EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 3 Number 2 (February-2015) pp. 298-302

www.ijcrar.com

Assessment of borehole water quality for irrigation purposes: A case study of Obingwa L.G.A of Abia State

Ugwu E.C.* and Emeka-Chris C.C.

Agricultural and Bio-resources Engineering Department Michael Okpara University of Agriculture Umudike. PMB 7267 Umuahia, Abia State, Nigeria

Corresponding author

KEYWORDS

Irrigation,
Borehole water,
water quality.

A B S T R A C T

Borehole water in 20 villages of Obingwa Local Government of Abia State was assessed for their suitability for irrigation purposes. The water quality parameters namely: pH, bicarbonates, nitrates, chlorides, salinity, electrical conductivity, sodium, boron, suspended solids, alkalinity and sulphates were analysed for the purposes of irrigation. Results obtained are; pH (6.5-7.0 mg/l), biacarbonates (10.6-5 mg/l), nitrates (1.0-6.5mg/l), Chlorides (4.0-6.5mg/l), salinity (7.5-12mg/l), electrical conductivity (6.0-9.0umhos/cm), sodium (3.4-4.8mg/l), alkalinity (10.0-20.0mg/l) and sulphates (11.0-22.0mg/l). These values were compared the standard limits of irrigation water quality parameters given by the Food and Agricultural Organisation (FAO). The values were found to be within the acceptable standard for irrigation water.

Introduction

The principal sources of groundwater are precipitation, stream flow, sea water, lakes and ponds. Water bearing formation of the earth crust acts as conduits for transmission and reservoirs for storage of water. Aquifer stores water as reservoir and transmits it as a pipeline. This is because the void or pore spaces between particles in the water bearing formation serves as both storage and network of conduit. The groundwater is constantly moving slowly over extensive area from recharge region to discharge areas. The flow velocity is as small as few meters per day or per year (James, 1993).

No plant exists without water, for adequate crop production; there must be adequate and dependable supply of water (Michael and Ojha, 2003). For effective growth, supplemental rain is given to crops in form of irrigation. Irrigation is the artificial application of water to the soil to enhance soil growth (Hillel, 1989). It is a general believe that irrigation is important in arid region of the world, places that practice a great deal of irrigation to produce food and fibres.

However, irrigation density of the world is not restricted to these areas rather some of the most profitable irrigated agriculture are located in areas normally thought to have sufficient rainfall such areas include Central Brazil, Central America, the West Indians and West Africa. These areas have ample annual rainfall, but during the last six months of the year they have virtually no rainfall necessitating the needs for artificial supply of water to the crops to meet their moisture demand.

Irrigation water is any water used to supplement the natural rainfall. Groundwater could be extracted through wells or boreholes. Water from these sources could be applied to the field using water pumps channels, pipe and so on depending on the type of irrigation method. Water for irrigation is obtained from surface and groundwater sources. Surface sources includes; lakes, reservoirs, stream waters while ground waters are wells and springs (Pair et al, 1983).

The suitability of water for irrigation depends on several factors including legal constraints, the quality of water (i.e. the amount and quality in terms of suspended and dissolved materials in the water) as well as the ability of the sources to supply the total irrigation requirement year after year (James, 1993).

The hydrologic cycle plays an important role in the quality of water precipitation of water washes, particulates materials and gases from the air particles may have organic or inorganic chemical compounds attached (Larry, 1996). Some chemicals washes by rainfall are sulphuric (acidic rain) and nitrates. Runoff resulting from precipitation may carry inorganic chemical which dissolves in runoff, resulting in hard water. Runoff from agricultural lands and other surface water aquifer can markedly affects the quality of the groundwater. Nitrogenous compound and phosphorous compound in various forms are washed from the soil and transported into the aquifer (Marsh, 1982).

The objective of this study is to assess the suitability of borehole water quality in Obingwa Local Government Area, Abia state Nigeria for irrigation purposes. This research was carried out so as to justify borehole from groundwater as an alternative sources of water for irrigation. Since groundwater is a versatile water source; this study was conducted to add to the existing knowledge as it is also important to predict the quality of water from borehole in terms of certain measurable parameters.

Materials and methods

Obingwa Local Government Area is in Abia state Nigeria and lie between latitude of 4^0N and 4.70N and longitudes of 5.6^0E and 6.3^0E of the Greenwich Meridian. The prominent climates are the rainy and dry seasons. The rainy season lasts from March to October and dry season from November to February. The average annual rainfall is about 2250mm. The soil type is predominantly sandy loamy. The population is estimated at 286.821 (Okoli et al.,1995). The main occupation of the inhabitants are farming and trading. The major food crops are cassava, yam, cocoyam, maize, and three leaves yam. The vegetable crops are fluted pumpkin, melon among others. The cash crops include oil palms, pears, pawpaw, guava, and mangoes (Alozie, 2002).

Analysis were carried out at UNICEF Assisted Abia state Water Sanitation (WATSAN) Project Monitoring and Evaluation Department. The borehole water quality analysis of Obingwa Local Government Area from February 2004 to March 2006 collected were analysed in the laboratory section. The results of the

analyses were assessed by comparing them with irrigation water quality standard given by FAO irrigation and drainage paper No29 (Ayers and West Cot, 1976).

