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PHYSICOCHEMICAL CHARACTERIZATION OF SPRINKLING WATER FROM THE FIELDS OF THE SAGBAYA MARKET GARDENING GROUP IN THE FARANAH URBAN COMMUNE

Diallo Mamadou Aliou*[1], Barry Mamadou Alpha[1], Tonguino Sâa Poindo[1], Diallo Diariou[1], Sakouvogui Ansoumane[2]

[1]Higher Institute of Agriculture and Veterinary, Faranah, Guinea.

[2]Higher Institute and Technology, Mamou, Guinea.

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***Corresponding Author**
Diallo Mamadou Aliou
Higher Institute of Agriculture and Veterinary, Faranah, Guinea.

ABSTRACT

The general objective of this research is to characterize the irrigation water used by the SAGBAYA market gardening group in Faranah. For this we determined the physical parameters (temperature, turbidity, conductivity and mineralization) and chemical parameters (pH, chlorides, nitrates, iron and manganese) of irrigation water and then analyzed and interpreted the results. The research work that took place in the period from October 10, 2014 to June 20, 2015 was conducted in the field (in situ) and at the Water and Hygiene - Hydrotechnics - Civil Engineering Laboratory - UGAN Conakry. The physical and chemical parameters of the irrigation water were determined by measurements and by colorimetric, potentiometric and volumetric methods. After analysis, the results obtained showed that the irrigation water is characterized on average by: a temperature of 24.9^{o}C; a pH of 4.98, a turbidity of 117.89 NTU, a conductivity of 215.94 micro-siemens/cm, a mineralization of 101.5 mg/l. The chemical analyzes showed an average presence of: 20.79 mg/l of chlorides, 49.94 mg/l of nitrates, 0.15 mg/l of iron and 0.68 mg/l of manganese. These results showed that the water used for watering is favorable for watering vegetable crops.

KEYWORDS: Physicochemical, characterization, sprinkling, water, market gardening.

1. INTRODUCTION

Today, worldwide, there is an intensification of industrial and agricultural activities, as well as a rapid increase in population and growth in living standards (Diallo, Diallo, Kante and Bangoura, 2020). In rural areas, water comes either from a surface water source (river, pond, backwater), or from a traditional well (Ghislain, 2013). These activities have introduced into hydro-systems (estuaries, groundwater, courses water, lakes, lagoons, oceans…) polluting substances which have harmful repercussions on the environment and subsequently on human health. Indeed, some chemicals can be the cause of the disappearance of certain animal and/or plant species and therefore cause the trophic chain to malfunction. Water is an essential element in the life of living beings, especially in that of man and animals, having it available in sufficient quantity and of good quality, contributes to the maintenance of health (Diallo, Diallo, Kante, Bangoura and Sakouvogui, 2019).

In several developing countries, watering accounts for 95% of all water use, and plays an important role in agriculture, particularly in market gardening. The future agricultural development strategies of most of these countries depend on the possibility of maintaining, improving and expanding irrigated agriculture.

In addition, there is increasing pressure on water resources, amplified by competition from other water-using sectors and by respect for the environment. The intensity of watering in different countries obviously depends on the climate, the type of crop and the source of water.

In arid and semi-arid conditions, farmers have to use different sources of water for watering their crops. On some sites, they use untreated wastewater, which can come from both households and industries. The hydro-chemical data show intense macro pollution in well water (Camara, 2017). Given the intensive exploitation of all these resources, it is now necessary to carry out a qualitative study of these waters intended for irrigation, especially from water points or wells. Agriculture, in general, is a large consumer of water. Thus, wells must be properly maintained and water must be regularly tested for the presence of microbial, chemical, inorganic and organic contaminants. Water from wells in the Sagbaya market garden is of natural origin (runoff), urban (wastewater), underground and agricultural (drainage water) from watersheds (Tonguino, Barry and Sakouvogui, 2019).

