

Environmental Impacts of Uncontrolled Waste Collection Points in the Urban Municipality of Coyah, Guinea, West Africa

Marie Rose Bangoura¹, Alain Gbilimou², Lucien Solie³

¹Laboratoire d'Etude et de Recherche Urbaine (LERU), Institut Supérieur architecture et d'Urbanisme, Conakry, République de Guinée

²Laboratoire de Recherche Appliquée en Géosciences et Environnement (LRA), Institut Supérieur des Mines et Géologie de Boké (ISMGB), Boké, République de Guinée

³Centre d'Etude et de Recherche en Environnement (CERE) de l'UGANC, Conakry, République de Guinée

Email: alaingbilimou22@gmail.com

How to cite this paper: Bangoura, M. R., Gbilimou, A., & Solie, L. (2025). Environmental Impacts of Uncontrolled Waste Collection Points in the Urban Municipality of Coyah, Guinea, West Africa. *Journal of Geoscience and Environment Protection*, 13, 302-315.

<https://doi.org/10.4236/gep.2025.131016>

Received: December 19, 2024

Accepted: January 23, 2025

Published: January 26, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

This article is descriptive research that takes into account the growing concerns of the authorities of the municipality of Coyah regarding waste management, as well as our desire to contribute to improving the living conditions of the inhabitants of this region. The main objective is to assess the environmental impacts of uncontrolled waste collection points on the receiving environments, by characterizing and evaluating them. This will make it possible to propose appropriate measures for rational and sustainable management of the environment in Coyah. The study addresses the characterization and assessment of pollution of receiving environments, including water, soil and air. Environmental analyses were carried out according to standard methods of EPA (1997), adapted to the equipment of the companies Hach, Millipore and Verlan. During the environmental impact assessment, we identified the sources of pollution and assessed the potential impacts. This research highlighted the pollution of receiving environments by waste located in the vicinity of collection points, while considering solutions for efficient and sustainable waste management.

Keywords

Environmental Impacts, Waste, Sustainable Management, Receiving Environment, Collection Points

1. Introduction

The term “waste” has its origins in the Latin “torn”, which designates a fallen or lost property (Ghezali, 2017), and reflects cultures and values. It also reveals the

standard of living of populations and the state of the environment (Mery, Mtibaa, & Torre, 2009). Waste from human activity poses a major problem (Christian & Régent, 2012), especially in developing countries, where their management is particularly difficult.

Cities in Guinea, including Conakry, suffer from inadequate waste management systems. In most secondary cities and regional capitals, household waste causes major environmental impacts. Only the cities of Conakry and Labé have uncontrolled landfills (Abdelli, 2005) and industrial cities such as Fria and Kamsar.

In Guinean cities, more particularly in Coyah, waste pollution results from their mixing, from markets to dumps and uncontrolled landfills. This mixing renders waste unusable and transforms it into bio-reactors, producing microbes, gases, liquids and solids that are different from what these wastes could have become if they had been sorted and valorized as secondary raw materials for agro-pastoral production or recycling. As Maiga Fatoumata et al. (2021) point out, “waste is increasingly seen as a resource that, instead of being dumped in bulk in landfills, must be transformed into useful products for consumption, hence the expression: waste is gold”.

This situation constitutes a major obstacle to sustainable development and the well-being of the population, leading to significant environmental, health and economic consequences. Also, disorderly urbanization and rapid population growth have led to the formation of neighborhoods without adequate systems for household waste management, which has led to a considerable increase in the amount of waste produced (Bangoura, 2004).

The lack of sustainable management of this waste has serious repercussions on the environment and on health. It encourages residents to dump their garbage in the streets, gutters, backwaters, along the railways, forming mountains of waste (illegal dumps) with nauseating odors where flies, mosquitoes, cockroaches, rats, etc. proliferate.

However, the Guinean Environmental Code, in its Article 60, prescribes the adequate treatment of waste in order to eliminate or reduce its harmful effects on human health, natural resources, fauna, flora and the quality of the environment in general. In addition, the Public Health Code, in its Article 105, makes it mandatory to set up one or more landfills for the collection of solid waste in each locality. These landfills must be located in appropriate areas, taking into account geological characteristics, and maintained by the road services, while respecting the technical standards for waste disposal and environmental protection against nuisances that could harm public health.

However, despite these regulations, the municipality of Coyah faces inappropriate management practices due to lack of resources and adequate infrastructure. As a result, waste produced by households is often dumped in illegal dumps, which we refer to here as uncontrolled collection points. This phenomenon increasingly complicates public sanitation and solid waste management through contamination of water resources, soil degradation, and air pollution. Also, the rapid growth of the population, anarchic urbanization, low civic-mindedness, non-compliance with texts relating to waste management and precarious living

conditions linked to poverty lead to an increase in insalubrity and remains a major challenge for those responsible for the issue.

Thus, Coyah, with a population of 30,039 inhabitants in 1996 spread over 4,091 households (Mamandou, 2000), includes six districts (Coyah Centre, Doumbouyah, Fily, Km 54 Nord and Somayah), a prefectural hospital, two health centres, as well as industrial units that generate a significant quantity of waste. Two large markets, where various goods from the interior of the country as well as from Sierra Leone and Liberia are sold, also contribute to this waste production.

