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Physical and Chemical Characterization of the Waters Gbamban River for the end of Irrigation, Urban Commune of Kissidougou, Guinea

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Abstract *: The general objective of this research is to characterize the physicochemical quality of the waters of the Gbangban River, for irrigation purposes in the urban commune of Kissidougou. The work was carried out in the period from 08 January 2021 to 20 February 2021. The analyses focused on the determination of the following physical and chemical parameters: pH; temperature; turbidity; electrical conductivity; dissolved totals; nitrites and nitrates. During the months of January, February and March, nine (9) water samples were taken from the 1.5 liter bottles. The samples taken are sent to SNAPE's laboratory in N'Zérékoré for analysis. Physicochemical analyses have yielded the following results: the turbidity content varies from 52NTU to 189NTU, the conductivity of the water varies from 87µg/l to 115µg/l; the temperature varies from 25°C to 34.6°C, the pH varies between 6.5 and 7.4, the nitrite contents vary from 0.02mg/l to 0.07mg/l, nitrate values range from 5.19mg/l to 38.25mg/l and finally, solid totals vary between 38.6 mg/l and 109 mg/l. According to the results of the analyzes obtained, we can confirm that the waters of the Gbangban River are of good quality for irrigation and comply with acceptable standards for agriculture.*

Keywords: characterization, waters, river, Gbangban, irrigation, urban commune of Kissidougou.

1. INTRODUCTION

Climate change and increased pollution of water sources contribute to the reduction of the volume of water in the world. Man, through his activities, participates greatly in its degradation, thus mortgaging its availability and risks limiting its use by future generations [1]. Indeed, population growth, industrialization and the unsustainable use of fertilizers and pesticides and the lack of awareness of the population on the protection of the environment inevitably lead to an imbalance of the ecosystem. On the other hand, they generate polluting elements that can affect the physico-chemical and biological quality of the receiving aquatic environments [2, 3].

In Guinea, the agricultural system remains traditional. This situation carries the risk of misuse of plant protection products, environmental pollution, lack of control of the irrigation system and the quality of water intended for crop irrigation. In addition, the vicissitudes of the climate mean that agriculture faces a crucial problem of water scarcity in the dry season [4].

The Urban Commune of Kissidougou is not on the margins of this agricultural activity which supports a significant number of the population. To solve this problem, farmers in the shallows, along the banks of the river Gbangban, use this water for the irrigation of their vegetable crops, especially during the low water period, without any quality control. Especially since these waters could cause health risks for humans, animals and also seriously affect the yield of crops. This is why it would be useful to carry out a physicochemical analysis of the quality of the water of this river used by individual market gardeners, certain riparian families and by the Sabarikagni group [5].

The general objective of this work is to characterize the waters of the Gbangban River for irrigation purposes in the urban commune of Kissidougou. The specific objectives are: Evaluate the physico-chemical quality of the waters of the Gbangban River and Identify the sources of pollution of waters.

2. MATERIAL AND METHODS

2.1. Material

2.1.1 Description and status of the site

On the Gbangban River, the research site is located north-south of the commune of Kissidougou of Kissidougou. It crosses the city for a length of about 6 kilometers, it has its source in the Songbon sector and is confluent to the Niandan River in the Korodou territory, to the south. It is about one kilometer one hundred and fifty meters (1150 km) from the city center. According to the DNGR (2018), the geo-referenced perimeter of the undeveloped lowland of Gbangban is one hundred and ten (110) hectares.

Nowadays, Gbangban has become the dumping ground for neighborhoods, crossed, with high human concentration; which means that in places, the shallow is in deep degradation. The soil is hydromorphic downstream and on the right bank the bottom is exploited by private market gardeners and some riparian families. The SABARIKANYI group operates the shallows on an area of 2.5 ha and uses a HONDA motor pump, connected to a pipe of diameter fifteen, to irrigate crops, such as (red pepper, lettuce, tomato, eggplant and onion). The low water period during the month of March is characterized by a minimum flow ($Q = 0.017 m^3/s$) and that of floods in August, a maximum flow ($Q = 0.514 m^3/s$) [6]. The map of the area is shown in figure 1 [7].