In the urban commune of Faranah and in the surrounding prefectures (Dabola, Kissidougou), vegetables are rare and expensive in the dry season. This is how certain women from the

Faranah prefecture created a market gardening group in SAGBAYA, along the Niger river towards the East side in order to meet the needs of the population in this period on the one hand and to develop collectively somewhere else. This group has about 60 people including 8 men who are mostly illiterate. Thus, water from traditional wells is used by this SAGBAYA market gardening group, but from the quality point of view it is not known (Ministère de la Santé, 2015).

The general objective of this study is to characterize the irrigation water used by members of the SAGBAYA market gardening group. As for the specific objectives, they aim to determine the fluctuation of the physical parameters of the irrigation water (Temperature, pH, Turbidity, Conductivity and Total Dissolved Solids) and assess the presence of the chemical parameters in the irrigation water (Chlorides, Nitrates, Iron and Manganese).

2. MATERIAL AND METHODS

2.1. Material

2.1.1. Presentation of the study area

The administrative region of Faranah is the central part of the country which stretches between Fouta Djallon, Guinea Forestier and High Guinea. It is located at 8°50 and 12°0 north latitude and 9° and 11°29 west longitude. It covers an area of 40122 km² for a total population of 942733 inhabitants in 2014. It is predominantly rural (80%).

The climate as a whole is of the Sodano-Guinean type with the alternation of two seasons: rainy and dry. The relief is little uneven. The soils are ferralitic, clay-loam and hydromorphic. The hydrographic network is dominated by the Niger River and its tributaries. The average annual rainfall varies between 1200 mm and 1700 mm. Temperatures are generally high. They oscillate between 27°C and 30°C on average. The relative atmospheric humidity varies between 69 and 85% on average. The region is primarily agropastoral in vocation with significant agricultural potentials, the valuation of which still suffers from poor water control (3.81% of the areas) and the use of traditional methods giving low yields (Tonguino, Barry and Sakouvogui, 2019).

2.1.2. Presentation of the SAGBAYA market gardening group

The SAGBAYA market gardening group was created in 2006 (Order No.502/MATDS/SACCO/2006 of November 02, 2006) notified by a registration certificate N°048/MATDS/2006 of November 07, 2006, on the initiative of 20 members. It is a mixed group currently composed of 60 members including 8 men. It is renowned for the production of vegetables for domestic consumption.

The group is located and evolves in the Urban Commune of Faranah in the Sirikolony district in the SAGBAYA sector, it occupies a plain of two (2) hectares since November 02, 2006. The watering of the various cultures is done from traditional wells (table 1) with the following equipment: sump, bucket and watering can with a capacity of 15 liters.

2.1.3. Analysis material

The following materials were used for the analysis of the different samples: a thermometer, a pH meter (pH-HJ90B), a turbidimeter (2100P HACH EDIT), a spectrophotometer (DR/2000 HACH), a conductivity meter (CO/150 HACH) one, Ten (10) empty plastic bottles, 25 ml cuvettes, capsules (reagent), electrodes (probes), a reagent tube rack, pipettes, 300 ml polyethylene tanks and graduated cuvettes.

2.2. Methods

The water samples were packaged and sent to the Water and Hydrotechnical Hygiene of Civil Engineering laboratory at Gamal Abdel Nasser University in Conakry for their analysis. The temperature and electrical conductivity were determined by the potentiometric method; the pH by the colorimetric method; hardness, turbidity, nitrate and other characteristics by the volumetric method (Abai, Ombolo, Ngassoum and Mbawala, 2014; Mehounou, Josse, Pierre, Serge and Toklo, 2016).

3. RESULTS AND DISCUSSIONS

3.1 Results

The results obtained during this research are presented in table 1 and illustrated by figures 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 for a good interpretation.

Table 1: Results of the physicochemical characterization of irrigation water.

