

# Microbiological and Physico-Chemical Analysis of the Waters of the “Mamouwol” Stream in the Urban District of Mamou (Republic of Guinea)

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## Abstract

Water is essential to life and to the sustainable socio-economic development of a nation, it is therefore interesting to have a better knowledge of the quality of this water. The aim was to determine the degree of microbiological and physico-chemical pollution of the water of the “Mamouwol” river in the town of Mamou. To do this, we chose four (4) sampling sites spread throughout the town of Mamou. During the month of March (2024), 4 water samples were analyzed to monitor the water quality of this river. The average values of the flora analyzed show that these water are heavily contaminated with bacteria indicative of fecal and metal pollution. This study showed that sites: Mam4; Mam2 and Mam1 contain the highest loads, with Total Coliform counts ranging from 1534 CFU/100 ml to 2100 CFU/100 ml, the number of faecal coliforms varies between 526 and 1240 CFU/100 ml, and that of faecal streptococci between 526 and 841 CFU/100 ml. Metal content, BOD5 and COD all comply with the laboratory's analysis criteria, although they vary from point to point.

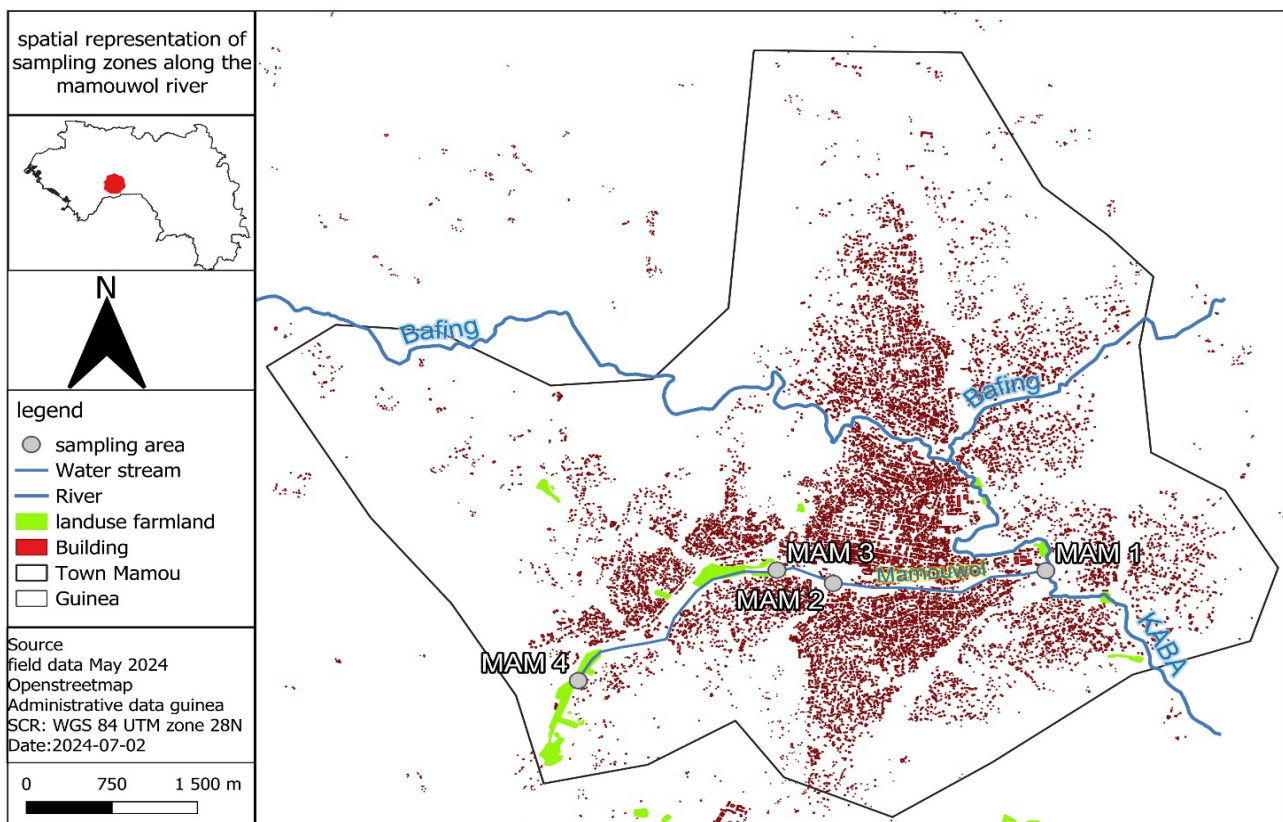
## Keywords

Pollution, Water, Watercourses, Waterborne Diseases, Microbiological Analysis

## 1. Introduction

A modelling study has shown that, by 2100, 5.5 billion people worldwide could be affected by polluted water [1]. At present, according to the report published

by UNESCO on behalf of UN-Water at the United Nations Conference on Water in 2023 in New York, nearly (2) billion people (26% of the population) have no access to drinking water and 3.6 billion (46% of the population) lack reliable sanitation [2] [3]. It should be noted that visions on climate, socio-economic development and surface water quality have already been assessed by some researchers in the form of maps. In Africa, 70% to 80% of water-borne diseases in children are mainly due to poor water quality [3]. In the case of the Republic of Guinea, the hydrographic network includes 1161 watercourses, 23 of which are basins and 14 of which are international [4] [5]. However, according to UNICEF results published in New York in March 2023, 190 million children living in 10 African countries, including the Republic of Guinea, are exposed to risks linked to: climatic hazards, water-related diseases and lack of specialized water supply services [4]. The distribution of drinking