ISSN No:-2456-2165

Assessment of Groundwater Quality in Some Selected Residences of Kano Municipal Local Government Area, Kano State, Nigeria

Gora, M. A.,*Odewade, L.O.
Department of Environmental Management,
Faculty of Earth and Environmental Sciences,
Bayero University, Kano,
Nigeria

Joseph Oluwaseun Odewade
Department of Microbiology,
Faculty of Life Sciences, Federal University,
Dutsin-Ma, Katsina State,
Nigeria

Abstract:- The study was conducted to evaluate the physiochemical parameters quality of ground water for residential use in the ten selected household's borehole water sources in Kano Municipal Local Government, Kano State, Nigeria. The physicochemical parameters analyzed include Electric conductivity (EC), Phosphate, Nitrate, Dissolved oxygen (DO), Total dissolved solids (TDS), Potassium, Sodium, Magnesium and Calcium using standardized methods. The results revealed that parameters such as pH, dissolved oxygen, phosphate, nitrate, sodium, potassium, magnesium and calcium were found to be within NSDWQ and WHO standards permissible limits in most of the sampling locations while conductivity and total dissolved solids mean concentration values were high than the recommended values for the stipulated standards in most of the sampled water locations. The study concludes that most of the physicochemical parameters analyzed in water sources studied were within the NSDWQ and WHO permissible limits while conductivity and total dissolved solids were high in almost all the groundwater sources and also above the recommended values for the two standards. Hence, there is need for prior treatment of affected water sources before consumption.

Keywords:- *Groundwater, Physicochemical parameters, Urban residences.*

I. INTRODUCTION

Water is an essential commodity that supports all forms of plant and animal life (Vanloon and Duffy, 2005). About 60% percent of human body is water as life began in water and life is nurtured with water (Fasunwon *et al.,* 2010). Access to adequate safe drinking water is of prime importance to many governmental and international organizations and without doubt it is the principal component of primary health care and a basic component of human development as well as a precondition for man's success to deal with hunger, poverty and death (SOPAC/WHO, 2005). Water is primarily used for industrial, domestic, agricultural activities and necessary for sustainable economic development of an area as it is the next major support to life after air (Pritchard *et al.,* 2007). The availability of pipe-borne water, borehole water and shallow wells in urban areas is an indication that water is a vital component of human existence.The quality of water that human beings ingest is critical in determining the quality of their lives (Fetter, 1994). The World Health Organization has frequently insisted that the single major factor adversely influencing the general health and life expectancy of a population in many developing countries is the ready access to potable water (Hoko, 2005).The usefulness of water for a particular purpose is determined by the water quality (Fetter, 1994). According to Ishaku (2011), groundwater is used by about 1.5 billion people worldwide. The sources of groundwater contamination are many and the contaminants are numerous. Increasing industrialization has been accompanied throughout the world by the extraction and distribution of mineral substances from their natural deposits. Subsequent to contamination, water sources undergo chemical changes through technical processes, finely dispersed and in solutions by way of effluent, sewage, dumps and dust into the water, the earth and the air and finally into the food chain (Fetter, 1994). Groundwater is by far the most essential component, accounting for nearly all accessible freshwater after excluding the polar ice caps and glaciers. Groundwater resources have a prominent role in human life and economic activities; hence their use and conservation are consequently critical (Bataiya *et al*., 2017).

The groundwater all over the world has emerged as a potential source for domestic and irrigation purposes. In this case, it becomes important to assess the quality of groundwater before assigning it for domestic or irrigation purposes. For many metropolitan, municipal, industrial, and irrigational enterprises, ground water is the primary source of water. Worldwide, the stress on the freshwater resources from surface and groundwater sources is ever increasing due to population growth and rapid industrialization. Natural occurring groundwater is typical of high quality, but it can deteriorate due to insufficient source protection and poor resource management. Its contamination may be due to improper dwelling of well and waste disposal (Shawai *et al.,* 2018). The demand for groundwater supply for drinking, domestic, agricultural, and industrial use has been steadily increasing. It is still the largest available source of freshwater, making it an essential component of the water supply chain (Ibrahim, 2019). The population growth is characterized by high population concentration, increasing industrial, commercial and agricultural activities, environmental degradation, and indiscriminate disposal of all types of wastes, is perceived to pose serious pollution threats, with all of the associated health hazards on groundwater quality, particularly in urban areas (Balogun *et al.,* 2020). As a result, the high reliance on untreated groundwater extracted from shallow and deep wells has resulted in the innate proliferation of diseases and other health-related issues. According to Sanders *et al.* (2018), Severe potable water scarcity has been one of the major problems the population within Kano metropolis had to contend with, and very few areas within the metropolis could boast of access to potable water supply from the water board. This has forced the city's population to rely solely on groundwater exploration for municipal, industrial, and agricultural purposes. Groundwater is a primary source of water supply in Kano metropolis, therefore, there is a constant need to evaluate its quality for domestic use.