N°	Parameter	Well										Average
		Well N°1	Well N°2	Well N°3	Well N°4	Well N°5	Well N°6	Well N°7	Well N°8	Well s N°9	Well N°10	
1	Depth (m)	4.30	5.10	5.55	5.10	5.60	5.20	5.20	4.70	4.60	4.10	**4.95**
2	Water level (m)	3.10	3.20	3.65	3.30	3.30	3,10	3.10	2.90	2.80	2.80	**3.13**
3	Temperature (°C)	23	24	25	26	25	25	25	26	25	25	**24.90**
4	pH	5.16	4.37	4.63	4.53	4.73	4,78	5.6	5.03	5.45	5.51	**4.96**
5	Turbidity (NTU)	71.32	57.45	57.23	393	364.5	115.5	23.94	27.30	27.97	40.73	**117.89**
6	Conductivity (µs/cm)	94	111	90.30	117	122,1	123	329	466	375	332	**215.94**
7	Mineralization (mg/l)	44	52	42	55	57	57	155	221	175	157	**101.50**
8	Chlorides (mg/l)	17.5	10	20	22.5	22.5	20	22.5	35.0	20.0	17.9	**20.79**
9	Nitrates (mg/l)	18.48	22.88	54.56	47.52	54.56	54.56	40.48	125.40	43.56	37.40	**49.94**
10	Iron (mg/l)	0.05	0.20	0.15	0.30	0.47	0.18	0.04	0.07	0.03	0.05	**0.15**
11	Manganese (mg/l)	0.30	0,50	0.50	1.50	1.60	0.80	0.40	0.40	0.30	0.50	**0.70**

The different figures are as follows.

