

**CONSEQUENCES OF POOR MANAGEMENT OF HUMAN EXCRETA AND DOMESTIC WASTEWATER ON THE ENVIRONMENT AND HUMAN HEALTH IN THE MUNICIPALITY OF DASSA-ZOUMÈ**

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**ABSTRACT**

Dassa-Zoumè's population has no spillway of human excreta and domestic wastewater. Management of excreta and wastewater pose real problems on the environment and human health. The objective of this work is to study the consequences of poor management of human excreta and domestic wastewater on the environment and human health. Documentation, direct interview, interviews and observations of water samples, were the methodological steps for data collection. Analysis of linear regression tests helped in assessing the degree of connection between fecal and hygiene and sanitation hydro diseases. This was complemented by socio-economic investigations and the application of the model PEIR (Pressure-State - Impact-Response) to better analyze the consequences of poor management of human excreta and domestic wastewater on the environment and health. The analysis shows that in the commune of Dassa-Zoumè, good numbers of fecal hydro diseases stem from poor management of excreta and wastewater. The lack of sanitation pollutes water wells and surface water. The physico-chemical and bacteriological analyzes of well water and river are the main sources of drinking water revealed the presence of high levels of fecal coliform bacteria that are in the order of 7777.5 CFU / ml for well water , 21946.15 CFU / ml for water tank 71,385.71 CFU / ml for river waters and E . Coli 2773 UFC/100ml for wells, tanks for UFC/100ml 6363.73 and 7751.52 UFC/100ml for rivers. These water sources are polluted and unfit for consumption. The use of this water causes many cases of fecal the most recurrent in common are diarrheal diseases, gastrointestinal infections hydro diseases. In 2011 the town had more than 133 cases of cholera and many cases of gastro- intestinal infections. He is urgent to improve access to safe drinking water to all the people of the town and to provide these populations works excreta disposal and wastewater to limit the consequences of defecation to outdoors on the environment and human health.

**Keywords:** Effets, excreta management, environment , health, Dassa- Zoume.

**1. INTRODUCTION**

Water and sanitation, like education and health, are fundamental to the fight against global poverty. The sanitation needs in developing countries are enormous. In these countries, faecal