water is supplied by: Guinea Water Exploitation Company SEG (Guinea Water Company), National Water Point Development Service (SNAPE) which are public services and some private individuals, mainly through boreholes. At present, all of Guinea's water resources are threatened by massive silting of our watercourses caused by drought provoked by anthropogenic activities. [3] [6] [7]. Numerous works have been reported on water management and treatment around the world [6] [8]-[10]. We recently reported a study investigating anthropogenic activities along the same watercourse one of the most important watercourses in the commune of



**Figure 1.** Special representation of the Mamouwol stream showing sampling sites.

Mamou in the Republic of Guinea is Mamouwol, which plays an important role in the lives of the people living along the river [11]. For a continuation, we report a Microbiological analysis of the water of the “Mamouwol” stream in the urban commune of Mamou (Republic of Guinea). **Figure 1** shows the special representation of the river Mamouwol and sampling sites.

## 2. Materials and Methods

### 2.1. Presentation of the Study Area

This study was carried out in the Mamou prefecture. According to the administrative division, the Mamou prefecture is the capital of the Mamou Administrative Region and comprises 13 sub-prefectures plus the urban commune. It is made up of 28 neighborhoods. It covers an area of 17,074 km<sup>2</sup> with a population of 340,956 inhabitants (RGPH, 2016) including 43 inhabitants per km<sup>2</sup>. The Mamou prefecture lies between 9°54' and 11°10' North attitude and between 11°25' and 12°26' West longitude with a foutanian climate and an alternation of two (2) seasons: A dry season from November to April and a rainy season from May to October.

### 2.2. Study Framework

The laboratory of the National Office of Quality Control (ONCQ) at Matoto (Conakry, Republic of Guinea) was used as the setting for this study.

### 2.3. Sampling and Equipment Used

Sampling was carried out upstream and downstream of the Mamouwal River (Mamou commune) at four (4) sampling points: Mamou 1, 2, 3 and 4 (**Table 1**), followed by sample conditioning and transport to the laboratory for physico-chemical and microbiological analysis. The equipment used is GARMIN 72 GPS, camera, 50 cl sterile bottles, cooler, motorcycle, glue, pen, notepad. The sampling points were chosen according to the intensity of anthropogenic activities at these points, as shown in (**Figure 2**). Sampling was carried out on Sunday 24/03/2024.