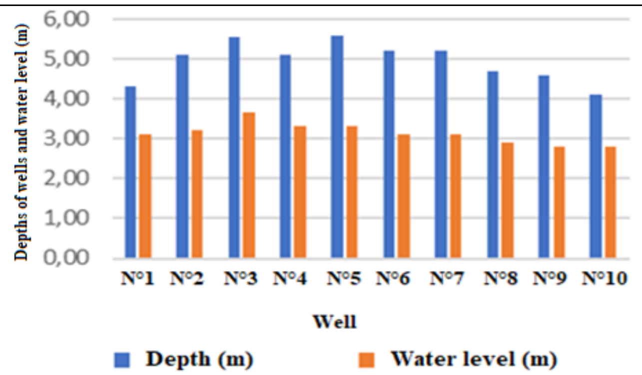

Figure 1: Depths of wells and water level

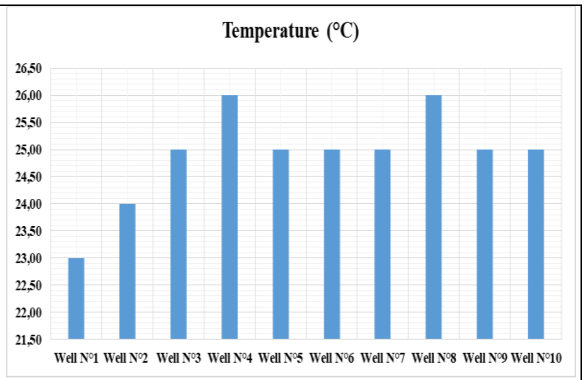

Figure 2: Temperature

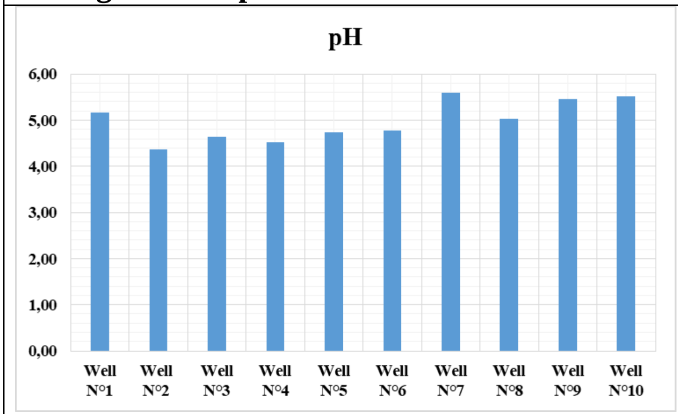

Figure 3: pH

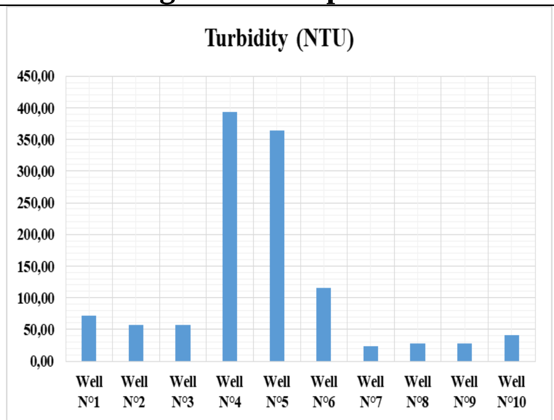

Figure 4: Turbidity

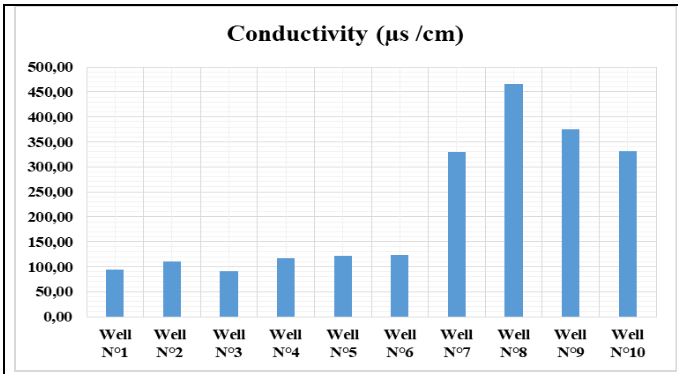

Figure 5: Conductivity

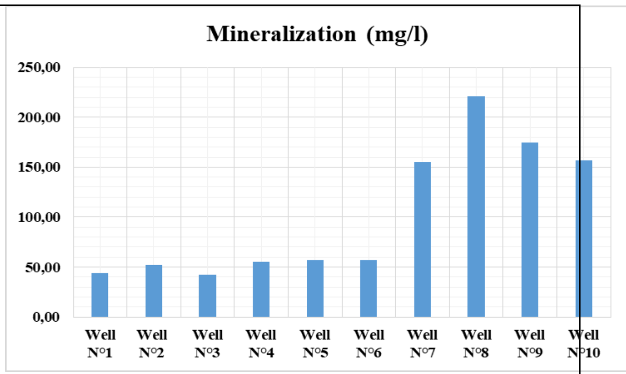

Figure 6: Mineralization

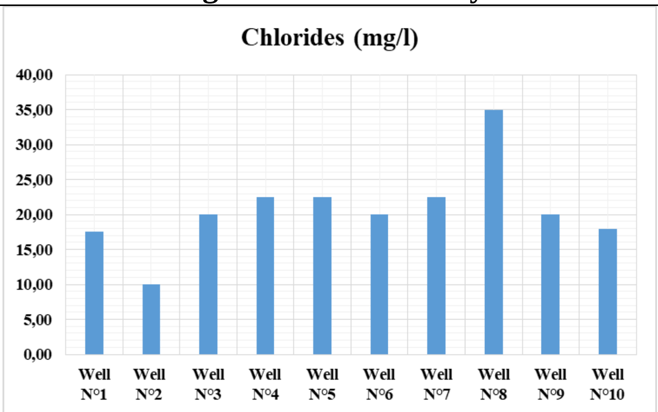

Figure 7: Chlorides

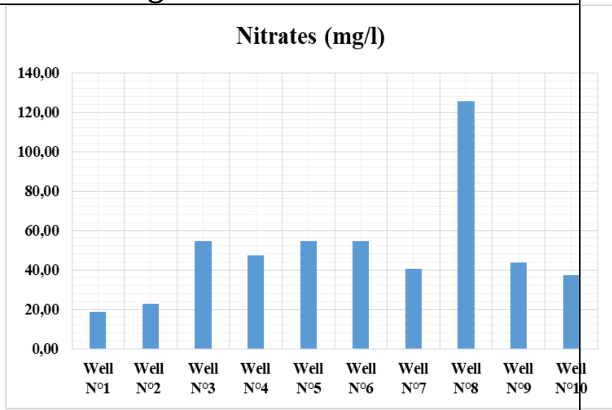

Figure 8: Nitrates

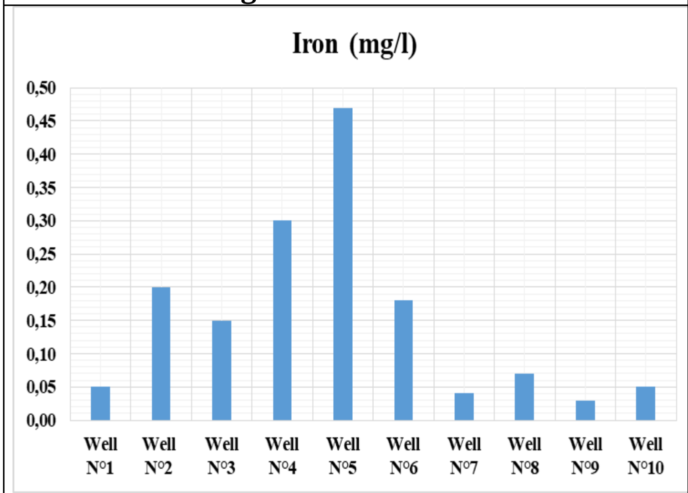

Figure 9: Iron

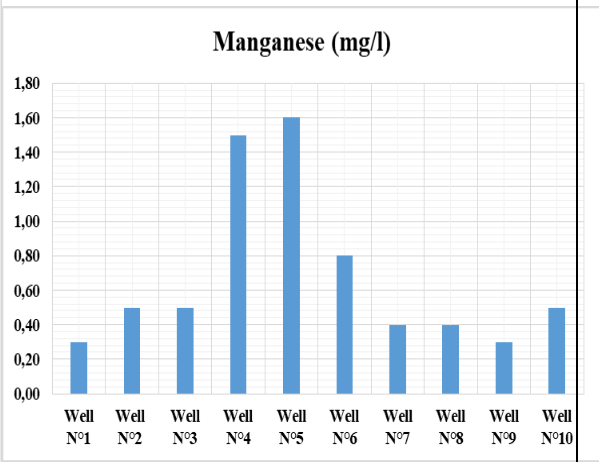

Figure 10: Manganese

3.2. DISCUSSIONS

3.2.1. Well depths and water level

The diagram in Figure 1 shows the shallowest well is Well No. 10 (4.10 m) with a water level of 2.80 m. The deepest well is Well No. 5 (5.60 m) with a water level of 3.30 m. The water levels in different wells in the pool exceed half of the different depths, more than 50%. The average depths and water levels are respectively 4.95 m and 3.13 m, which facilitates the maintenance of these water points.

3.2.2. Temperature

Water temperature is a factor of great ecological importance. It regulates the solubility of gases, dissolved salts, the speed of chemical and biochemical reactions and it also acts on the metabolic activity of aquatic organisms (IBGE, 2005). It also influences the distribution of living organisms in the aquatic environment (Leynaud, Allardi, Jamain, Rogger and Savary, 1974).