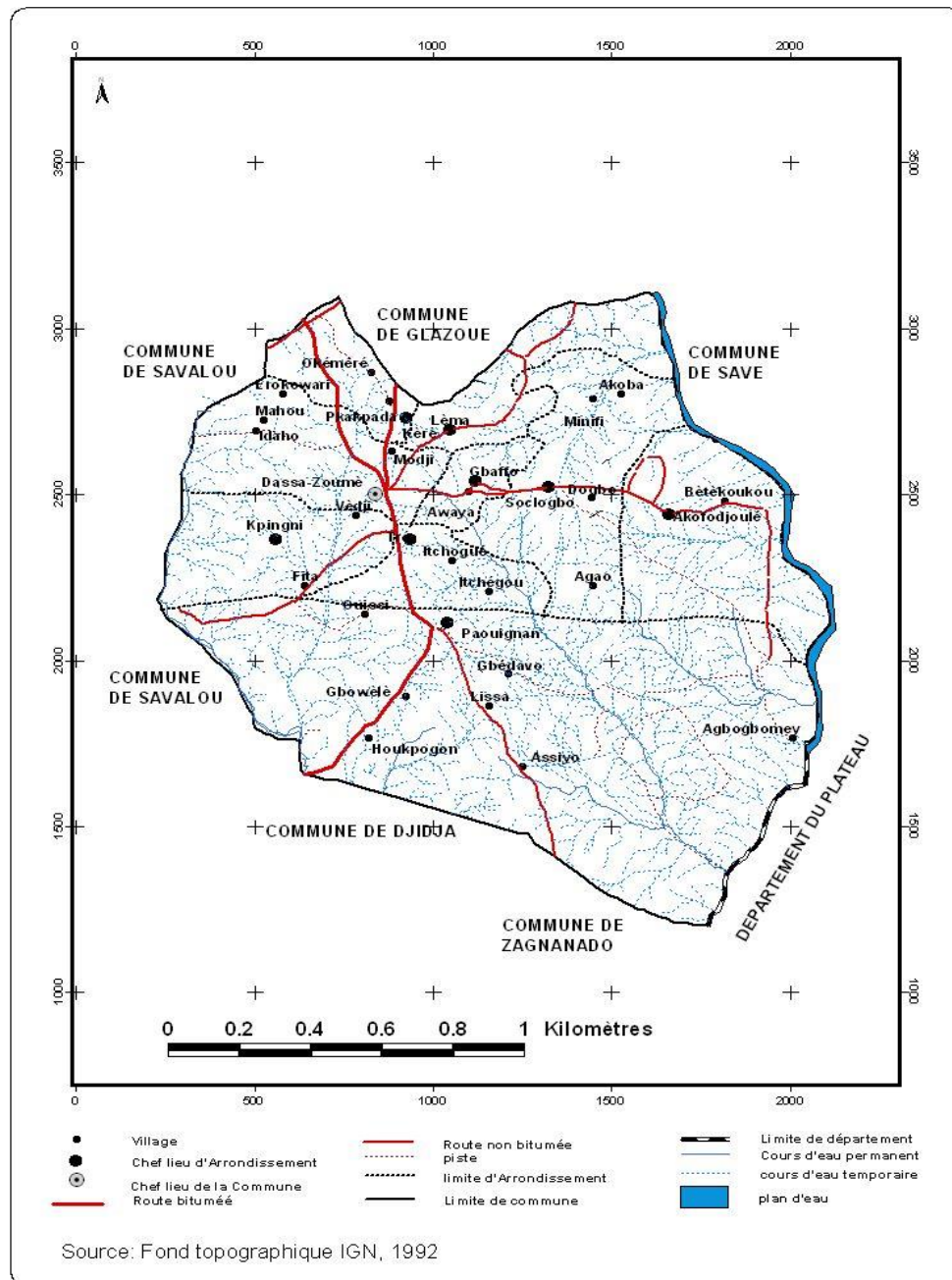
and unhealthy diseases account for a significant proportion in the morbidity and mortality tables (Hartemann, 2001). The mismanagement of excreta, risky hygiene practices and the under-information of populations in matters of hygiene and sanitation are the main causes (CREPA, 2008). Indeed, 63% of the African population does not have access to basic sanitation facilities and only 10% of wastewater is treated in Africa before returning to the natural environment (UNDP, 2018). Poor management of excreta and wastewater leads to the presence of faeces in nature, stagnation, infiltration and pollution of shallow groundwater, contamination of surface water and sources of water supply. This causes the proliferation of diseases linked to fecal peril such as various diarrhea, dysentery, typhoid fever, cholera and parasitic diseases (DHAB, 2010). This lack of health infrastructure causes serious epidemics such as cholera and typhoid fever (waterborne diseases) every year. This results in numerous deaths, 90% of the victims of which are children under the age of 5 (DHAB, 2010). This also has serious social consequences (low rate of access to school), economic (increase in healthcare costs, loss of the number of actual working days) and environmental (contamination of groundwater, degradation of ecosystems) (WASTE, 2006). In Benin, the lack of sanitation is a major challenge. Only 5% of rural households have access to adequate sanitation and 76% of the rural population continues to defecate in the open (WHO, 2018). The consequence is that it is the health and the chances of survival of humans who are seriously threatened. This country has been affected in recent years by a serious cholera epidemic which caused more than 800 cases in 2010 (DHAB, 2010). The diffusion of adapted sanitation technologies is therefore crucial to deal with this crisis in the Municipality of Dassa-Zoumè, especially since the rate of access to sanitation is much lower (5%) in rural areas (WHO, 2018). As the issue of rural sanitation is increasingly forgotten, it must be taken into account more effectively in order to prevent the situation from stagnating in future years. This very worrying situation in rural areas of developing countries requires a sustainable sanitation policy. This is the context for this study.