II. MATERIALS AND METHODS

A. Study area and sampling points

Kano metropolis covers an area of about 600 km^2 located between longitude 8º and 9ºE and latitude 10º and 12ºN. It is one of the earliest commercially significant aspects of trans-Saharan trade (Tanko & Momale, 2014). The climate area of Kano is the tropical wet and dry type with dry season lasting for about seven to eight months and wet season between May and September (Dan Azumi & Bichi, 2010).The area of study was found in Climate of Kano region is tropical wet and dry type coded as Aw based on Koppen’s classification of climate(Tanko &Momale, 2014).It has been described as semi-arid climate with the mean daily temperature of 30°C. The months of December to February are colder, with the lowest temperature recorded around 20°C while the rainfall regime usually lasted between four to five months.Water samples were collected at ten selected households in ten selected wards comprising of Sheshe, Marmara, Kabara, Tudun wuzirchi, Chiranchi, Kurmawa, Yakasai, Indabawa, Sagagi, Sharada cikin gari in Kano Municipal Local Government area within the period of four months and the water samples collected were analyzed for physicochemical parameters using standard method (APHA, 1998). Figure 1 showed the map of the study area indicating the sampled groundwater locations.

III. RESULTS

The results of water quality for the water sources analyzed from the study area are presented in Table 1. Electrical conductivity (EC)1411µS/cmwas recorded to be highest in Sheshe area and lowest at Charanci 555µS/cm. The pH observed ranges between 4.7 to 7.5. The water sample collected at Kabara was found to be most acidic (4.7) while that of Kurmawa has the most slightly.