The curve in Figure 2 shows the temperature values are between 23 and 26oC. This slight variation in the temperature of the water samples in the 10 wells is due to the exposure of some wells to solar radiation. The average water in these wells is 24.90 ° C, this value is within the range of accepted standards (20 to 30°C) for vegetable watering (Nadia, Mohamed and Souad, 2016; Belghyti, Bouchouata and Bounouira, 2009).

3.2.3. pH

The curve in figure 3 shows that the hydrogen potential (pH) that, well water used for irrigation has pH values that are between 4.37 and 5.60. This variation in pH is due to the topographical position of the wells targeted as study material for the market gardening domain, which could cause the presence of mineral and/or organic acids during floods in the rainy season in the waters used for watering the vegetable crops.

The average pH value of sprinkler waters is 4.98, which indicates these waters are acidic. This value is lower than that found for irrigation water from the Dennabalo de Modia market gardening group in Faranah (6.57) (Tonguino, Barry and Sakouvogui, 2019).

3.2.4. Turbidity

Turbidity is a measure of the relative transparency of water. It is not a direct measure of the materials suspended in water, but rather a general measure of their effect of diffusion and absorption of light (Jaag, 1963; Santé Canada, 2012). The curve in figure 4 shows a large fluctuation in the turbidity of the water in the wells studied. This large fluctuation would be due to the topographic position of the market garden in relation to the sources of supply of alluvium on the one hand and on the other hand to the structure of the soil on which the water surface of the well rests.