All this waste piled up at the level of the illegal dumps constitutes potential sources of pollution for the receiving environments. It is thus important to note that among the multitude of waste collection points identified, six have particularly caught our attention: the dumps of Soumbouyah pharmacy, as well as those of the districts Center 1, Center 2, North 1, North 2 and North 3. These points are often located along the backwaters, behind houses or in public places, which makes them likely to affect the quality of the surrounding water, soil and air.

Due to the lack of controlled landfills or suitable places for the disposal of waste, their management remains difficult and their effects threaten the health of the population and the environment. Considering that no environmental impact study was carried out when these waste collection points were created in the municipality of Coyah, it is essential to assess their environmental impacts. This will allow us to better understand the real extent of the pollution and nuisances caused by the current method of urban waste management, and to consider effective measures to reduce them.

2. Research Objectives

2.1. General Objective

The main objective of this research is to assess the environmental impact of uncontrolled collection points for household solid waste on the receiving environments of the urban commune of Coyah.

2.2. Specific Objectives

The specific objectives of this study are as follows:

- ✓ Identify the sources of pollution affecting the receiving environments of the commune of Coyah;
- ✓ Characterize and evaluate the pollution of receiving environments resulting from the current method of grouping waste in the municipality;
- ✓ Propose measures to mitigate pollution of receiving environments caused by solid waste.

3. Materials and Methods

To achieve our objective, the methodological approach adopted consisted of gathering relevant literary information on the subject, conducting surveys and sampling campaigns and environmental analyses, as well as identifying negative and positive

impacts. The environmental analyses focused on the characterization of the parameters of the receiving environments that have environmental significance (water, soil, air). This made it possible to formulate measures aimed at mitigating negative impacts or enhancing positive impacts, using a matrix of potential impacts.

3.1 Presentation of the Study Area and Site

Presentation of the Coyah Prefecture

The study area shown in **Figure 1** is located in the central part of Maritime Guinea, it is limited to the East by the prefecture of Kindia, to the West by the Atlantic Ocean and the region of Conakry, to the North by the prefecture of Dubréka.

The prefecture of Coyah, located 50 km from Conakry, is experiencing strong demographic and spatial growth, linked to the increase in the population of the city center and suburbs of Conakry. This situation raises questions about the impact of this growth on the production of urban waste in Coyah. To manage this rapid expansion, the authorities are implementing sanitation policies to improve the living environment of citizens.

It includes four sub-prefectures: Manéah, Wonkifong, Kouriah and the Urban Commune. Its proximity to Conakry and its accessibility by a paved road facilitates trade and make it an area of influence of the capital. This presentation is shown in **Figure 1** below the Commune of Coyah has a relief composed of low