## **2. STUDY FRAMEWORK, MATERIALS AND METHODS**

### **1.1. Study framework**

The Commune of Dassa-Zoumé is one of the six Communes in the Hills department with an area of 1,711 km<sup>2</sup> and represents 1.52% of the total area of the national territory. It is bounded in the North by the commune of Glazoué, in the South by the communes of Zagnanado and Djidja, in the East by the Communes of Savè, of Kétou, in the West by the commune of Savalou (Figure 2).

The Commune is subdivided into 10 arrondissements, 68 villages and city districts with a multitude of hamlets.



**Figure 1:** Geographical location of the Commune of Dassa-Zoumè

### 1.2 Materials and method and study

This was a descriptive and analytical cross-sectional study which took place from November 2018 to January 2019 in the Municipality of Dassa-Zoumè. The data used in this study are those which made it possible to assess the modes of excreta and wastewater management in the Municipality of Dassa-Zoumè. They were also used to assess the effects of mismanagement of excreta and wastewater on the environment and the health of the populations of this Municipality.

The research took place along four main lines, namely:

- Documentary research;
- Surveys and interviews;
- Direct observations in the field;
- physico-chemical and bacteriological analyzes of drinking water.

The documentary research was carried out in several documentation centers, laboratories as well as website. Data collection in the field is done through direct observations and interviews based on an interview guide with resource people. Several interview techniques were used for data collection. These were:

- Semi-direct interview;
- Direct interview;
- The focus-group.

Two sampling methods were used: the probabilistic method applied to the household group and the non-probabilistic method which took into account women with children from 0 to 5 years old.

Multiphase stratified and then cluster sampling was chosen. The sample size was determined using Schwart's formula:

$$N = \frac{(E \times E \times p(1-p) \times FC)}{e^2}; \quad N = \frac{1,96 \times 1,96 \times 0,2(1-0,2) \times 2}{(0,05)^2} = 491.72 \text{ then } N = 491.72$$

Since the number of clusters admitted for this kind of study must be greater than or equal to 30 (WHO et al., 2000), 30 clusters were chosen for the sampling of this study. Dividing the sample size by the total number of clusters resulted in approximately 16 households. Thus, the sample for the Municipality includes 30 clusters of 16 households, for a total of 480 households surveyed.

The choice of households for the study was made by respecting the following 6 steps:

- Determination of strata;

- Determination of the weight of the strata;
- Determination of the number of clusters per stratum;
- Determination of the sampling interval;
- Choice of clusters;
- Choice of households.

Two types of analyzes were carried out on a total of 29 samples of well water, cisterns and rivers which constitute the main sources of water supply for the populations of the Municipality of Dassa-Zoumè. These were physico-chemical and bacteriological analyzes. They are essentially summarized in the determination of pH, conductivity, turbidity, color, dissolved oxygen, nitrates, nitrites, ammonium, fecal coliforms, E. Coli. The values obtained from the dosage were interpreted in relation to the standards in force in Benin. The samples were sent as soon as possible to the Quality Control Laboratory of the Public Hygiene Service in the Republic of Benin in containers which guarantee freshness. The waters were collected in sterilized 500 ml bottles. These bottles were washed, rinsed and dried in the laboratory. They were wrapped in aluminum foil and sterilized at 121 ° C for 20 to 30 min in the laboratory.

### **The hydrogen potential (pH)**

It is measured using a pH meter. The electronic method with combined electrode was used to determine the pH of the sampled water. It actually consists of switching on the instrument, rinsing the electrode with distilled water, immersing the electrode in the solution to be measured to a minimum depth of four centimeters, waiting for the value to stabilize before reading.

### **Conductivity**

This parameter was measured using a conductivity meter. To measure the conductivity of the water, the electrode was rinsed with distilled water, then the cell was immersed in the sample to be analyzed. Finally the device was switched on to read the value.