The turbidity values varied from 23.94 NTU (well No.7) to 393 NTU (well No.4), with an average value of the various wells of 11.789 NTU. This value is lower than that found for sprinkler water from the Dennabalo de Modia market gardening group in Faranah (86.25)) (Tonguino, Barry and Sakouvogui, 2019).

3.2.5. Conductivity

Conductivity is one of the ways to validate physicochemical analyzes of water (Abboudi, Tabyaoui, Hamichi, Benaabidate and Lahrach, 2014). It is a parameter which also makes it possible to assess the amount of salts dissolved in water (Pescod, 1985). The curve in figure 5 indicates that the values of the conductivity of the various oscillate between 466 µs/cm (well N°1) and 90.3 µs/cm (well N°8) with an average of 215.943 µs/cm. The variation in conductivity depends on the quantity of dissolved salts linked to the temperature which acts on natural water, on the one hand and on the other hand to the rate of dissolution of certain rocks which release cations and anions in the hydrographic basin. The average value found (215.943µs/cm) is largely that of the irrigation water from the Dennabalo de Modia market gardening group in Faranah (24.33)) (Tonguino, Barry and Sakouvogui, 2019) and relatively higher results from other authors (189.65µS/cm) (Maoudombaye, Ndoutamia, Seid and Ngakou, 2015). On the other hand, this result (215.943µs/cm) is also very inferior to other results which vary between (1671 and 2360 µs/cm) (Nadia, Mohamed and Souad, 2016).

3.2.6. Total Dissolved Solids

Total dissolved solids are made up mainly of inorganic substances dissolved in water. The main constituents of dissolved solids are chlorides, sulfates, bicarbonates, calcium, magnesium and sodium. Above all, they cause the taste of the waters to deteriorate (Centre d'expertise en analyse environnementale du Québec, 2001).

The curve in Figure 6 shows that the mineralization of the water used for watering has fluctuated greatly after analysis. Thus, the smallest value is 42 mg/l (well No. 3) and the largest is 221 mg/l (well No. 8) while the others have occupied intermediate positions. This variation in Total Dissolved Solids depends on the presence of Chloride, Nitrate, Iron, Manganese ions in the irrigation water in varying proportions. The average total dissolved solids in the irrigation water of the various wells is 215 mg / l, this value is lower than the results of other authors, which vary from 591 to 648 mg/l (Naima, Mohamed, Brahim and Lakhdar, 2012).

3.2.7. Chlorides

Chlorides are important inorganic anions contained in varying concentrations in natural waters, usually in the form of sodium and potassium salts (Lakhili, Benabdelhadi, Bouderka, Lahrach, and Lahrach, 2015). From figure 7, we see that the water used for watering the market gardening group contains chlorides. The values obtained after analysis are between 10 mg/l and 35 mg/l. The average level of chlorides in well water is 20.79 mg/l, the level of chlorides is generally higher in water from springs underground (Nadia, Mohamed and Souad, 2016).

3.2.8. Nitrates

Nitrates are synthetically supplied by fertilizers and are one of the factors that degrade water quality. Nitrates also constitute the final phase of nitrification and represent the most oxidized form of nitrogen present in water (Chapman and Kimstach, 1996). They are the form of nitrogen used by most plants and their increase in streams is mainly due to agricultural use (Meybeck, 1982). Figure 8 shows that the quantities of nitrates obtained in the irrigation water after analyzes are between 18.48 mg/l and 54.6 mg/l, with an average of 49.94 mg/l. of Nitrates mainly depends on external inputs of nitrogen fertilizers in which the nitrogen fraction not consumed by plants is leached by infiltration or runoff of rainwater. The average nitrates found in the site's sprinkling water is 49.94 mg/l, this value is relatively close to the result of other researchers, ie 43.998 mg/l (Naima, Mohamed, Brahim. and Lakhdar, 2012) and it is higher than the result of the water of the Dennabalo market garden grouping area from Modia to Faranah, ie 22.11 mg/l) (Tonguino, Barry and Sakouvogui, 2019).