Result and Discussion

The result of water analysis is shown in Table 2 for the twenty villages in Obingwa Local Government Area. The assessment of boreholes waters for irrigation were based on comparison between the already set irrigation water quality and that of boreholes waters. The irrigation water quality standard is given in FAO irrigation and draining paper No 29 (Table 1) (Ayers and west Cot,1976).

pH

The pH ranges for the water sample are 6.5 - 8.4. Any water with pH below or above the range stated will not be suitable for irrigation. pH values below 6.5 means the acidity will be too much for irrigation, thereby having the ability of corroding accessories use for irrigation. pH value below 6.5 will lead to root rot and crops with low adaptability to acidic properties will not survive and there will be low crop yield.

Bicarbonates

The bicarbonates range from 10.0-50 mg/1 for the borehole water. These range of value falls within the irrigation water of <91.5 mg/1. The absence of bicarbonates or present of bicarbonates below the standard limit indicates pure alkaline water because bicarbonates is an acidic derivation. The presence of bicarbonate in excess results in the formation of white substance on the leaves of plants after irrigation with water. It can also cause toxicity problems which results in crops failure.

Nitrates

The nitrates data maximum of 6.5mg/1 was obtained for the borehole water and this values falls within the standard limit of <30.0mg/1. The presence of nitrates above the standard limit will tend to cause delay in maturity and logging of crops. It will also cause excessive vegetative growth and low quality of grain. The values of nitrates in very low quantity will lead to yellowing of aerial plant parts, premature dropping of leaves and stems becoming thin and chaffy especially in grains.

Chlorides

The chlorides value ranges for the borehole water are 4.0mg/1 to 6.5mg/1 and these values are within the acceptable irrigation standard values of 4.0mg/1.

Salinity

Salinity has value ranges of 7.5mg/1 to 12.0mg/1 for the borehole water and it is within the 7.5mg/1 to 30.mg/1 standard acceptable irrigation range. Salinity values below the standard range will deny surface soils of soluble minerals and salts will accumulate in the crop root zone, to the extent that yields are affected as crops will have difficulty extracting enough water from the salty soil solution. There will be reserve osmosis thus leading to plant wilting and death.

Electrical Conductivity

The electrical conductive of the borehole water has value range of 6.0umhos/cm to 10.0umhos/cm. values of electrical conductivity above this range will result in the closing of the pores spaces thereby creating problem in the passage of water or air in the soil.

Table.1 FAO Acceptable Parameter for Irrigation Purposes

Parameters	Units	Acceptable range
pH	Mg/l	6.5-8.4
Nitrates	Mg/l	≤30
Bicarbonates	Mg/l	≤91.5
Chloride	Mg/l	4.0-10.0
Salinity	Mg/l	7.5-30.0
Electrical Conductivity	Umhos/cm	0.22-10.0
Sodium	Mg/l	3.0-9.0
Boron	Mg/l	<2.0
Suspended Solid	Mg/l	<30.0
Alkalinity	Mg/l	10-30.0
Sulphate	Mg/l	10-25.0

Table.2 Borehole water parameters in all the Villages in Obingwa L.G.A of Abia State

S/N	Villages	pH	Nitrates (Mg/l)	Bicarbonates (mg/l)	Chlorides (mg/l)	Salinity (mg/l)	EC (umhos/cm)	Sodium (mg/l)	Boron (mg/l)	Suspended solid (mg/l)	Alkalinity (mg/l)	Sulphates (mg/l)
1	Itu-Ngwa	6.5	4.5	18.0	4.5	9.0	6.0	3.8	0.04	0.04	12	12
2	Owo Ahiaofor Ntingha	6.5	4.5	10.6	5.0	8.5	6.0	3.5	0.02	0.60	12	12.5
3	Umuologu Akanuokpulor	6.5	4.5	45	5.5	7.8	6.5	6.0	0.06	0.10	10	14.0
4	Owo Abia	6.6	4.5	45	6.0	7.5	7.0	6.5	0.08	0.20	10.5	16.0
5	Asaeme	5.8	3.5	35	6.5	10.5	6.0	3.8	1.0	0.20	12.4	14.0
6	Umulogele	6.5	4.5	45	4.0	8.0	6.4	4.0	0.04	0.10	12	12.0
7	Obibi	6.5	3.5	35	4.5	8.5	6.6	4.0	0.04	1.00	12	12
8	Umuekere Akanuokpu	6.8	3.5	45	4.0	8.0	6.0	3.6	1.01	0.20	12	12
9	Obiba Ntubie	6.6	5.5	45	4.0	8.0	6.0	3.4	1.00	0.10	12	16
10	Owo Elu	6.5	3.0	30	6.0	9.0	6.0	3.5	0.02	0.10	14	14
11	Umuko Owoahiafor	6.5	3.5	45	6.5	8.5	6.4	4.5	0.20	2.00	18	20
12	Alojo Akanu	6.6	4.5	45	6.1	12.0	6.0	6.0	0.40	1.00	12.5	21
13	Ntigha Uzo	6.5	4.5	45	4.0	10.0	6.5	7.0	0.20	1.00	18.5	20
14	Akoli Akanu	7.1	4.5	35	4.5	10.0	9.0	5.0	0.40	1.40	16.5	11
15	Ihearji	7.8	4.5	45	4.5	8.0	7.5	8.0	0.40	2.50	10.5	12
16	Agbururike	6.5	4.0	40	5.0	9.5	7.5	7.7	0.06	2.0	12.5	15
17	Amapu Ideobia	7.0	1.0	50	4.0	9.5	6.0	6.0	1.00	2.70	15.0	13
18	Itu Nenu	6.5	2.0	30	4.0	8.0	6.0	8.0	0.80	2.20	11.5	18
19	Umu Akaka Akanu	7.1	3.5	45	6.0	8.0	6.0	8.6	0.50	2.0	20.0	22
20	Umuaro	6.5	6.5	50	5.6	8.0	6.0	5.5	0.80	0.80	12.0	20.