### **The colour**

It is measured using a spectrophotometer. To get there, we turned on the device, enter the number 120 of the stored program for color, adjusted the wavelength to 450 nm, placed the white (25 ml of distilled water) adjusted to zero of 1, remove the blank and place 25 ml of the filtered sample (true color), press READ and the result in ptCo unit is displayed.

### **Turbidity**

It is measured using a turbidimeter. To measure the turbidity, we proceeded as follows: press the power button, fill a clean cuvette with the water to be analyzed up to the line (30 ml) avoiding the formation of air bubbles, hold the cuvette by the stopper and wipe it with a tissue, place the cuvette in the measuring well and close the cover, press the SIGNAL key. To choose the signal integration mode, read and note the displayed result, open the cover and remove the cuvette from the measuring well.

### **Dissolved oxygen**

It is measured using an oximeter. The oxygen measurement was made with the electro metric method which consists of immersing in the sample, a specific electrode, turning on the device, rinsing the electrode with distilled water and immersing it in the solution. to measure at a certain depth, wait for the value to stabilize before reading.

### **Nitrate and nitrite**

They are measured using the DR 2800 spectrophotometer

To demonstrate the nitrate (NO<sub>3</sub><sup>-</sup>), the cadmium reduction method was used on a DR 2800 molecular absorption spectrophotometer. The assay procedure using this method consists in taking 25 ml of water sample in a tank to which nitrate 5 is added (appropriate HACH kit compatible with the DR 2800). Stir for one minute and allow to stand for 5 minutes before reading against a blank which is the sample without the reagent on the spectrophotometer. The value is displayed on the screen in mg / l.

Nitrite (NO<sub>2</sub><sup>-</sup>) has been demonstrated by the diazotization method. The dosing procedure by this method consists in taking 25 ml of water sample in a tank to which the nitrite Ver 3 is added. The mixture is stirred for one minute and the reaction is allowed to take place for 20 minutes before being introduced into the DR 2800 spectrophotometer for reading the value. A blank is also created and read with a spectrophotometer.

### **Ammonium**

To highlight ammonium (NH<sub>4</sub><sup>+</sup>), the NESSLER method was used. This method consists in taking 25 ml of the sample to which three drops of stabilizing mineral have been added first and three drops of polyvinyl alcohol and after homogenization, 1 ml of the Nessler solution is added and then 5 minutes after the reading on the spectrophotometer and the value is displayed on the screen in mg / l.

### **Fecal coliforms and E. Coli**

The membrane filtration method was used to identify the germs sought.

This method consists of:

Take 1 ml of the sample and carry out the successive dilutions at 10<sup>-1</sup> and 10<sup>-2</sup>,

Take 1 ml of the 10<sup>-2</sup> dilution and filter using a filtration ramp, on a sterile porous membrane, the porosity of which is (0.45 µm) to retain bacteria. The membrane is then incubated (put under conditions which favor development) in an oven at 44 ° C for 24 hours for E. coli and 24 hours at 37 ° C for fecal coliforms.

Read on: E. colonies. Coli are purple and those of fecal coliforms are blue.

The results from the physico-chemical and bacteriological analyzes of the drinking water samples contributed to the estimation of the dangers linked to this source of pollution, which are the landfills which carry excreta and wastewater.

The results were analyzed using the PEIR (Pressure-State-Impact-Responses) model (Figure 1). This model made it possible to describe the causal relationships that exist between the population of the municipality of Dassa-Zoumè and the environment. Poor management of excreta and wastewater are indeed the source of the driving forces which exert pressure on the environment and affect its state; they cause subsequent impacts on ecosystems, human well-being and the availability of natural resources. The population provides responses aimed at preventing, repairing or compensating for damage to the environment caused by poor management of excreta and wastewater.