3.2.9. Iron

Iron as well as Manganese are for the most part trace elements essential for the course of biological processes in metabolism and become toxic only above a certain threshold. They dissolve very well in acidic water (low pH). They precipitate and accumulate in the sediment in neutral or basic waters (Devillers, Squilbin and Yourassowsky, 2005).

Figure 9 shows that, irrigation water contains iron with amounts ranging from 0.03 mg/l to 0.47 mg/l. The variation in the water-soluble iron concentration is due to the submersion of the area caused by flooding of the river as well as rainwater runoff. The average value of Iron in the irrigation water is 0.15 mg/l, this value is very close to the result of other authors, ie 0.158 mg/l (Toukam, 2015).

3.2.10. Manganese

From figure 10, we notice that the sprinklers contain manganese whose values are between 0.3 mg/l and 1.6 mg/l. The fluctuation of this chemical element could be governed by the pH and the redox conditions of the medium. The rate of manganese varies greatly depending on the geological context. The average value of the rate of Manganese is 0.68 mg/l. This value is higher than the results of other researchers, ie 0.020 mg/l (Toukam, 2015).

4. CONCLUSION

The results of the irrigation water analyzes have shown that: the water temperature is within the usage standards (23 to 26°C), the turbidity is within a considerable range; the electrical conductivity charges in different salts dissociated in cations and anions which increase with that of the temperature; irrigation water is acidic due to the presence of mineral and/or organic acids in natural water, irrigation water is highly mineralized because it contains chlorides, nitrates etc. and also contain, chlorides from underground sources caused by contamination by surface water; the waters used contain a significant amount of nitrate and ammonia which are very unstable in nature due to the presence of nitrogen.

The physicochemical characteristics of sprinkling water from wells in the fields of the SAGBAYA market gardening group in the urban municipality of Faranah vary according to the different seasons (rainy or dry). The results obtained show that these well waters can be globally qualified as good quality for watering vegetable crops.

REFERENCES

1. Abboudi A., Tabyaoui H., El Hamichi F., Benaabidate L. et Lahrach A., Etude de la qualité physico chimique et contamination métallique des eaux de surface du bassin versant de Guigou, Maroc. *European Scientific Journal*, 2014; 10(23): 84 - 94.
2. Diallo AD., Bangoura M., Kante C., Diallo MB., Sakouvogui A., Physicochemical and Microbiological Characterization of The Singuedala River at Mamou (Republic of Guinea), International Journal of Engineering Science and Computing, 2019; 9(5): 21855 – 21858.
3. Diallo AD., Diallo MB., Kante C., et Bangoura M., Traitement des eaux usées par adsorption sur charbon actif en grain (CAG) préparé à partir des coques d'arachides. Application sur les eaux des rivières Mamouwol et Singuedala à Mamou, République de Guinée, *Afrique SCIENCE, ISSN* 1813548X, 2020; 16(2): 101-109.