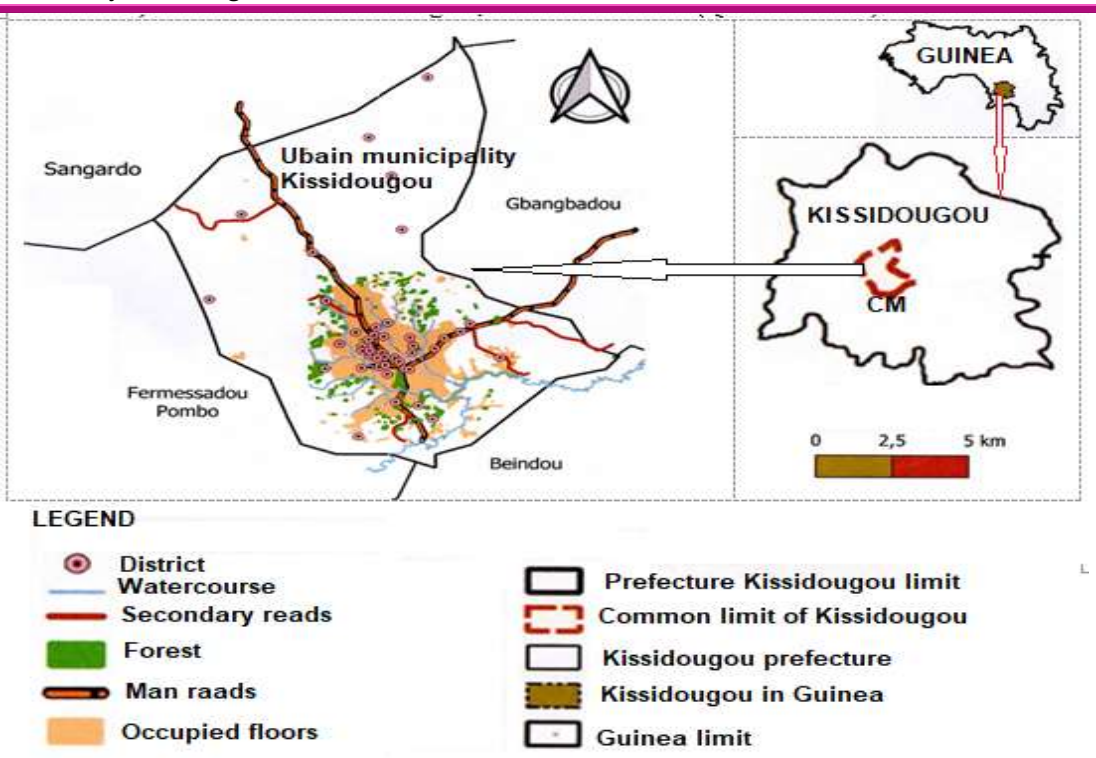


Figure 1 : Presentation of the study area

2.1.2 Technical equipment

The technical equipment used in the field is shown in the table 1.

Table 1: List of technical equipment

No	Designation	Quantity	Use
1	Maps (geographical and topographical)	2	Geographic boundary (Source Rural Engineering, 2018)
2	Graduated metal ruler	1	Measurement of the depth of water in the bed
3	100 m metal tape	1	Measurement of river sections
5	Rope, float, stopwatch	1	Determination of speed and flow rate
4	Survey sheets	60	Collects data
5	Motorcycle-TVS GLX Victor	1	Research activities
6	Bic pencil	2	Note-taking
7	Notepad	1	Note-taking
8	Computer	1	Data entry
9	Waterproof	2	Protection against rain
10	Oar	2	Draft and draw
11	Digital camera	1	Taking pictures

2.1.3 Hardware used to perform the scans

The equipment used to perform the analyses of the physical and chemical parameters is announced in the following table 2.

Table 2: List of analytical equipment

No	Designation	Use

1	Thermometer HI 9040	Taking the temperature of the water
2	pH meter	Determination of water pH
3	Turbid meter	Determination of water turbidity
4	Conductivity meter	Determination of water conductivity
5	Plastic bottles 1,5 liters(9)	Sampling
6	Coolers(1)	Secure storage of samples
7	Polyethylene tank	Keeps samples under a temperature of 4°C

2.2 Methods

2.2.1 Water sampling method

Water samples are taken from three stations, consequently, located on the river: *(i) Station 1* - located upstream of the Gbangban River at the double scupper connecting the Songbon neighborhoods to N'balia Koura; *(ii) Station 2* - 900 m away from the first station, it is located at the bridge in the Missira district; *(iii)* Station 3 - is located downstream of the river near the Korodou bridge on the national road No.2, Kissidougou - Gueckedou [5].