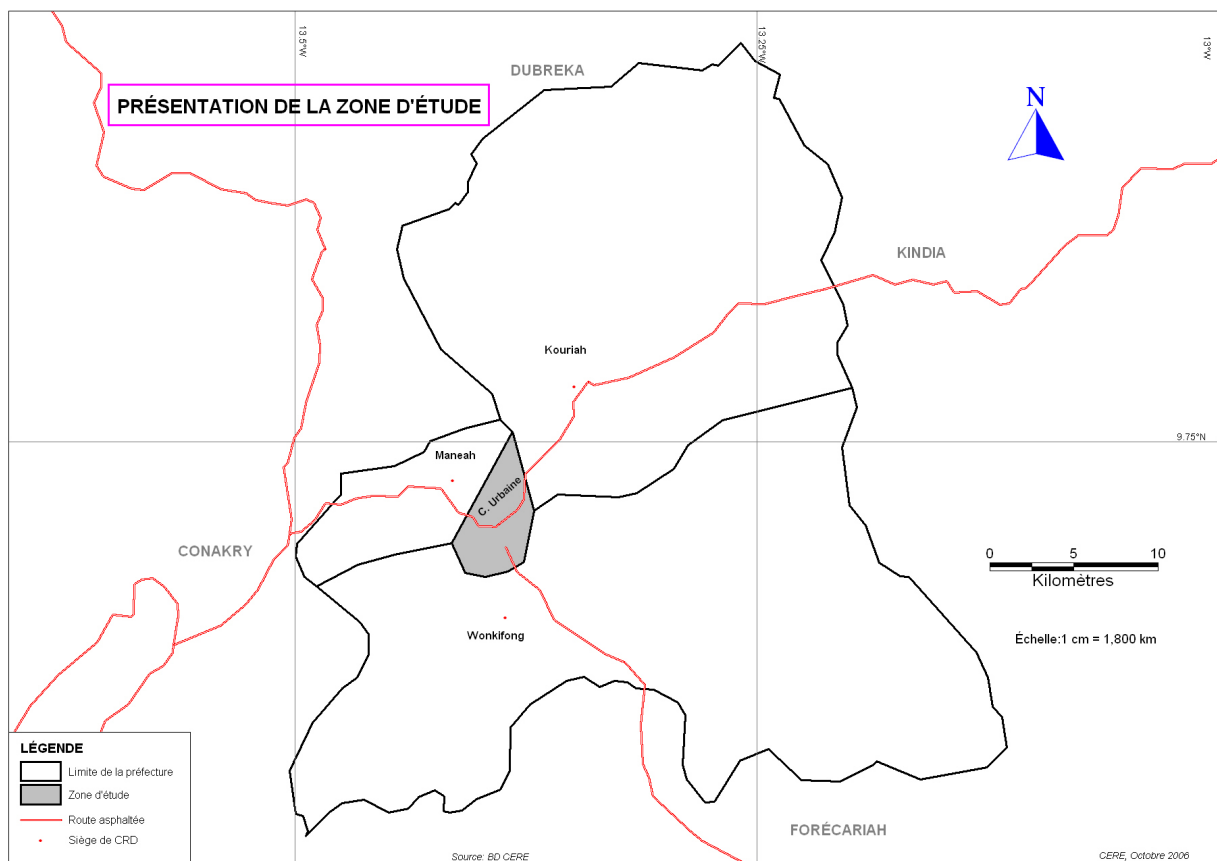


Figure 1. Presentation of the study area.

hills, plateaus and alluvial plains, suitable for flooded rice cultivation. The tropical climate, with a dry season from November to April and a rainy season from May to October, influences waste management. Urbanization is developing in a radio-centric manner, but without adequate infrastructure management. The population of Coyah has increased significantly, from 13,000 inhabitants before 1990 to 49,738 in 2014 [United Nations \(UN\), Economic and Social Commission for Asia and the Pacific, State of the PDU \(2003\)](#), in parallel with urban expansion. Socio-economic activities include agriculture, livestock, fishing, commerce, crafts and industry. All of these activities constitute potential sources of pollution, see **Photo 1** and **Photo 2** below.



Photo 1. Center 1 dump.



Photo 2. Center 2 regrouping point.

3.2. Characterization of Water Pollution

3.2.1. Sampling

Sampling was carried out during the dry and rainy seasons in order to study the variation of the different parameters measured depending on the season. To do this, two campaigns were conducted: the first in March 2022, corresponding to the dry period, and the second in September of the same year, for the rainy season. Water samples were taken from six domestic wells and three backwaters located near six waste collection points. In addition, leachate samples were also collected

at the site of two collection points during the rainy season.

It should be remembered in the Guinean context that there are two seasons in the year, which is why our sampling was done in these two periods.

All samples were collected in 500 ml polyethylene bottles, carefully washed, sterilized and labeled beforehand. Those intended for microbiological analysis were stored in a cooler. Water and leachate samples were acidified with nitric acid for metal analyses, and with sulfuric acid.

for organic matter (COD) analyses. Subsequently, the samples were transported to the CERE laboratory for analysis within the specified time frame.

To assess the impact of waste on water quality, control samples were also taken from wells and at certain points in backwaters protected from any contamination by garbage dumps. The geographical location of the different sampling points is shown in **Figure 2**.