#### 2.3.1. Sampling Method

After rinsing and sterilizing the polymer bottles intended to take the water sample, we waited a few minutes for the water to flow through them, we proceeded to levy samples in these previously prepared vials. The flasks were then placed in a polystyrene cooler at a temperature of around 5°C, and transported directly to the laboratory for spectrophotometric analysis. Conventional gallery and PCR amplification enabled us to identify the salmonella typhi strain.

#### 2.3.2. Microbiological Analysis

Microbiological analyses were carried out using the enumeration method. This method consists in determining the micro-organism content in a product in order to control its quality [12].



**Figure 2.** Showing photos of the Mamouwol stream. With a traditional toilet (a); a water merchant with cans and tricycle (b); teenagers: mechanic cleaning his hands and clothes, then drinking afterward, and boatman on old car tanks with shoes in hand (c), (d).

### 2.3.3. Physicochemical Analysis

Heavy metals are metallic elements whose density exceeds  $5 \text{ g/cm}^3$ . They are referred to as trace metals in the environment, and generally come from pollution of human origin. Their intensification in aquatic environments can have effects on human and environmental health [13] [14]. Some, such as iron, manganese and lead, have been measured by UV-visible spectrophotometry using photo Lab. 7600. Biological and chemical oxygen demand (BOD5; COD) are indices of water pollution that assess the biodegradable fraction of carbon pollution in water and the quantity of dissolved oxygen capable of oxidizing organic matter, in order to assess the impact of effluents, chemical parameters were also determined using a Real-Tech measuring device.

## 3. Results and Discussion

The results of the geographical coordinates in degrees, minutes and seconds (DMS) of the sampling points, the times and the microbiological and physico-chemical analyses of the water are shown in (Tables 1-4 and Figure 3).

Table 1 shows the results obtained from the use of GPS in this study, which enabled us to take the coordinates of the sampling points in the various locations of the Mamouwol watercourse where anthropogenic activities are intense at the times indicated in (Table 1). Microbiological analyses of water samples taken

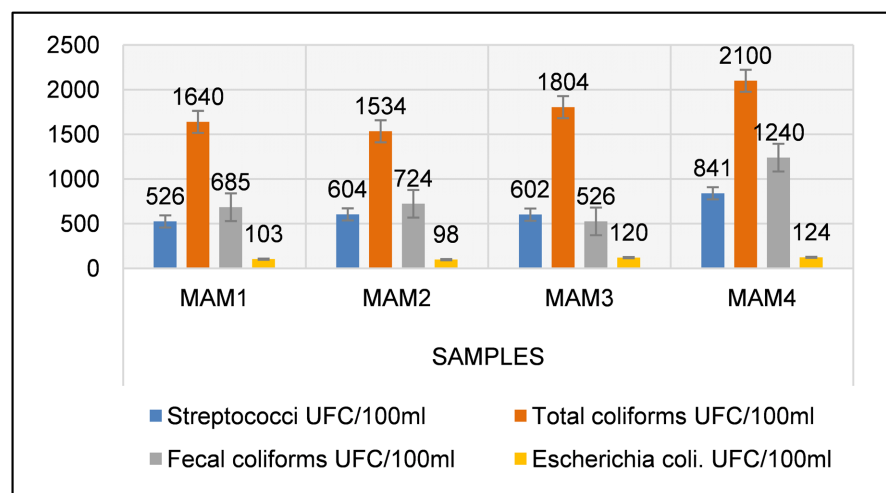
from these points were carried out, and the results are reported in (Table 2). The results show that the water analyzed contains certain microorganisms of fecal origin, accompanied by pathogenic organisms, in particular bacteria: *Salmonella*; *Faecal Streptococci*; *Total Coliforms*; *Faecal Coliforms*; *Escherichia coli*.