ISSN No:-2456-2165

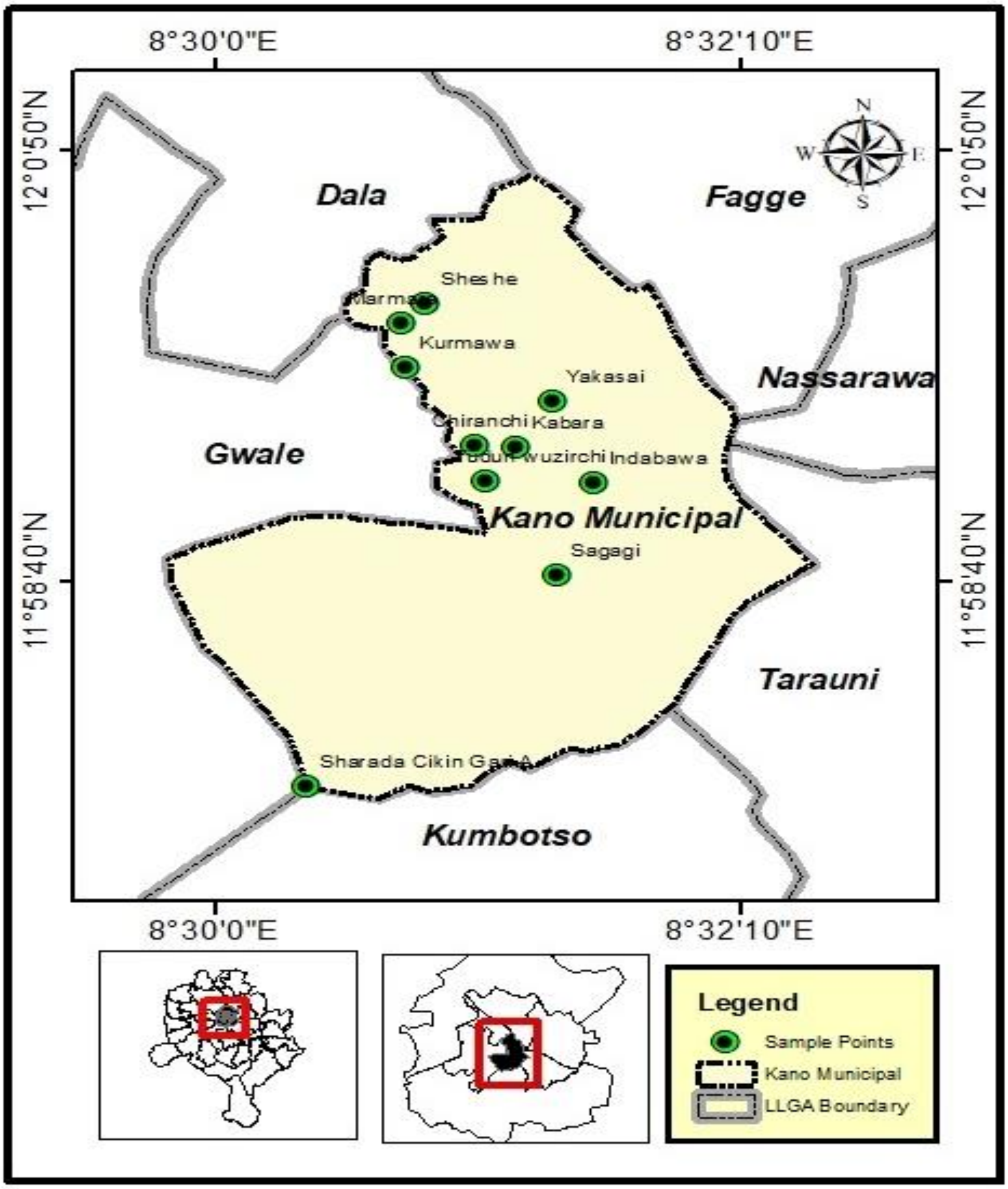

Fig. 1: Map of the study area showing the sampling points

alkaline mean concentration value of 7.5.The phosphate (PO_4^{3-}) mean concentration valuel1.175mg/Lwaslowest atSagagi and highest at Chiranci and Kurmawa with the mean concentration valueof 15.7625mg/Lfor each of the locations. Nitrate (NO_3^-) mean concentration value of 2.80mg/L was observed at Sheshe, Marmara, Kabara, Chiranci, Kurmawa, Indabawa and Sharada, and 4.20mg/L mean concentration value was recorded atT/wuzurci, Yakasai and Sagagi. The lowest total dissolved oxygen TDS mean concentration value 330mg/L was recorded at Sharada and the highestmean concentration value 857mg/L was observed at T/wuzurci followed by Marmara (846mg/L) and Sagagi (760mg/L). The lowest mean concentration of Potassium ion (K^+) was observed at Sagagi (0.66mg/L), Kurmawa and Yakasai has the same value of 4.94mg/Lwhile the highest mean concentration value was recordedat Marmara as 6.10mg/L. The highest mean concentration value of dissolved oxygen (DO) 4.30mg/L was observed at Kurmawa while the lowest mean concentration value of 1.90mg/L was recorded at Sheshe location. The lowest sodium Na^+mean concentration value 2mg/L was recorded at Sagagi area while thehighest mean concentration value of 4.0mg/L was observed at T/wuzurci. The highest Magnesium mean concentration was recorded at Marmara and the lowest mean concentration value of 10.7mg/L was recorded at Sagagi area. Themean concentration value of calcium 150.9mg/L was highest at Sagagi and lowest at Charanci area.