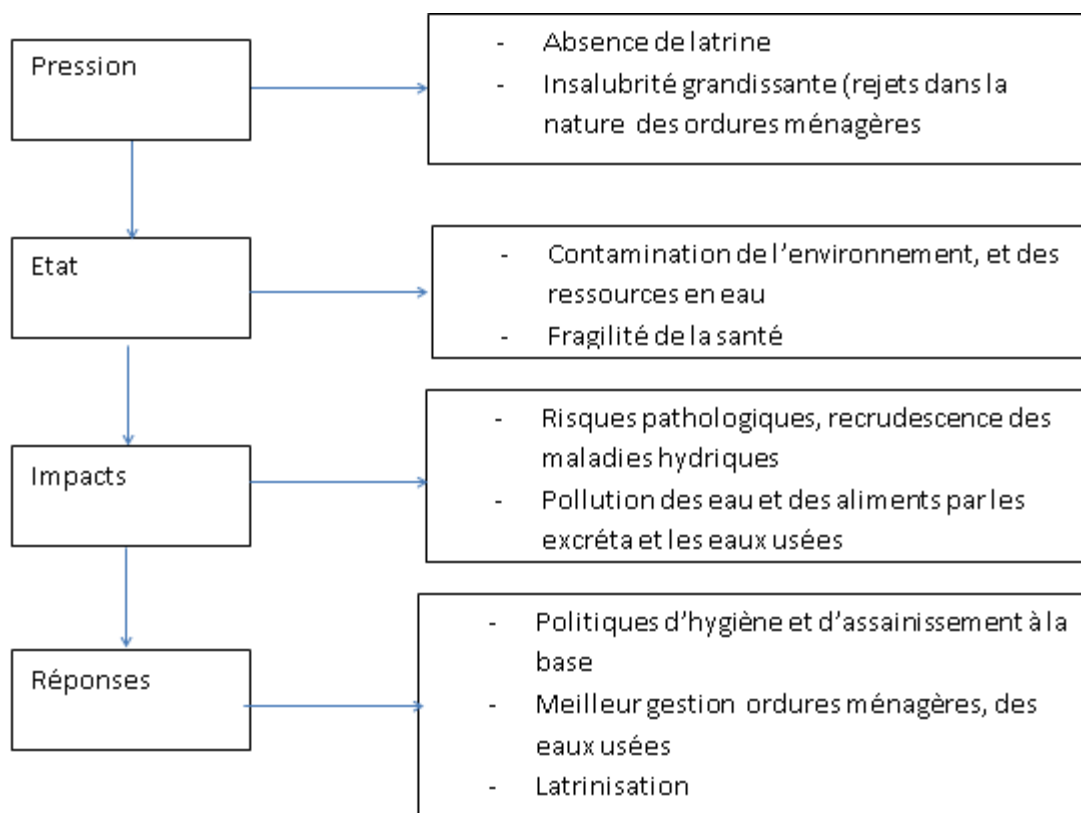


Figure 2: PEIR model applied to the study of the consequences of poor management of excreta and domestic wastewater in the commune of Dassa-Zoumè

Source: Field survey results, November 2018

### 3.RESULTS AND DISCUSSION

Socio-anthropological surveys have shown that the populations of the town of Dassa obtain water from three main sources: rain and surface water (45%), well water (23% ) and modern sources (32%). These various sources of water supply are for the most part subject to pollution due to the poor sanitation of the environment. Of the 480 households questioned, only 58 or 12.08% have latrines. The others make their need in nature. In most villages, the places of defecation are not far from homes. Due to the fact that faeces are widespread in villages, it is therefore common to trample them. In addition, fecal particles will stick to either the soles or the feet and will be transported home. Children playing on the ground can integrate these small particles and become contaminated. Flies and other insects are also involved in the transportation of pathogens in these villages. More than 4/5 of households with latrines are not satisfied with the operation of these works because of the lack of a vehicle for emptying latrines immediately after filling and the permanent presence of flies, mosquitoes, cockroaches and mice , the emission of foul odors, construction faults. There are many latrines that do not have a ventilation chimney or are poorly oriented relative to the air flow. The result is the release of foul odors in dealerships. The handling of children's stools was observed in two women per district. All 20 women considered revealed that they had received no special education in handling children's stools. Observations have shown that children defecate on the ground. To get rid of this waste, women use either paper or teak leaves and wipe their hands on their loincloth without washing their hands before continuing their activities even if they are in the kitchen.