4. Belghyti D., Bouchouata O., Bounouira H., Caractérisation physico-chimique des eaux usées d'abattoir en vue de la mise en œuvre d'un traitement adéquat : cas de Kénitra au Maroc. Afrique SCIENCE, 2009; 05(2): 199-216.
5. CAMARA T. Etude de la qualité physico-chimique et bactériologique des sources d"approvisionnement en eau dans la ville de Conakry. Thèse de doctorat, Université Gamal Abdel Nasser de Conakry, 2017; 298.
6. Centre d'expertise en analyse environnementale du Québec, Méthode d'analyse. Détermination des solides totaux et volatils dans les effluents; méthode gravimétrique. MA. 115- S.D. 0.1, Ministère de l'Environnement du Québec, 2001; 11.
7. Chapman D., et Kimstach V., Selection of water quality variables. Water quality assessments: a guideto the use of biota, sediments and water in environment monitoring, Chapman edition, 2nd ed. E &FN Spon. Chapter, 1996; 3: 74 - 133.
8. Devillers J., Squilbin M. et Yourassowsky C., Fiche 2: Qualité physico-chimique et chimique des eaux de surface: cadre général, Institut Bruxellois pour la Gestion de l'Environnement/Observatoire des Données de l'Environnement. Les données de l'IBGE: "L'eau à Bruxelles", 2005; 16.
9. Abai EA., Ombolo A., Ngassoum MB., Mbawala A., *Suivi de la qualité physico-chimique et bactériologique des eaux des cours d'eau de N'Gaoundéré, au Cameroun*, Afrique SCIENCE, 2014; 10(4): 135-145.
10. Lakhili F., Benabdelhadi M., Bouderka N., Lahrach H. et Lahrach A., Etude de la qualité physico-chimique et de la contamination métallique des eaux de surface du bassin versant de Beht (Maroc). European Scientific Journal, 2015; 11: 132 - 147.
11. Leynaud G., Allardi J., Jamain R., Rogger M. et Savary M., Incidences d'un rejet thermique en milieu fluvial sur les mouvements des populations ichtyologiques. Bulletin Français de Pisciculture, 1974; (255): 41 - 50.
12. Ghislain de Marsily, Les problèmes de leau en 26 questions. Livret sur l'environnement. Institut de France, Académie de Sciences, 2013.
13. IBGE: Institut Bruxellois pour la Gestion de l'Environnement / Observatoire des Données de l'Environnement, Qualité physico-chimique et chimique des eaux de surface : cadre général, 2005; 216.
14. Pescod MB., Design, operation and maintenance of wastewater stabilization ponds in treatment and use of sewage effluent for irrigation. Ed. Pescodand Arar, 1985; 93 – 114.
15. Meybeck M., Carbon, nitrogen and phosphorus transport by World Rivers. Amer. J. Sci., 1982; (282): 401 - 450.

16. Maoudombaye T., Ndoutamia G., Seid AM., Ngakou A., Etude comparative de la qualité physico-chimique des eaux de puits, de forages et de rivières consommées dans le bassin pétrolier de Doba au Tchad, Larhyss Journal, ISSN 1112-3680, 2015; 24: 193-208.
17. Mehounou JP., Josse RG., Pierre DY., Serge FSe., Toklo RM., Caractérisation physico-chimique et microbiologique des eaux souterraines et superficielles dans la zone de production cotonnière d'Aplahoué. Journal of Aplied Biosciences, 2016; 103: 9841-9853.
18. Ministère de la Sante, Direction Régionale de la Santé de Faranah, Annuaire Statistique Sanitaire", Rapport, 2015; 109.
19. Nadia I., Mohamed K., et Souad EA., Caractérisation physico chimique et analyse biologique des eaux de surface de l'Oued Daliya, Maroc, *Afrique* SCIENCE, 2016; 12(4): 256 – 270.
20. Naima EH., Mohamed S., Brahim L. et Lakhdar EM., Évaluation de la qualité des eaux souterraines pour l'utilisation dans l'eau potable et l'agriculture : plaine de Tadla, Maroc, Afrique SCIENCE, 2012; 08(1): 54 - 66.
21. Jaag O., Corrélation entre la turbidité, la transparence et la couleur de quelques-unes de nos eaux de surface. Bull. Soc. Vaud. Sc. Nat., 1963; 68(310): 205- 212.
22. Tonguino SP., Barry MA., Mahamoud R., Sakouvogui A., Physical and Chemical Characterization of Watering Waters of The Dennabalo - Modia Marine Group at Faranah (Republic of Guinea), American Journal of Engineering Research (AJER), 2019; 8(1): 226-232.
23. Santé Canada, Recommandations pour la qualité de l'eau potable au Canada: Document technique. La turbidité, Bureau de la qualité de l'eau et de l'air, Direction générale de la santé environnementale et de la sécurité des consommateurs, Santé Canada, Ottawa (Ontario), (Numéro de catalogue, H144-9/2013F-PDF), 2012; 86.
24. Toukam UA, Pratiques phytosanitaires chez les producteurs de la tomate et impact de celles-ci sur la qualité physicochimique de l'eau, dans la localité d'Okok II (Cameroun), Mémoire Licence Professionnelle, Université de Ouagadougou, 2015; 69.