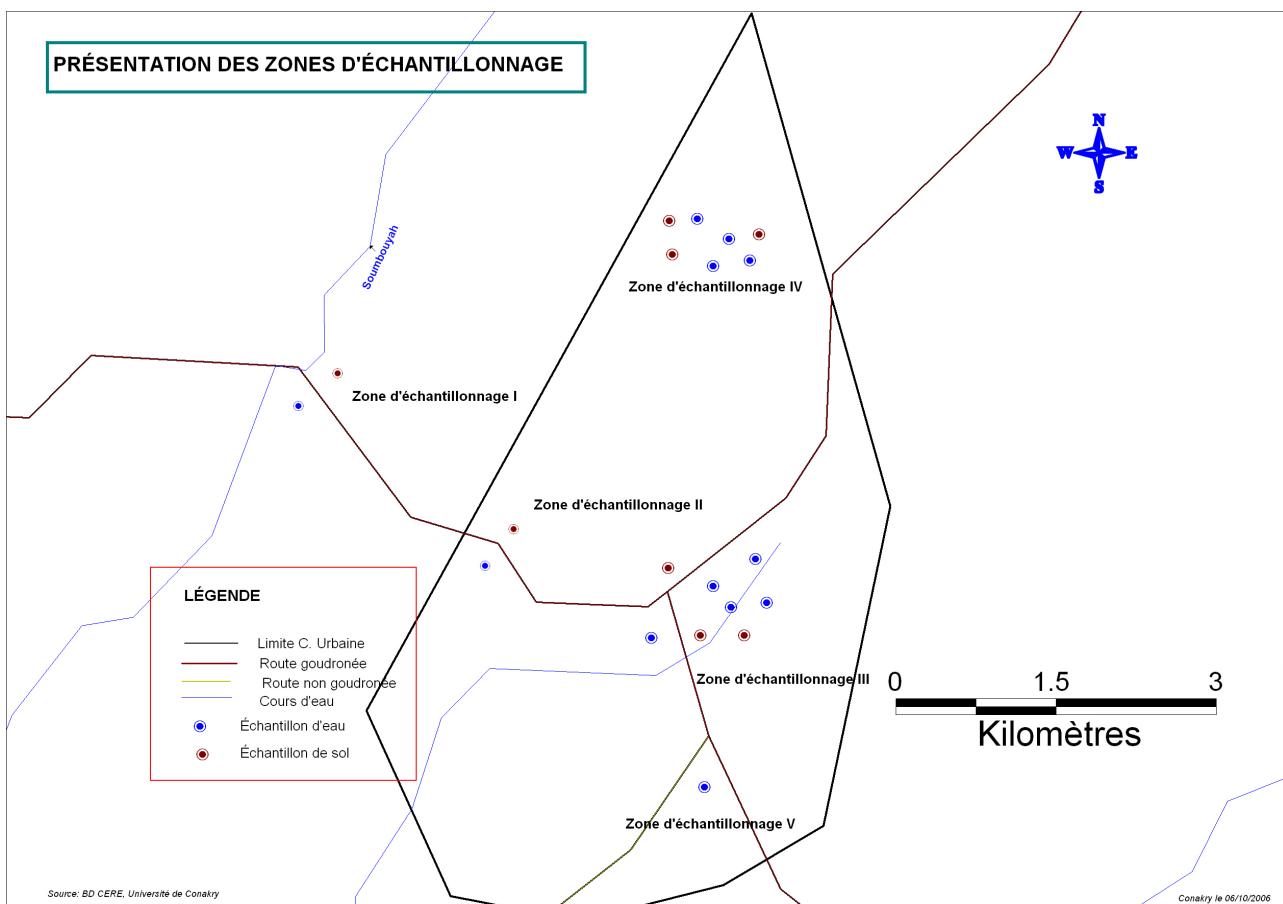


Figure 2. The geographical location of the different sampling points.

3.2.2. Parameters Evaluated

The assessment of water quality (wells and backwaters) and leachates was carried out based on several physicochemical, organic, inorganic and bacteriological parameters, for which standards have been established. The analyses were carried out according to the standard methods of **Camara Mamadou (2000)** and **EPA**

(1997), adapted to the equipment of the companies Hach, Millipore and Varian. The parameters measured include:

Temperature, pH, conductivity and turbidity: these first three parameters were measured in situ using a HACH conductivity meter (model 44600-00), while turbidity was measured with a Hanna turbidimeter (model HI 8733).

Color, suspended solids (SS), dissolved solids (DS), anions (NO_2^- , NO_3^- , PO_4^{3-} , SO_4^{2-} , Cl^- , F^-), dissolved iron and chemical oxygen demand (COD): these parameters were analyzed by spectrophotometry using the DR200. COD was determined after digestion of the sample at 150°C in a COD REACTOR, using a mixture of $\text{K}_2\text{Cr}_2\text{O}_7$, H_2SO_4 and HgSO_4 contained in glass cells.

- ✓ Total hardness and alkalinity: these parameters were measured by titration, respectively with 0.020N EDTA, using the indicator Eriochrome Black T ((1-hydroxy-2-naphthylazo)-6-nitro-2-naphthol-4-sulfonic acid), and with 0.020N sulfuric acid in the presence of the Bromocresol green indicator.
- ✓ Lead, cadmium, chromium, zinc, copper and cobalt: these metals were measured by atomic absorption spectrometry using a Varian Spectra A 110 spectrometer.
- ✓ Fecal coliforms: their concentration was determined by the filtration method on a 0.45 μm porosity membrane, followed by incubation on the M-FC culture medium at 44.5 °C for 24 hours.
- ✓ All manipulations were carried out with equipment and instruments sterilized using a flame obtained with 95% ethanol.

3.3. Characterization of Soil Pollution

3.3.1. Sampling

In order to assess the impact of waste on soil quality, random soil samples were collected from the six study cluster sites. These composite samples were made from subsamples collected from different locations within the dumpsites. In addition, a control sample was collected upstream of the dumpsites to assess the impact of solid waste on soil quality.

3.3.2. Physicochemical Analyses

Soil sample extracts were analyzed for the presence of heavy metals (Zinc, Chromium, Nickel, Lead, Copper, Manganese and Cobalt) using a nitric acid matrix (HNO_3 1N). This analysis was performed by the Air-Acetylene Flame Atomic Absorption method, using the Varian Specter A 110 spectrometer.

3.4. Air Analysis

The analysis of gases around the dump sites focused on determining the concentrations of CO_2 , CH_4 and H_2S . This analysis was carried out using a Japanese Gaztech pump model IMO 4GV 100E1, to which specific reducing tubes for each type of gas are attached. Since the measurement conditions are standardized (temperature from 0 to 40 °C, humidity from 10 to 90%), the values obtained are multiplied by a correction factor f based on the atmospheric pressure mentioned in the instructions accompanying the tubes.

Assessment of Potential Environmental Impacts of Waste Collection Points

To assess the environmental impact of waste collection points on receiving environments (water, soil, air), we followed the following path:

- ✓ Identification of sources of waste production in the commune of Coyah and location of these sources.
- ✓ Identification and assessment of potential impacts.

As part of this assessment, sampling points were selected and samples were taken. We then proceeded to characterize the physical environment through physical, chemical and bacteriological analyses. The values obtained were compared to those of the control samples as well as to the standards established by the WHO, Environment Canada and the European Union.