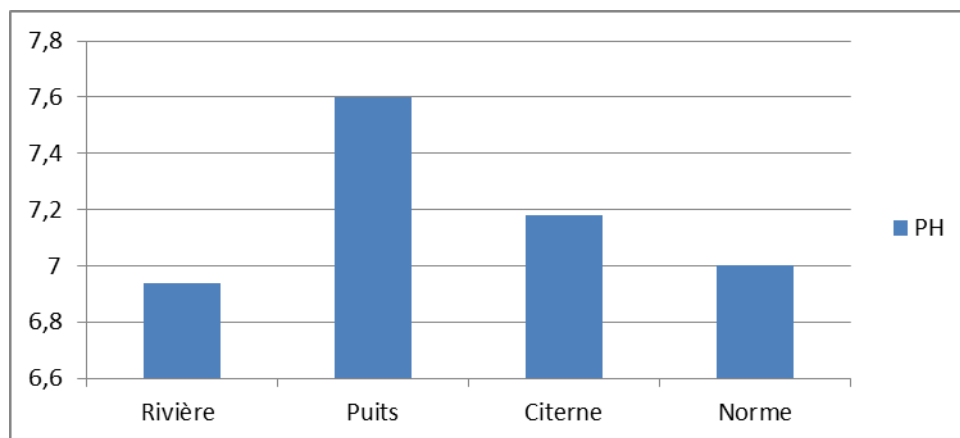
The toilet water in the houses is collected near the streets around the cabin. These waters are poured directly into the street, overflow and invade the tracks to form with the kitchen and washing water, small ponds and make circulation difficult especially for pedestrians. This stagnation generates sites favorable to the proliferation of mosquitoes, flies and other vectors of diseases. Some rare families use sumps dug according to the traditional technique. Given the nature of the soil, these sumps are very shallow and fill quickly, allowing the overflow of bath water to flow into the streets. Other households do not have a sump and have their bath water drained directly down the street. The final evacuation of wastewater is generally done either by evaporation of the water spilled on the ground or by flow.

This mismanagement of excreta and wastewater affects the physicochemical and microbiological quality of the town's drinking water sources, as evidenced by laboratory analysis results.

## Hydrogen potential

**Figure 3** represents the average pH of the water samples taken according to the sources of supply.





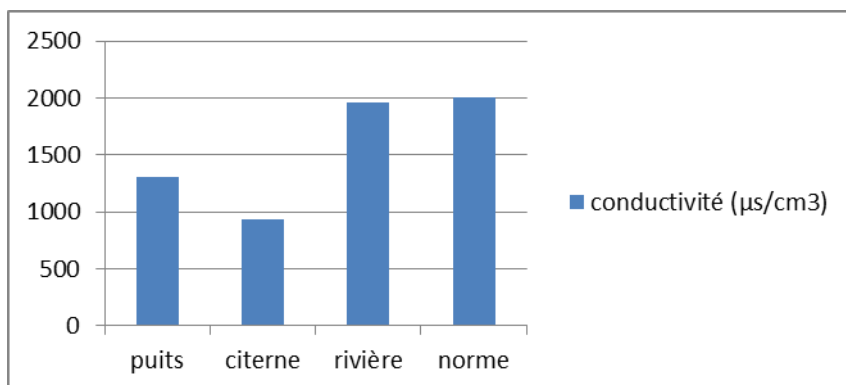
**Figure 3:** pH of sampled water

Source: Results of field survey November 2018

The pH of a water represents its acidity or alkalinity; at pH 7 a water is said to be neutral, at a pH less than 7 a water called acid and at a pH greater than 7, it is said to be basic (Rodier, 2009). Analysis of the graph shows that the average pH of well water (7.6), tank water (7.18) are all greater than 7. These waters are then basic. The pH of river water (6.94) is less than 7 so on average, the sampled river water is acidic.