**Table 1.** Geographical coordinates of sampling points and times.

Sampling points	Date of Sample	Time of Sampling	Location and contact details GPS
Mamou1	24/03/2024	09 h - 57 mn	10°.21'51.50"N - 12°.03'45.01"W
Mamou 2		11 h - 03 mn	10°.37'40.88"N - 12°.07'16.66"W
Mamou 3		14 h - 20 mn	10°.38'16.40"N - 12°.08'02.64"W
Mamou 4		16 h - 45 mn	10°.38'59.39"N - 12°.08'94.55"W

**Table 2.** Results of microbiological water analysis.

N°	Types	Units	Samples				Criteria
			MAM1	MAM2	MAM3	MAM4	
1	<i>Salmonella</i>	Abs/ml	Present	Present	Present	Present	Absent
2	<i>Streptococci</i>	UFC/100 ml	526	604	602	841	$\leq 500$
3	<i>Total coliforms</i>	UFC/100 ml	1640	1534	1804	2100	$580 - 13.10^4$
4	<i>Fecal coliforms</i>	UFC/100 ml	685	724	526	1240	$0 - 83.10^3$
5	<i>Escherichia coli</i>	UFC/100 ml	103	98	120	124	$\leq 126$



**Figure 3.** Concentration diagram of microorganisms found during the study.

#### Evaluation of salmonella concentration at points (Mamou 1, 2, 3 and 4)

Etesting for salmonella in the water of the Mamouwol stream revealed the presence of salmonella at all sampling points (Mam1, 2, 3 and 4) during the



hours indicated in **Table 1**. 100% of water samples taken during the study period were found to be positive for salmonella. This depends on the epidemiological and environmental conditions in the regions where the studies were carried out [15].

#### **Evaluation of fecal streptococci concentration**

The count of fecal pollution indicators shows that the water analyzed is colonized by fecal streptococci. Streptococcus concentrations range from 526 CFU/100 mL to 841 CFU/100 mL. However, the highest value was obtained at Mamou 4, followed by Mamou 2, Mamou 3 and Mamou 1 respectively (**Table 2**). These high concentrations of fecal streptococci observed in these points are probably linked to the consequences of human activities such as water from residential sewers, vehicle washing stations, traditional toilets, winter run-off from the tambassa cemetery, mechanical garages, poultry farms, washing, all of which are less than 25 m from the watercourse.

#### **Changes in total coliform (TC) concentrations at the various stations studied**

Total coliform (TC) concentrations for sampling sites Mam1; Mam2; Mam3 and Mam4 were: 1640, 1534, 1804 and 2100 CFU/100 ml respectively. Maximum concentrations were obtained at the following sampling points: Mam4 (2100) and Mam3 (1804 CFU/100 ml). However, minimum concentrations were observed at sampling points Mam2 and Mam1: 1640, 1534 CFU/100 ml respectively, with a difference of 106 CFU/100 ml between the two sampling sites. According to the results of studies carried out by [16] on the surface waters of Oued Hassar (Casablanca, Morocco), total coliform concentrations of: 7.4.10<sup>3</sup> and 6.4.10<sup>10</sup> CFU/100 ml, were far higher than those reported in our study.

#### **Changes in fecal coliform (FC) concentration**

**Table 2** shows the results for fecal coliform (FC) concentrations. The table shows a jagged variation in values: 685; 724; 526 and 1240 CFU/100 ml for (Mam1; Mam2; Mam3 and Mam4) respectively. However, the highest value is observed at Mam4 and the lowest at Mam3 (1240; 526 CFU/100 ml). According to the standards indicated by [17], values in excess (> 1000/100 ml CFU/100 ml), classify this water as of poor bacteriological quality for agricultural use. The results of our study are close to the values indicated by the laboratory's analysis criteria (**Table 2**). This compliance would probably be due to certain factors such as sampling mode and times; frequency rate of human and animal activities; and even the impact of public awareness campaigns.