The results of this impact assessment and the qualification of the environmental value of the elements of the receiving environments will be presented in the following chapter. This value is determined both by the appreciation of the inhabitants of the locality and by the expertise of specialists in integrated management of natural resources.

4. Results and Discussion

4.1. Results of Socio-Economic Surveys

Surveys conducted in Coyah reveal that the female population outnumbers the male population, due to a mass exodus of young men to other regions in search of better opportunities. The majority of respondents are illiterate, which impacts their behavior towards sanitation problems. Solid waste comes mainly from households, markets, hospitals and other activities, and is often grouped together in an anarchic manner in the streets and illegal dumps.

Regarding waste management, 52% of respondents believe that good sanitation is essential for health, while 22% stress that poor hygiene promotes diseases. The causes of poor sanitation include carelessness of the population, lack of infrastructure, high illiteracy and uncontrolled urbanization. Waste management challenges are linked to the inability of households to pay for collection, lack of proper dumping sites and uncontrolled dumping of garbage. Finally, 90% of respondents believe that waste management is the responsibility of the state and local authorities, while 10% believe that religious leaders and families should also be involved in raising awareness about waste management.

In the commune of Coyah, waste is scattered throughout the neighbourhoods, flooding streets, public squares and waterways, leading to serious environmental problems, particularly due to the proximity of the dumps to homes. The nuisances caused by these dumps, such as bad smells and the proliferation of insects and rodents, give rise to complaints. Surveys reveal that this situation is due to several factors, including population growth, uncontrolled urbanization, lack of resources and appropriate infrastructure, as well as low civic-mindedness and lack of awareness of sanitation laws. The majority of respondents believe that waste manage-

ment is the responsibility of the State, while a minority believe that everyone should contribute to solving the problem of unsanitary conditions. No waste management methods were observed in the commune.

4.2. Physico-Chemical and Bacteriological Analyses

Regarding the results of the analyses, we have represented them in graphical form for better understanding.

4.2.1. Physicochemical and Bacteriological Analysis of Water Samples

The analysis of **Figure 3** shows that the water temperature of the control well is around 20°C, in line with WHO standards, while around the dumps it reaches an average of 30°C, indicating thermal pollution due to the decomposition of organic waste. In addition, the water colour of wells P2 and P4 exceeds the WHO standard

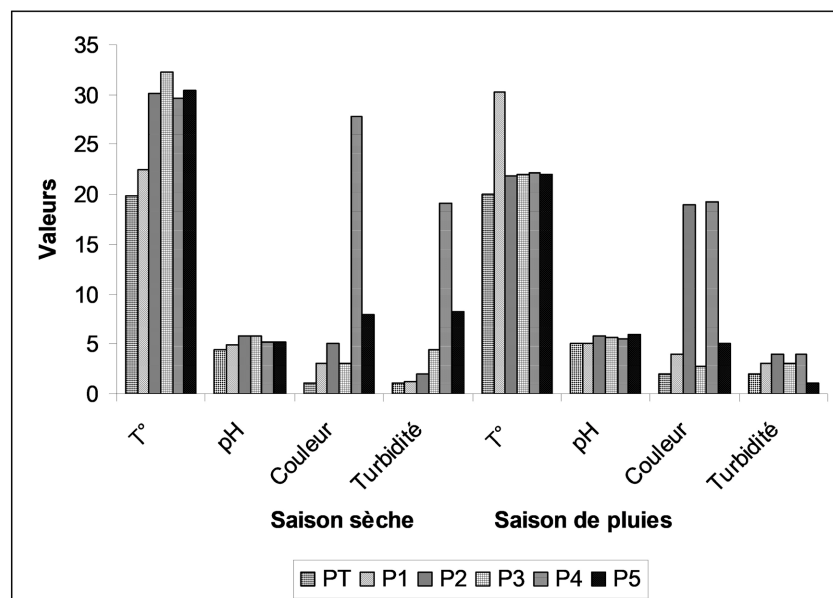


Figure 3. Results of analysis of T°, pH, color and turbidity in well water samples.

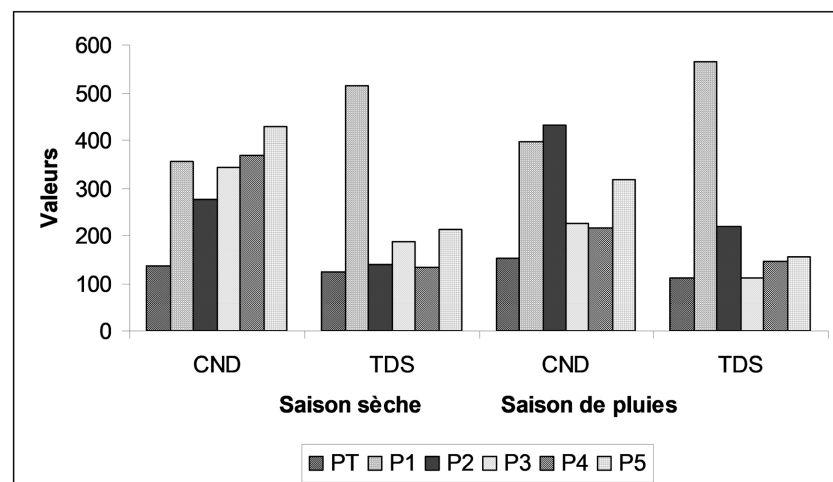


Figure 4. Results of CND and TDS analysis in well water samples.