**Conductivity**

Electronic conductivity refers to the ability of water to conduct an electric current (Derwich et al, 2010). According to Rodier (2009), measuring the conductivity of water makes it possible to quickly assess the overall mineralization of water and to follow its evolution. Contrasts in conductivity make it possible to highlight pollution, areas of mixing or infiltration of polluted water. Figure 4 shows the average values of the conductivity of the sampled water



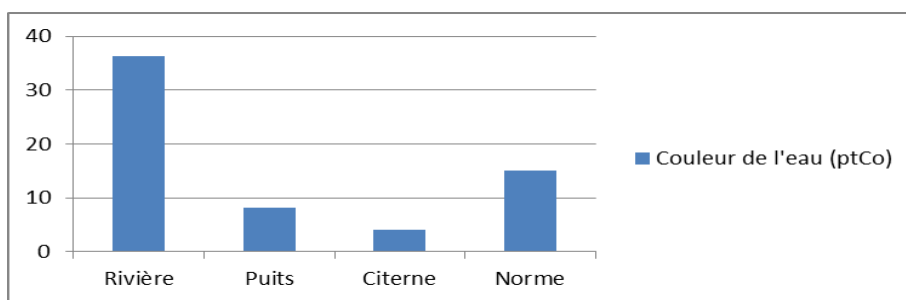
**Figure 4:** Conductivity of sampled water

Source: Field survey results, November 2018

All the waters sampled in the municipality of Dassa-Zoumè have conductivity values below the standard which is 2000  $\mu\text{S} / \text{cm}$ . These waters are then weakly mineralized. Analysis of the figure shows that river water has a higher conductivity (1961,28) than that of well water (1,299.75) and tank water (927.38). This highlights the pollution of these water sources by seepage of wastewater.

**Colour**

Colour is one of the parameters that indicate the quality of the water. It has no effect on health, but allows you to appreciate the appearance of water. The different values of the color of the sampled waters are illustrated in Figure 5.



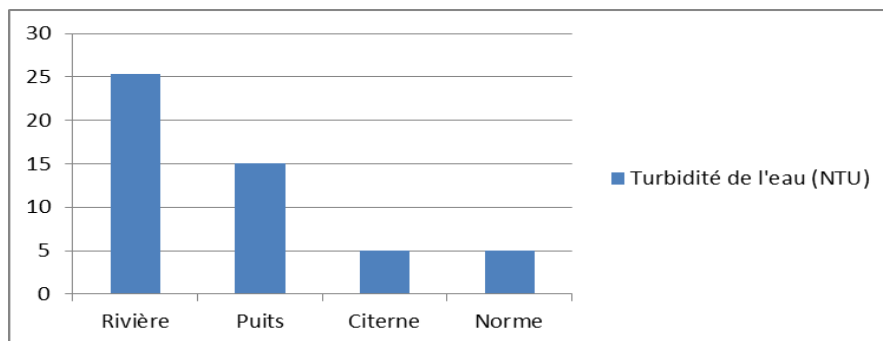
**Figure 5:** Color of sampled water

Source: Field survey, November 2018

Apart from river waters whose average color value (36.38 ptCo) is higher than the standard which 15 ptCo, the color values of the other water samples are within the required standards.