#### **Assessment of Escherichia coli concentration in water**

Numerous studies have shown that this species is generally associated with a fecal source. Today, E. coli is considered an indicator of the onset of pollution by human or warm-blooded animal faeces [18]. In contrast to the other microorganisms listed in (**Table 2**), we found Escherichia-coli in the various sampling points (Mam1; 2; 3; 4) with growth from upstream to downstream of the town; the concentrations found were: (Mam1 = 114 CFU/100 ml; Mam2 = 98 CFU/100 ml; Mam3 = 120 CFU/100 ml; Mam4 = 124 CFU/100 ml) respectively. Based on

these results, two (2) trends were observed: An increase to 120 and 124 CFU/100 ml at points Mam3 and 4, and a decrease to 103 and 98 CFU/100 ml at points Mam1 and 2. These variations are probably due, on the one hand, to the maintenance of domestic habits and behaviours and, on the other, to the low frequency of visits by the population. A recent study reported by [19] in the town of Mamou confirmed the presence of *E. coli* in the waters of Mamouwol.

#### The origin of faecal contamination according to [19]

The origin of fecal contamination is determined by the quantitative ratio R: CF/SF (where CF is fecal coliform; SF is fecal streptococcus). According to the criteria defined by [20], contamination is of animal origin if the R ratio is less than 0.7, and of human origin if R is greater than 4. The origin of the contamination is said to be predominantly animal if R is between 0.7 and 1, uncertain if R is between 1 and 2, and predominantly human if R is between 2 and 4. **Table 3** presents the results and conclusions of our report on the origin of pollution.

Concentrations of certain physicochemical parameters such as iron, manganese, lead, calcium, biological oxygen demand (BOD5), chemical oxygen demand (COD) and salinity are shown in (**Table 4**).

**Table 3.** Origin of pollution at the various stations studied.

Sampling sites	CF/SF	Source of contamination
Mam1	3.11	Mixed, predominantly human
Mam2	2.53	Mixed, predominantly human
Mam3	2.99	Mixed, predominantly human
Mam4	2.49	Mixed, predominantly human

**Table 4.** Results for physicochemical parameters.

N°	Parameters	Units	Samples				Criteria
			MAM1	MAM2	MAM3	MAM4	
1	Iron	mg/l	0.041	0.034	0.036	0.036	< 1
2	Manganese	mg/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3	Lead	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
4	Calcium	mg/l	139.5	138.4	134.4	134	< 270
5	BOD5	mg/l	24.1	18.4	26.1	25.84	< 30
6	COD	mg/l	40	36	29	43	< 50

The results (**Table 4**) show that the levels of the identified metals comply with the laboratory's analytical criteria (**Table 4**). However, manganese levels in the (4) sampling sites are identical to the normal value of the laboratory's analysis criterion, which is: < 0.50 mg/l. other iron, lead and calcium levels comply with

criteria, but with variations in values between sampling sites. It should be noted that iron and manganese often occur together in spring water. However, manganese is generally found in much lower concentrations according to [19]. However, in our analytical results, manganese has the highest content compared to iron.

#### 4. Conclusion

In this work, we have processed the microbiological and chemical analysis of the water of the river “Mamouwol” in the town of Mamou in order to determine the degree of pollution of this important river for the population of the town of Mamou. To do this, we have processed a series of sampling on four (4) points of levy upstream and downstream, namely Mamou 1, 2, 3 and 4 (**Table 1**). Microbiological and chemical analysis using enumeration techniques and UV-visible spectrophotometry has enabled us to confirm that the four samples analyzed contain microorganisms of fecal origin, in particular pathogenic bacteria that are: salmonella; fecal streptococci; total coliforms; faecal coliforms; escherichia coli. However, the analysis showed that the content of the identified metals complied with the analytical laboratory’s criteria, and the manganese and lead contents were identical in the four sampling points at know: (0.50) *et* (0.01) respectively. In contrast to iron, lead and calcium, their contents present a variation of value in the four sampling sites in **Table 4**. A sensitization regional on the protection of this nurturer river for the town of Mamou will make a significant contribution to the sustainable management of this water resource.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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