Boron

The boron value ranges from 0.2mg/1 to 1.0mg/1. These values are within the standard range of < 2.0mg/1for boron. The absence of boron in irrigation water does not create any side effect to plant however plants need boron in a negligible quantity. Presence of boron above the standard limit will cause toxicity problem.

Sodium

The sodium data range are 3.4mg/1 to 8.6mg/1 and these values are within the acceptable standard range of 3.0mg/1 to 9.0mg/1 for sodium in irrigation water plants need sodium in minute's quantities for effectives crop yield. The presence of sodium in excess results to toxicity problem which causes crops failure.

Suspended Solid

The suspended solid data ranges are 1.0mg/1 to 2.7mg/1 and these values are within the acceptable standard range of <30mg/1. The presence of suspended solid above the standard range will tend to block the accessories used for irrigation

Alkalinity

The alkalinity ranges for the borehole water are 10.0mg/l to 20.0mg/l, these are within the standard acceptable range of 10.0mg/l to 300mg/l. Alkalinity indicates the pH of more than 7, the presence of excess alkaline results in such salt build up in the soil. When salt distribution in the soil profile becomes excessive, crop growth is deteriorated. Such soils have white surface crust.

Sulphate

The data ranges of sulphates are 11.50-22.0mg/l and these values are within the acceptable standard of irrigation water range of 10.0mg/l to 25.0mg/l.

Conclusion and Recommendation

Borehole waters in the 20 villages of Obingwa Local Government Area of Abia State was assessed for their suitability for irrigation purposes. The values of water quality parameter namely pH, bicarbonates, nitrates, chlorides, salinity, electric conductivity, sodium, boron, suspended solids, alkalinity, and sulphates were analysed for their suitability for irrigation purposes. The results obtained are pH (6.5-7 mg/l), bicarbonates (10.6-5mg/l), nitrates (1.0-6.5mg/1), chloride (4.0-6.5 mg/l), salinity (7.5-7mg/l), electrical conductivity (6.0-9.0 umhos/cm), sodium (3.4-8.6mg/l), alkalinity (10.0-20.0 mg/l) and sulphates (11.0-22.0 mg/l) respectively. These values were compared with standard limits of irrigation water quality parameters as listed in Food and Agricultural Organization Irrigation and Drainage paper No 29. The values were found to be within the acceptable standard irrigation water. Generally, from the irrigation water quality parameters standard, the water quality of boreholes in all the 20 Villages in Obingwa Local Government Area in Abia State is not hazardous to crops and therefore is recommended for irrigation purpose. Further studies should be carried out to determine the concentration of parameter in wet and dry session seasons.

Acknowledgment

The authors recognize the immense contributions of the UNICEF Assisted Abia State, Water and Sanitation (WASTANT) Project Monitory and Evaluation Department.

References

Alozie, I. (2002). Economics of Goat product in Abia State, a case study of Obingwa Local Government Area of Abia State. Unpublished B.Sc thesis, Michael Okpara University of Agriculture Umudike, Abia State.

Ayers, R.S. and West cot, D.W (1976): Water quality for Agriculture Food and Agricultural Organization Irrigation and Drainage paper No 29.

Hillel, D (1989). Soil and water physical principles and practices, Wiley, New York, P. 417.

James, G.L (1993): Principles of farm irrigation system design. Kaueger published Malabo, Florida. 110-125.

Larry, W. M. (1996). Water resources. Handwork. McGraw-Hill, book. Companies New York.

Marsh, A.W. (1982). Guideline for evaluating water quality related to crop. Companies New York.

Michael, A. M and Ojha T.P (2003): Principles of Agriculture Engineering Vol 11. M/S Jain Brothers. New Delhi.

Okoli, O. Onyenweaku, C. E and Ikeorgu, J. C.G.(1995): Report on South-Eastern Zone, Livestock sub-section. Paper presented at the National Agricultural Strategy Plan for Nigeria, Zaria.

Pair, C. H. Hinz, H. W.H, Frost, K. R, and Sneed, R. E. (1983): Irrigation. The irrigation Association, Silver Spring:p 686.