Table 1: Concentration of physicochemical parameters of water sources Analyzed

Location	EC (µS/cm)	pH	PO_4^{3-} (mg/L)	NO_3^- (mg/L)	TDS (mg/L)	K^+ (mg/L)	DO (mg/L)	Na^+ (mg/L)	Mg^{2+} (mg/L)	Ca^{2+} (mg/L)
Sheshe	1286	6.9	12.13	2.80	733	2.31	1.90	3.3	31.2	97.6
Marmara	1377	7.4	13.34	2.80	846	6.10	2.8	3.3	39.4	51.4
Kabara	1260	4.7	12.73	2.80	738	0.82	2.46	4.0	24.7	54.7
T/wuzurci	1411	6.8	6.67	4.20	857	3.29	3.64	4.6	38.2	53.1
Charanci	696	6.2	15.76	2.80	387	1.65	3.81	3.3	10.8	35.4
Kurmawa	868	7.5	15.76	2.80	547	4.94	4.31	4.0	28.3	82.9
Yakasai	929	6.8	10.91	4.20	526	4.94	4.09	4.0	17.1	150.9
Indabawa	1251	6.6	15.16	2.80	760	0.82	3.58	3.3	29.2	126.9
Sagagi	881	6.4	1.18	4.20	520	0.66	3.42	2.0	10.7	185.7
Sharada	555	6.1	13.94	2.80	330	1.65	2.02	2.6	19.9	142.9

EC= Electrical Conductivity, TDS= Total Dissolve Solids, DO= Dissolve Oxygen, K^+ = Potassium ion, Na^+= Sodium ion, Mg^+=Magnesium ion, Ca^{2+}= Calcium ion.

Table 2: Present study Comparison with the Nigerian Standard for Drinking Water Quality and World Health Organization

Parameters	Present Study	NSDWQ	WHO Guideline
EC(µS/cm)	1051.4	1000	1000
pH	6.5	6.5 – 8.5	6.5 – 8.5
TDS (mg/L)	624.0	500	600
DO (cm^3/dm^3)	3.2	NA	6.0
K^+(mg/L)	2.7	100	NA
Na^+(mg/L)	3.4	200	200
Mg^+(mg/L)	25.0	20	<150
Ca^{2+}(mg/L)	98.2	200	<150
NO_3^-(mg/L)	3.2	50	50
PO_4^{3-}(mg/L)	11.7	NA	NA

Source: NSDWQ (2015) and WHO (2017) NA = Not Applicable

IV. DISCUSSION

The results for water quality parameters were represented in Table1. The findings revealed higher mean concentration value ofelectrical conductivity and total dissolved solids parameters when compared with both the NSDWQ and WHO standards across all the sample locations. The electrical conductivity (EC) mean values of the collected water samples ranges between 555-1377µS/cm. Onwughara *et al.* (2013) reported value of 9.32 µS/cm which is within the range of the recommended limit of both the NSDWQ and WHO standards. Meanwhile, the electrical conductivity value recorded in study carried out by Karpagam and Ramesh (2015) contravened this study where the value of pre-monsoom from 1050 to 2990 µS/cm and post monsoon from 1320 to 2140 µS/cm was reported and these values are well above the allowable limit by both the NSDWQ and WHO standards.

The pH range 6.5-8.5 values recorded in this study conforms with the pH range value recommended by both the NSDWQ and WHO. Moreover, as observed in this study, all the sampling locations were safe at pH level except for Charanci, Sagagi and Sharada sampling locations which are acidic in value. The pH values of all the samplinglocations are presented in Table 1.The pH is not a contaminant, rather it is an indication of the presence of some chemical constituents present in water bodies. As such, pH is often regarded as an important water quality parameter that have an indirect effect on public health and aquatic lives (WHO, 2017). However, Kabara has acidic water than the remaining locations and this could be attributed to the inflow of effluents released from residences. Most of the values for TDS were observed to be higher than both the NSDWQ and WHO recommended limit except for Chiranci (387mg/L) and Sharada (330mg/L) which are within the recommended limit for NSDWQ. Also, Kurmawa (547mg/L), Yakasai (526mg/L) and Sagagi (520mg/L) values were within the WHO standard limit of 600mg/L. TDS concentration represents the amount of inorganic salts and small amounts of organic matter that are dissolved in water. The hardness of groundwater could be due to the occurrence of alkaline earth metals calcium carbonates and bicarbonates of magnesium, chlorides and sulphates of calcium and magnesium.