2.2.2 Sampling schedule

Water withdrawals from Gbangban were taken in January, February and March 2021, on the following dates: 15 january 2021; 15 february 2021; 25 march 2021. A total of nine (9) samples are taken, i.e. one (1 sample per station according to the sampling schedule. At the time of sampling, the 1.5 liter plastic bottles are rinsed several times with water to be sampled. Water is taken at a depth of 15 - 30 cm from the surface, avoiding air penetration. Samples are labelled and stored in a cooler until the analytical laboratory.

2.2.3 Securing and routing samples

After the sampling operation, the samples are placed in a cooler in which ice grains are deposited in order to maintain the temperature during their transport to the N'zérékoré laboratory, where the samples are analyzed within 24 hours.

2.24 Methods used in the laboratory for the analysis of samples.

The 9 samples, which are the subject of physical and chemical analysis at the SNAPE laboratory in N'zérékoré, were taken from the waters of the Gbangban River. They are used to irrigate vegetable crops, practiced by farmers including the SABARIKANYIN group, in the shallows during the low water period.
In the laboratory the methods used are as follows: the potentiometric method for temperature and electrical conductivity; the calorimetric method for pH; the volumetric method for turbidity; nitrates and nitrites [8, 9, 10]. Using QGIS and Microsoft Excel software, the data are processed, maps and statistical analysis are compiled [4].

3. RESULTS AND DISCUSION

3.1 Results

The results of the physical and chemical analyses carried out at the SNAPE/N'zérékoré laboratory on the water samples are presented in Table NUMBER III.

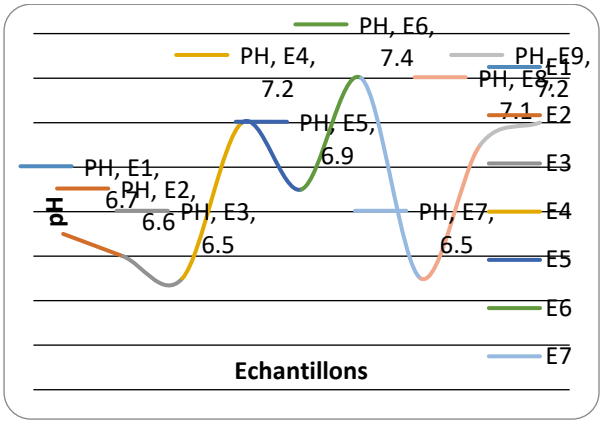
Table 3: Results of the physical and chemical parameters of the samples

Dates Sampling	**15/01/2019**			**15/0 2/2019**			**25/03/2019**		
Sampling section	Double scupper	Missira Bridge	RN2 bridge	Double scupper	Missira Bridge	RN2 bridge	Double Scupper	Bridge Missira	Bridge RN2
Samples	I	II	III	IV	V	VI	VII	VIII	IX
Physical parameters									
T° (C)	25.70	26.0	26.10	37.0	34.6	28.3	24.8	24.6	24
EC (µg/cm)	91	93	115	95	102	108	88	87	89
Turbidity (NTU)	65,9	52.0	83.5	83,7	93.8	84.7	173	170	189
TDS (mg/l)	46.30	62.70	6I.30	38..60	109	98,6	44.60	72.8	63.4
Chemical parameters									
Ph	6.7	6.6	6.5	7 ,2	6,9	7,4	6.5	7.	7.2

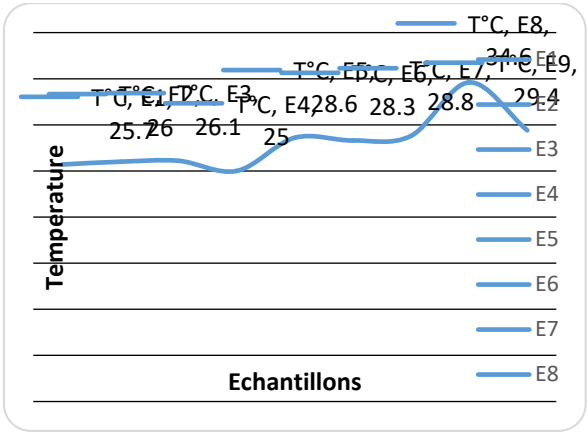
NO_2(mg/l)	0.04	0.05	0.04	0.02	0.07	0.03	0.05	0.03	0.03
NO_3(mg/l)	5,19	25,1	35,7	20,21	27,03	18,5	38,25	22,4	44.67
Dates Analyses	17 /01/2019			18 /02/2019			27/03/2019		

