely divided organic matter, plankton or other microscopic organisms. The colloidal materials provide absorption sites for chemicals that may be harmful to health or cause undesirable tastes or odours. High turbidity levels therefore are associated with poor water quality; hence the high turbidity levels of the samples suggest poor water quality of the well.

3.2 Chemical Analysis of Samples

The results of chemical analysis of samples are as shown in Table 2. The value of pH obtained for the two samples 1 and 2 was constant at 7.8. When the value is compared with WHO standards for drinking, livestock and irrigation water use, the water is potable and also good for irrigation purposes. Apart from the fact that pH regulates biological functions and may sometimes have an inhibitory effects on process rates, drinking of acidic water can affect digestion, corrode watering equipment, and be incompatible with drugs and vaccines. Field research indicates that drinking water with a pH lower than 6 can impair broiler performance. The value of Nitrate obtained (64mg/L) when compared with the standard values was found suitable for livestock consumption. However, it is capable of causing methemoglebinemia (infant cyanosis, or blue baby disease) in infants who have been given water or fed formulas prepared with the water because of the Nitrogen concentration of 64mg/L which is more than 45mg/L standard limit (WHO, 1985). High presence of Nitrate may have been caused by runoff containing fertilizer or humus and animals wastes. It can also be due to the poultry waste deposited near the well site. High iron concentration values 56.3mg/l to 57.8mg/h in samples 1 and 2 respectively suggests that the well water might not be good for consumption and irrigation purposes when compared with acceptable value of 0.1mg/L for potable water and 5.0mg/L for irrigation purposes. The high iron concentration may have stemmed from the geological characteristic of the area. For sulphur, the values of 54mg/l and 55mg/l obtained for samples 1 and 2 respectively falls within the permissible limit of 200mg/l for both human and livestock consumption.

Other metals such as sodium, phosphorus, zinc are found to be within the permissible limit. Also total hardness values of 124mg/L and 125.7mg/L in samples 1 and 2 respectively are found to be within the permissible limit of 200mg/l according to the international standard. Thus the water can be said to be soft and of good quality for washing, drinking and general domestic purposes. Salinity of samples determined by measuring its electrical conductivity was constant at 690mg/l in both samples 1 and 2 which is below the 700mg/l standard, however, values of chloride in samples which were 49.7mg/L and 52mg/L in samples 1 and 2 respectively are on the high side as compared with water quality for aquatic life and for human consumption. Consuming too much chlorine is said to have a detrimental effect on metabolism. A chloride level of 14mg/L is considered normal for well water. High level of chloride may indicate possible pollution from sewage sources.

3.3 Microbial Analysis of Samples

The microbial quality of drinking water is the most important aspect of potable water because of its association with water borne diseases. As shown in Table 3 below, typhoid fever, cholera, enteroviral disease, bacillary and ameobic dysentery and many varieties of gastrointestinal diseases can all be transmitted through water.

Although there are no numerical limits for both viruses and protozoa at present, however, it is desirable that no virus or protozoa be present in drinking water and therefore minimum removal or inactivation of Giardia cysts, Cryptoporidium oocysts and viruses is required in accordance with the standard guideline for drinking water. In line with this, Table 4 below shows that none of the water samples meet up with the recommended quality criteria for potable water (i.e zero coliform count). High coliform populations are indicators for pathogenic organisms (Adekunle, et al., 2007). They should not be found in drinking water but are usually present in surface water, soil and faeces of humans and animals. Human waste contaminant in water causes water borne diseases such as diarrhea, typhoid and hepatitis (Esry et al., 1986). High coliform count in the two water samples are an indication of poor sanitary conditions in the farm. Inadequate and unhygienic handling of solid wastes in the farm could have generated high concentration of microbial organisms. High coliform counts appear to be characteristics of rural ground water quality in Nigeria, consistent with the work of other researchers who worked on bacteriological and chemical characteristics of rural water supplies in other parts of the country (Akinro and Ologunagba, 2009; Adekunle, et al., 2007).

4. Conclusion

The results show that many of the physical and chemical parameters determined were within the tolerance limits for irrigation water for crop production in the study area and for human and animal consumption. However, there was high composition of salts like nitrate and iron which is attributable to the high total dissolved solids (TDS) in the samples analysed, while the coliform count was higher than recommended WHO (2003) limits for potable water. This indicates that although the water could be used for irrigation purposes, it might be unfit for drinking and domestic uses without standard treatment. Presence of coliforms is also an indication of contamination of well water by animal waste which might have flowed from the waste dump upstream the well.