(15 UCV) during both seasons, probably due to the fermentation of organic matter and leachates. The accumulation of waste around the dumps, carried by the wind to the unprotected wells, also contributes to the increase in turbidity, particularly observed in well P4.

Analyses of the well waters as shown in **Figure 4**, both for the control well and those near the dumpsites, show a relatively low pH, indicating an acidity that varies slightly according to the seasons. These values are below the WHO standard for drinking water (6.5 - 8.5), suggesting pollution. The acidity is probably due to H⁺ ions from leachates of rotting fruits and vegetables during the rainy season. In addition, high levels of conductivity and total dissolved solids indicate the presence of soluble compounds from the leachates, although these values remain below the WHO permissible limits for drinking water.

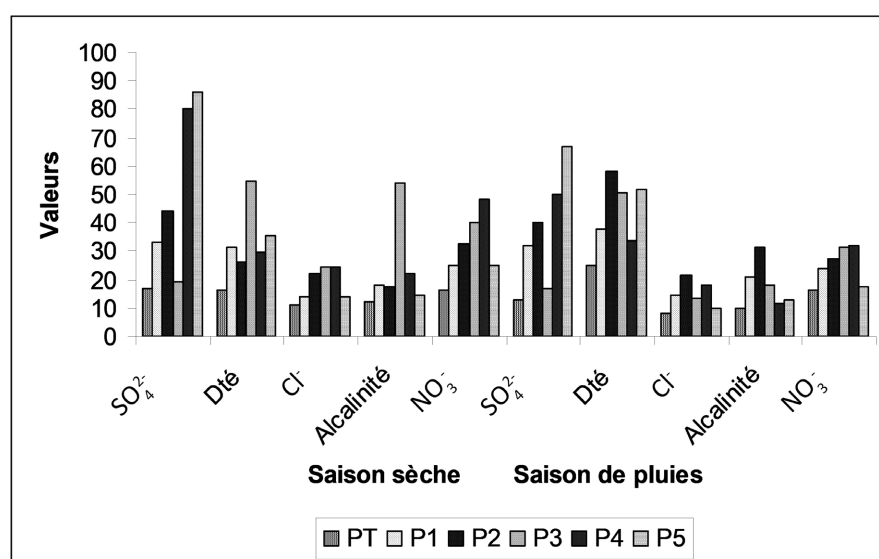


Figure 5. Analysis results of SO_4^{2-} , Dte, Cl^- , Alkalinity, NO_3^- , in well water samples.

Analyses of well water show that sulphate levels are low (**Figure 5**), indicating good drinking water quality, although those of wells close to landfills are higher, probably due to leachate. The dry season favours the concentration of sulphates by evaporation. Water hardness also varies, with levels of Ca^{2+} and Mg^{2+} ions exceeding the WHO standard (500 mg/L), suggesting pollution related to leachate. Chloride and alkalinity levels increase in the dry season, but remain below the WHO limits (250 mg/L for chloride and 30 mg/L for alkalinity). Finally, nitrate variations are low, attributed to insufficient oxidation of nitrogenous materials, with values below the WHO standard (50 mg/L).

Analyses of well water show that sulphate levels are low, indicating good drinking water quality, although those of wells close to landfills are higher, probably due to leachate. The dry season favours the concentration of sulphates by evaporation. Water hardness also varies, with levels of Ca^{2+} and Mg^{2+} ions exceeding the WHO standard (500 mg/L), suggesting pollution related to leachate. Chloride

and alkalinity levels increase in the dry season, but remain below the WHO limits (250 mg/L for chloride and 30 mg/L for alkalinity). Finally, nitrate variations are low, attributed to insufficient oxidation of nitrogenous materials, with values below the WHO standard (50 mg/L).

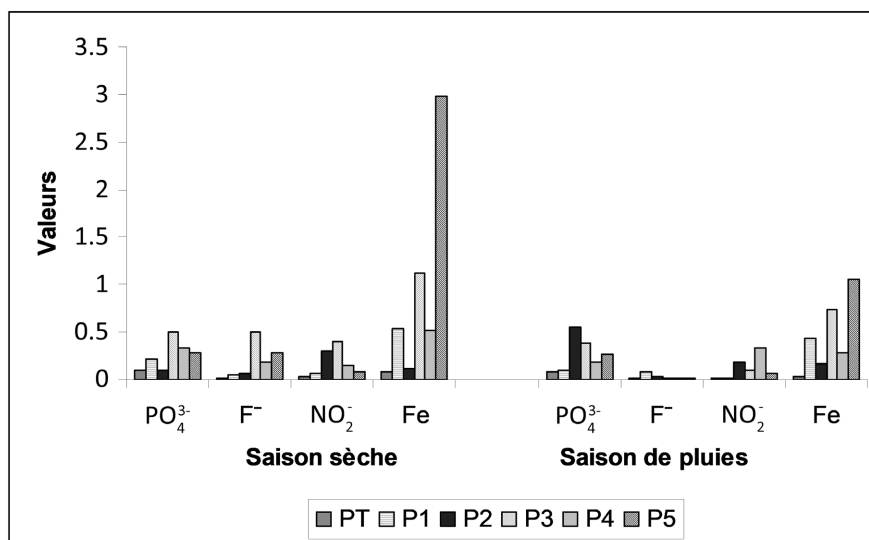


Figure 6. Analysis results of PO_4^{3-} , F^- , NO_2^- and Fe in well water samples.