3.2 Interpretation of results

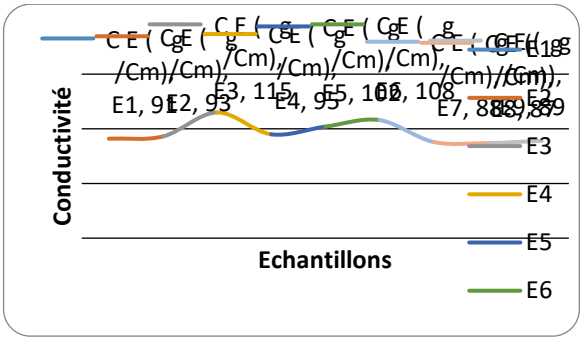
The results obtained, indicated in table 3 are schematized by the curves of figure 2 for a better interpretation and discussion.



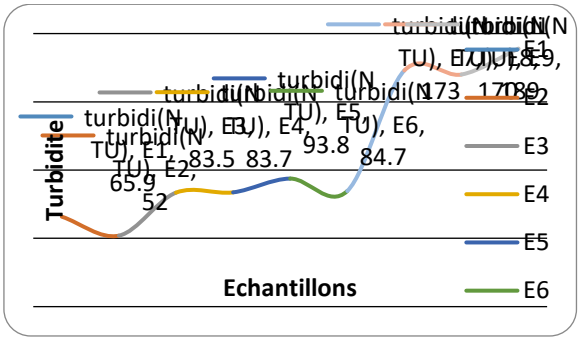
a) Change in the pH of the Water of the Gbangban River



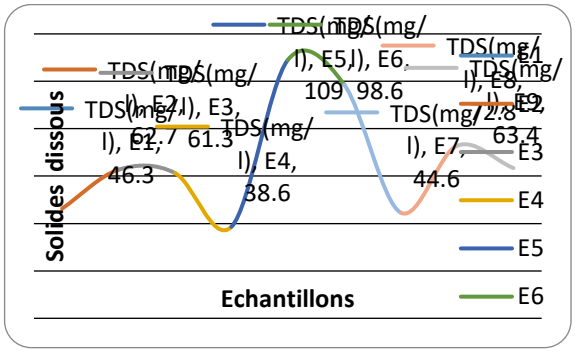
b) Variation in the Temperature of Gbangban Water



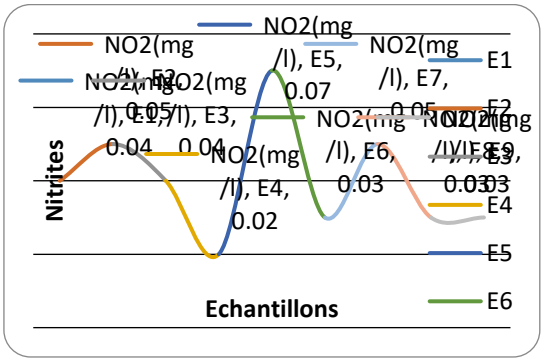
c) Variation in the electrical conductivity of water



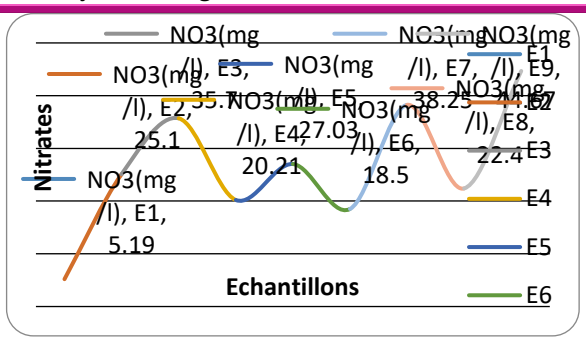
d) Change in water turbidity



e) Total dissolved solid TDS



f) Variation of Nitrites



g) Variation of Nitrates

Figure 2: Curves of variation of physicochemical parameters

3.2 Discussion

a) Hydrogen power (pH)