The mean concentrations of DO for all the sampling locations were below the WHO guideline value. Concentration of DO is a critical determinant of species diversity found in a water body. A vast majority of aquatic organisms are aerobes that depend on the amount of dissolved oxygen in the water. Thus, the consequence of low amounts DO on the affected species may mean death or forced migration to other areas with better oxygen supply. Numerous anthropogenic sources of pollutants can contaminate water environment, including inputs from waste waters flowing from mines and waste storage, runoff of pesticides from agricultural land or atmospheric deposition (Song *et al.,* 2010). Thenitrate (NO_3^-) mean concentrations recorded in all the sampling locations are within the recommended limit for NSDWQ and WHO standards. This is in line with the finding of the study conducted by Amoo *et al.* (2018) in Kano and it environ. However, low level of nitrate in the study area may be attributed to the less anthropogenic activity involving nitrate pollution of the groundwater.

Sodium ion recorded in this study in all the sampling points are within the NSDWQ and WHO standards and this corroborates previous study carried out by Kwari (2015) where a mean value of sodium ion was reported as 95.05 mg/L andwas within the NSDWQ and WHO acceptable limit for drinking water quality. Moreso, result reported by Bichi and Bello (2013) was contrary to this current study where a mean value of 102.33 mg/L was recorded and found to be above NSDWQ acceptable limit for drinking water quality. The mean concentrations of calcium ion reported in this study are falls within the recommended value set by NSDWQ standard for drinking water and this conforms to a similar study conducted by Adefemi (2012), who reported a mean value of calcium ion which ranged from 3.35 to 26.23 mg/Land found to be below the NSDWQ and WHO maximum acceptable limits. Magnesiummean concentration values for all the sampling locations were observed to be lower than the NSDWQ and WHO maximum acceptable limit.This study was similar to that of Fasae and Omolaja (2014) who worked on the assessment of drinking water quality from different water sources (tap, well, rain, stream and borehole) in smallholder ruminant production in Abeokuta, Nigeria where it was recorded that borehole water in the study area was fit for drinking as the organoleptic properties across treatments complies with the standard of drinking water with the exception of stream water where odour and particles were observed. This study was also similar to that of Dada (2009) who worked on sachet water sources in some parts of Nigeria where it was reported that freshly manufactured sachet water was fit for drinking due to the source been borehole water source.

V. CONCLUSION

The study concludes that most of the physicochemical parameters analyzed in water sources studied were within the NSDWQ and WHO permissible limits while conductivity and total dissolved solids were high in almost all the groundwater sources and were therefore above the recommended values for the two standards. Hence, there is need for prior treatment of affected water sources before consumption.

REFERENCES

[1.] Adefemi, A.O. (2012). Physicochemical and microbiological assessments of groundwater from Ijan-Ekiti South Western Nigeria. *Environmental Research Journal*, 6(5): 316-320.

[2.] Amoo, A.O., Gambo1, Y. H., Adeleye, A. O. and Amoo (2018). Assessment of Groundwater Quality in Sharada Industrial Area of Kano, North-Western Nigeria. *FUW Trends in Science & Technology Journal.* 3 (2): 407-411.

[3.] APHA 1998. Standard Methods for the Examination of Water and Wastewater, 20th edition. American Water Works Association, Environment Federation, Washington.

[4.] Balogun, D.O., Abe, G.O., Ibrahim, A., Ibrahim, B.K., Auta, U.S., and Adgidzi, J.A. (2020). Spatial Distribution of Groundwater Quality Using GIS in Kano Metropolis, Kano State, Nigeria. World Wide Journal of Multidisciplinary Research and Development; 6(5): 51-58.

[5.] Bataiya A.G., Habiba M., Ahmad S.I., and Muazu J. (2017). Analysis of Water Quality Using Physicochemical Parameters of Boreholes Water Taken from Areas around Dala Hills, Northwestern Nigeria. American Journal of Water Science and Engineering, 3(6): 80-83.

[6.] Bichi, M.H. and Bello, U.F. (2013). Heavy Metals Pollution In Surface Water and Groundwater

[7.] Used For Irrigation Along River Tatsawarki In Kano State, Nigeria. *IOSR Journal of Engineering,* 3(7): 2278-8719.