Figure 6 shows that the concentration of phosphates in the waters analyzed is lower than the WHO standard (2 mg/L), which does not affect the quality of the water. However, a slight increase in this content is noted in the wells around the landfills compared to the control well, an increase that could be due to the contribution of leachates. Furthermore, the nitrite and fluoride contents are insignificant in the waters analyzed. The WHO standards (1.5 mg/L for fluoride and 0.5 mg/L for nitrites) are not reached.

Figure 6 and **Figure 7** show, respectively, that the iron and heavy metal contents are low for the control well and high for the wells around the dumpsites. In the latter case, apart from zinc, the WHO standards for drinking water which are 0.3mg/L for iron, 0.05mg/L for chromium and nickel, 0.1mg/L for zinc, 0.005 for copper and 0.05 for lead are exceeded. The contribution of leachates produced by the dumpsites could be the cause.

The results of the bacteriological analyses (**Figure 8**) show that all the waters analyzed are contaminated. This contamination is lower in the dry season than in the rainy season and is more pronounced in wells close to waste dumps. Animal or human feces thrown into the garbage heaps certainly contributed to this phenomenon.

The examination of the results of the analysis of the backwaters shows that for the parameters evaluated, the trend is almost the same as that observed at the level of the well waters. The analysis results show in fact a clear influence of the dumps on the quality of the water through the variation during the two seasons of the parameters.

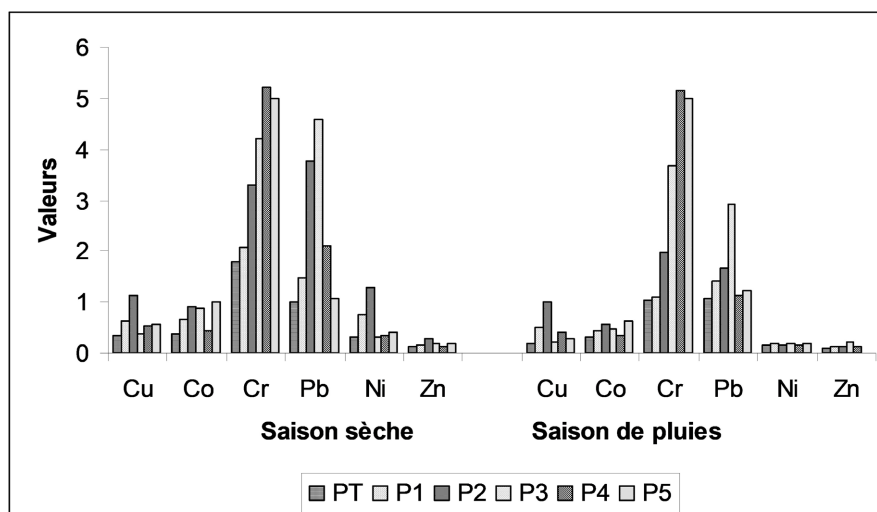


Figure 7. Measurement results of Cu, Co, Cr, Pb, Ni and Zn in well water samples.

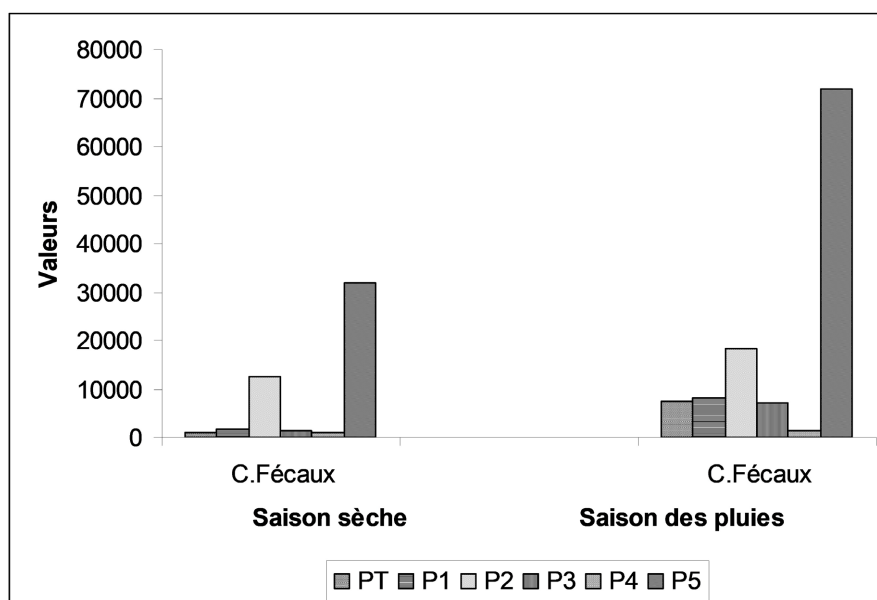


Figure 8. Results of faecal parcel assay in well water samples.