It is therefore, recommended that an aggressive public health enlightment and awareness campaign should be conducted in the farm. Also, adequate solid waste disposal method should be adopted, phasing out open dumpsites to safeguard public health from water borne diseases. Well should be located about 30 meters radially away from polluting sources. To avoid pollution from chemicals and fertilizers used in the farm, wells should be located at upland areas such that inflow of runoff from crop land is avoided.

References

Adekunle, I. M, Adetunji, M. T. Gbadebo, A. M and Banjoke, O. B. (2007). Assessment of Groundwater Quality in a Typical Settlement in Southwest Nigeria. Int. J. Environ. Res Public Health, 4(4), 307 – 318.

Akinro A. O. and Ologunnagba, I. B. (2009). Bacteriological and Physico-chemical Analysis of some Domestic Water Wells in Peri-urban Areas of Akure, Nigeria. J. Applied Irrig. Sc. Vol. 44(2) 231 – 238.

Donlagic, N. Odobasic, A. and Bratovcic, A. (2007). Influence of Agriculture on Water Quality: Significance of Heavy Metals Monitoring. Agriculture conspectus scientificus Vol. 72 (4) 377 – 381.

Esry, S. A. and Nabicht, J. P. (1986). Epidemiological Evidence for Health Benefits from Improved Water and Sanitation in Developing Countries. Epidemiologic reviews, 8:117–128.

FAO (1993a). An overview of Pollution of water by Agriculture, J. A. Sagarday. In: Prevention of Water Pollution by Agriculture and Related Activities. Proceeding of the FAO Expert Consultation, Santiago, Chile 20 – 23 Oct., 1992. Water Report 1, FAO, Rome pp 19-26.

Maguvu, E. S. and Mutengu, S. (2008). An Investigation into the Factors Limiting Effective Water Supply in Rurual Areas of Zimbabwe. A case study of Zhomba in Gokwe North District, Journal of Sustainable Development in Africa, Vol. 10, No 1, 120-138.

US – EPA (1993). National Pesticide Survey: Update and Summary of Phase II results, Office of Water and Office of Pesticides and Toxic Substances, United State Environmental Protection Agency Report EPA570/9-91-021, Washinton D.C

WHO (1985). Guideline for Drinking Water Quality vol. 3. Drinking Water Quality Control in Small Community Supplies. World Health Organisation, Geneva.

World Health Organization (WHO), (2003). Guidelines for safe recreational water environments: Coastal and Fresh Waters Vol.1, World Health Organization, 220pp.

WHO (1993). Guidelines for Drinking Water Quality, volume 1. Recommendations. (Second Edition), WHO, Geneva.

WHO/UNICEF, (2006a). Joint Monitoring Programme for Water Supply and Sanitation – http://www.wssinfo.org/en/welcomehtml, October, 2006.

Table 1: Results of physical analysis of water samples

Parameter	**Sample 1**	**Sample 2**
Odour	Odourless	Odourless
Colour	Odourless	Odourless
Taste	Sweet taste	Sweet taste
Temperature	3.5	33
Turbidity	10	10
Conductivity (μ mho/cm)	690	690

Table 2: Results of chemical analysis of samples

Parameter (mg/L)	**Sample 1**	**Sample 2**
Nickel	0.3	0.5
Alkalinity	95	98
Lead	0.4	0.6
PH	7.8	7.8
Manganese	0.3	0.3
Potassium	98.7	98.7
Magnesium	72	74.6
Dissolved Oxygen	2.35	3.1
Total Dissolved Solids	30	30
Chlorine	49.7	52
Phosphorus	45	45
Sulphate	54	55
Hardness	124	125.7
Iron	56.3	57.8
Zinc	1.0	1.1
Sodium	80.9	85
Nitrate	64	64
BOD	3.9	4
Total Solids	0.09	0.11
Total Suspended Solids	0.031	0.28

Table 3: Water borne disease and their causes

S/N	Water borne disease	Causes
1	Typhoid	Bacterial infections
2	Cholera	Bacterial infections
3	Paratyphoid	Bacterial infection
4	Bacillary dysentery	Bacterial infections
5	Infectious Hepatitis (jaundice)	Viral infections
6	Polionyelits	Viral infections
7	Ameobic dysentery	Protozoal infections

Source: WHO, 1985

Table 4: Result of Microbial Analysis of Samples

Sample code	Average Total Bacterial Counts (TBC) (cfu/ml)	Total Coliform Count (TCC) (MPN/100ml)	Total Fungal Count (TFC) (cfu/ml)
1	4	10	4
2	3	10	4