[8.] Dada, A.C. (2009). Sachet Water Phenomenon in Nigeria: Assessment of the Potential Health Impacts. *African Journal of Microbiology Research,* 3(1), 15-21.

[9.] Dan Azumi, S. and Bichi, M.H. (2010). Industrial Pollution and Heavy Metals Profile of Challawa River in Kano, *Nigerian Journal of Applied Science and Environmental Sanitation*, 5(1): 23-29.

[10.] Fasae, F.O. and Omolaja O.E. (2014). The Assessment of Drinking Water Quality from Different Sources in Smallholder Ruminant Production in Abeokuta, Nigeria. *Journal of Food Science and Quality Management.* 29, 25-57

[11.] Fasunwon, O.O., Ayeni, A.O. and Lawal, A.O. (2010). A comparative Study of Borehole Water Quality for Sedimentary Terrain and Basement Complex In Southern Nigeria. *Research Journal of Environmental Sciience*, 4(3): 327-335.

[12.] Fetter, C.W. (1994). Applied Hydrogeology, Third Edition. Prentice Hall, New Jersey

[13.] Hoko, Z. (2005). An Assessment of the Water Quality of Drinking Water In Rural Areas Districts In Zimabwe. The Case of Gokwe South, Nkayi, Lupane and Mwenezi Distrcts. *Journal Physical and Chemistry of Earth*, 30: 859-866.

[14.] Ibrahim, M.N. (2019). Assessing Groundwater Quality for Drinking Purpose in Jordan: Application of Water Quality Index. Journal of Ecological Engineering. 20(3), 101–111

[15.] Ishaku, J.M. (2011). Assessment of Groundwater Quality Index for Jimeta-Yola area, Northeastern

[16.] Nigeria. *Journal of Geology and Mining Research,* 3(9); 219-231.

[17.] Karpagam, V. and Ramesh, K. (2015). Assessments of Groundwater Quality of Chrompet Industrial Area. *International Journal of Engineeringr. Technology, Management and Applied Science,* 3(7): 2349-4476.

[18.] Kwari, W.J. (2015). Groundwater Quality Assessments: A Case Study of Groundwater from Hand-Dug Wells In Hawul LGA Of Borno State, Nigeria. *International Journal of Advanced Research*, 3(2): 537-546

[19.] NSDWQ (2007). Nigerian standard for drinking water quality. Standard Organization of Nigeria. Wuse, Abuja.

[20.] Onwughara, N.I., Ajiwe, V.I.E. and Nria, B. (2013). Physicochemical Studies of Water from Selected Boreholes In Umahia North, LGA Of Abia State, Nigeria. *International Journal of Pure and Applied Bioscience*, 1(3): 34-44.

[21.] Pritchard, M., Mkandawire, T. and O'Neil, J.G. (2008). Biological, Chemical and Physical drinking water quality from shallow wells in Malawi: Case study of blantyre, Chiradzulu and Mulanje. *Journal Physical and Chemistry of Earth*, 27: 845-850.

[22.] Sanders, T.G., Ward, R.C., Loftis, J.C., Steele, T.D., Adrian, D.D. and Yevjevich, V. (2013) Design of Networks for Monitoring Water Quality. Water Resources Publications, Littleton, Colorado, 323 pp.

[23.] Song, F., Parekh, S., Hooper, L., Loke, Y.K., Ryder, J., Sutton, A.J., Hing, C., Kwok, C.S., Pang, C., Harvey, I., (2010). Dissemination and publication of research findings: an update review of related biases. Health Technology Assessment. 14 (8)

[24.] SOPAC/WHO 2005. Drinking Water Quality in the Pacific Island Countries: Situation Analysis and Needs Assessment. World Health Organisation, Geneva, Switzerland

[25.] Tanko, A. I and Momale S. B (2O14) *Kano environment*, *society and development*; London & Abuja, Adonis & abbey publishers

[26.] Vanloon, G.W. and Duffy, S.J. (2005). The Hydrosphere. In: Environmental Chemistry: A Global Perspective. 2nd Edition. New York: Oxford University Press, pp. 197211.

[27.] WHO, (2017). Guidelines for drinking-water quality: fourth edition incorporating the first addendum. WHO Press, World Health Organization, Geneva, Switzerland.