The analyses revealed the presence of heavy metals in soil samples taken from the waste dump sites. **Figure 3** and **Figure 6** show that their levels are higher in these samples than in the control sample (see **Table A1** in the appendix). This would result from a contribution from leaching water. These metals can be carried away by infiltration water during the rainy season and thus contribute to the pollution of the water table. However, for the moment, the values remain below the European Union standards for public health.

The analysis of air pollution did not reveal high levels of the measured parameters. Pollution at this level therefore does not seem to be evident. On the other hand, surface and ground water are heavily affected, while the soil is moderately affected. As for the measured gases, their environmental value can be considered low.

4.2.2. Physicochemical Analysis of Soil Samples

Regarding air pollution measurements, **Table 1** and **Table 2** below provide a summary.

Table 1. Air pollution measurement results.

Settings%	Date	Soumb (D1)	Center1 (D2)	Center2 (D3)	North1 (D4)	North2 (D5)	North3 (D6)
CO ₂ (ppm)	April 2022	0.6	0.3	1.0	0.8	0.5	0.4
	Sept. 2022	0.8	0.5	1.2	0.7	0.9	0.7
H ₂ S (ppm)	April 2022	0.1	0.2	0.8	1.0	0.6	0.8
	Sept. 2022	0.2	0.4	1.4	1.2	1.3	1.7
CH ₄ (ppm)	April 2022	0.1	0.1	0.4	0.2	0.3	0.3
	Sept. 2022	0.2	0.3	0.5	0.1	0.1	0.1

Table 2. Qualification of environmental values and source of information.

Receiving environments	Assigned value		Value
	By the specialists	By the public	Environmental
Surface water	F	F	F
Groundwater	F	F	F

Note: F = Strong, M = Average, f = weak.

In summary, our research results show that poor waste management is dangerously affecting our waters. Indeed, water is the main vector of pollution caused by waste abandoned or disposed of in unsatisfactory ecological conditions. The pollution of water resources by inconsiderate discharge of waste is well known because of its consequences which appear such as the death of fish for example. This pollution occurs through percolation water which is in contact with waste which reaches groundwater or surface water.

Thus, the pollution of groundwater which contributes to the water supply intended for drinking “appears as the result of the infiltration and diffusion of leachate in permeable or fissured subsoil. As for the pollution of surface water, it can result from the overflow and flow of leachate storage basins into the hydrographic network” or runoff water leading to part of the waste being deposited in courtyards. of water. The waters of these rivers, regularly consumed or used by part of the population and animals in developing countries, are the cause of the mortality of 14,000 people per day worldwide

5. Conclusion

It follows from the analysis of the various results that the method of grouping waste in the municipality of Coyah effectively contributes to the pollution of the receiving environments in the dry and rainy seasons. Therefore, effective measures must be considered to reduce the negative impacts of these grouping points on

the environment. However, given the time and resources allocated to carry out this work, important aspects such as the study of the intra-seasonal variation of this pollution, the impact on health of the consumption of polluted well water in Coyah and the possibilities of developing a controlled landfill, as well as the contribution of other sources of pollution were not addressed.

Conflicts of Interest

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

References

- Abdelli, F. (2005). *Environmental Impacts of the Uncontrolled Landfill in the Regional Capital Labé and Mitigation Measures*. Master's Thesis, Gamal Abdel Nasser University of Conakry.
- Bangoura, M. R. (2004). *Solid Waste Management in a Commune in Guinea: Example of Dubréka*. Master's Thesis. Gamal Abdel Nasser University of Conakry.
- Christian, N., & Régent, A. (2012). *Waste, Effluents and Pollution: Impact on the Environment and Health*. Dunod.
- EPA (1997). Electrostatic Complementarity at Protein/Protein Interfaces. *Journal of Molecular Biology*, 268, 570-584. <https://doi.org/10.1006/jmbi.1997.0987>
- Ghezali, F. (2017). *Household Waste Management and Its Impacts on Sustainable Development: Case of EPIC ECODEM*. Master's Thesis, Mouloud Mammeri University of Tizi-Ouzou.
- Maiga, F. et al. (2021). Economic Benefits of Waste from Landfills in the District of Bamako. *Géovision, Ivory Coast*, 1, 109-116.
- Mamandou, C. (2000). *Monograph of the Prefecture of Coyah*. Department of Geography, University of Conakry.
- Mery, J., Mtibaa, R., & Torre, A. (2009). Local Dynamics and Waste Management: Application to Landfill. *6th Days of Proximity, Time for Debates, Poitiers*, October 2009, Poitiers, France, 8 p.
- United Nations (UN), Economic and Social Commission for Asia and the Pacific, State of the PDU (2003). *Collection and Transfer of Solid Waste in the City of Conakry: Fact Sheet. Profile of Operators*.

Appendix

Table A1. Approach to determining environmental values.

		Value attributed by specialists		
		Strong	Average	Weak
Value attributed by the public	Strong	Strong	Strong	Average
	Average	Strong	Average	Weak
	Weak	Average	Weak	Weak