The pH of the irrigation water varies according to the sampling sections in the months: in January, it varied from 6.5 to 6.7; in February, from 6.9 to 7.4 and in March from 6.5 to 7.2. Depending on the results of the analyses, the pH values found in water intended for irrigation vary from 6.5 to 7.4. According to the FAO, the pH values are in the grid from 6.5 to 8.4. Otherwise, for annual production, this water can be used for irrigation according to CRAAQ (2003), because its pH values are in the range of 5 to 8 [5].

b) Temperature

In January, the minimum water temperature is 25.7°C and the maximum observed is 26.1°C; in February, the minimum value is 25°C, while the maximum observed is 28.6°C and in March, it varied from 34.6°C to 28.8°C. The temperatures recorded after the analyses vary from 25°C to 34.6°C, these values are very close to 35°C which represents the upper limit value of the temperature for irrigation water indicated by HOEDEMAN and KISHIMOTO (2011). We affirm that these waters are usable for the irrigation of crops [4].

c) Electrical conductivity

Electrical conductivity varied from 91µs/cm to -115µs/cm in January, from 95µs/to 108µs/cm in February and from 87µs/cm to -89µs/cm in March. The electrical conductivity found in the irrigation waters of the Gbangban River varies from 87 µs/cm to 115 µs/cm. This low salinity water can be used for most crops on almost all soils in the area, just because these values are less than 250µS/cm indicated by [11].

d) Turbidity

Turbidity varied from 83.5 NTU to 83.7 NTU in January; from 93.8 NTU - 43.80 NTU in February and March it varied from 189 NTU to – 170 NTU. The turbidity found in Gbangban water ranges from 52NTU to 189NTU. According to Anonymous 2016, this water is cloudy because the values found are greater than 50NTU [12].

e) Total dissolved solid TDS

During the three months January, February and March the dissolved solids varied respectively as: from 62.7 mg/l to 61.3mg/l; from 109mg/l to 38.60 mg/l and from 44.60 mg/l to 72.8mg/l. The maximum value of total dissolved solids found in irrigation water is 109 mg/l. Regarding the waters analyzed, the mineralization is low because the value found is in the range of 100 < EC < 2000 µs/cm, indicated by RODIER and his collaborators (2009), This low mineralization is due to the rate of deposition at the bottom of the bed [5].

f) Nitrite

Nitrites varied from 0.04mg/l to 0.05mg/l in January; from 0.02mg/l to 0.07mg/l in February and from 0.03mg/l to 0.05mg/l in March. The results of our study revealed that all nitrite levels in the water samples analysed are within the required standards, as the values obtained vary between 0.02mg/l and 0.07 mg/l. This low rate indicates that said water is good for irrigation, because the value found is less than 1 mg / l according to [13].

g) Nitrates

Nitrates varied from 35.7mg/l to 5.19mg/l in January; from 27.03mg/l to 18.5mg/l in February and from 44.67mg/l to 22.7mg/l in March. Nitrate levels found in irrigation water range from 5.19mg/l to 44.67mg/l. The variation in nitrate levels is very large. But, all the same, remains below 50mg/l, which is the maximum nitrate limit provided for in irrigation water, according to [4]. This means that there is no risk of nitrate pollution of the water [13].

4. CONCLUSION

At the end of our research work on the theme: Physical and chemical characterization of the waters of the Gbangban River for irrigation purposes in the urban commune of Kissidougou, the results obtained from the parameters studied led to the following conclusions: In January, the pH of irrigation water, which varies from 6.5 to 6.7, is acidic while in February and March the pH of the water is slightly alkaline.

The temperature of the water analyzed varies from 25°C to 34.6°C. This shows that the quality of the water analyzed is good for the plants grown here. Given the electrical conductivity values, which vary from 95 to 115 µs/cm, the mineralization of these irrigation waters is low. Water turbidity values ranging from 52 NTU to 189 NTU show that the water used for irrigation is cloudy and requires filtering to reduce the presence of particles suspended in the water, before use, as they influence the photosynthesis of crops.

Ions responsible for changing the quality of irrigation water, such as nitrates and nitrites, have shown that water quality is significantly good. Thus, as shown by the results of the analyses obtained, the waters of the Gbangban River are usable for irrigation in accordance with the indicated standards, therefore acceptable. In perspective, we recommend further research on the following aspects: the study of the biological quality of water for irrigation; the physical and chemical study of soil texture.

Currently, research equipment gives us reliable information on water and soil in order to ensure proper management and optimal use of water resources; fundamental condition for better irrigation with sustainable and healthy productivity.

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