**Turbidity**

The turbidity of water is the measure of its more or less cloudy appearance. It reflects the presence of particles in suspension in water (organic debris, clays, silts, silica grains, microscopic organisms, etc.) (Rodier, 2009). According to the WHO, turbidity greatly affects the potability of drinking water. Figure 6 presents the results of the turbidity of the sampled water



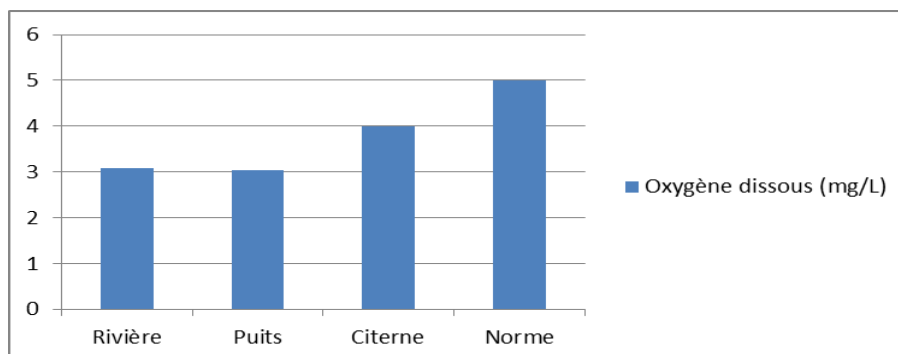
**Figure 6:** Turbidity of sampled water

Source: Field survey, November 2018

Apart from tank water whose turbidity (4.98 NTU) conforms to the standard which is 5 NTU, that of well and river water is much higher than the standard. This indicates the presence of suspended matter in water and the risk of exposure of populations to pathologies to the extent that strong turbidity can allow microorganisms to attach to suspended particles. These particles can be nutrients for the microorganisms they could use to grow. This can consequently cause illnesses in populations (Rodier, 2009).

### **Dissolved oxygen**

Indispensable for the respiration of organs, it facilitates the degradation of detrital organic matter and the accomplishment of biochemical cycles (Hamdi et al, 2008). It is one of the most important indicators of the degree of water pollution (Derwich et al, 2010). Very aerated water is generally oversaturated with oxygen, while water loaded with organic matter degradable by microorganisms is under saturated. Indeed, the strong presence of organic matter in a body of water for example, allows microorganisms to grow while consuming oxygen. Figure 7 shows the dissolved oxygen in the sampled water.



**Figure 7:** Dissolved oxygen in sampled water

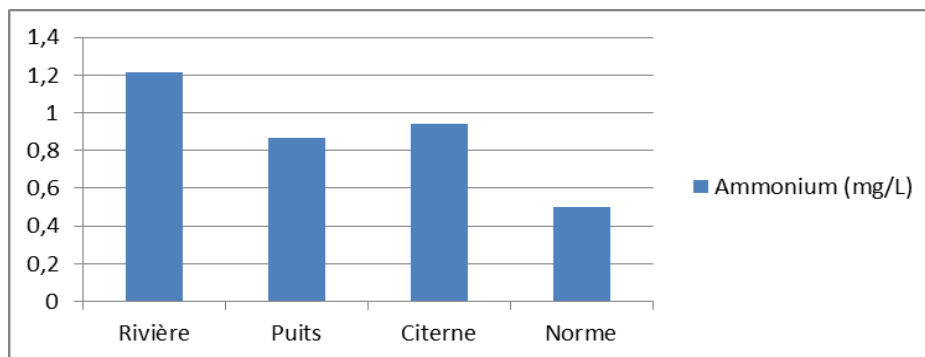
Source: Field survey, November 2018

None of the water samples has a normal dissolved oxygen value (greater than or equal to 5 mg / l). The low dissolved oxygen content in these waters could be explained by the presence of microorganisms which use them for their biological activities and ensure their multiplication.

### **Ammonium**

Ammonium is the product of the final reaction of nitrogenous organic substances and inorganic matter in water and soil. It also comes from the excretion of living organisms and the biodegradation of waste, without neglecting the contributions of domestic industrial and agricultural origin (Derwich et al 2010). It is used by the phytoplankton as a source of nitrogen and oxidized by nitrifying bacteria. The ammonium in surface waters can originate from the

vegetable matter of watercourses, organic matter from animals or humans (Rodier 2009). Generally speaking, ammonia changes fairly quickly to nitrites and nitrates by oxidation. The ammonium content in the water samples taken is shown in Figure 8.



**Figure 8:** Ammonium content of sampled water

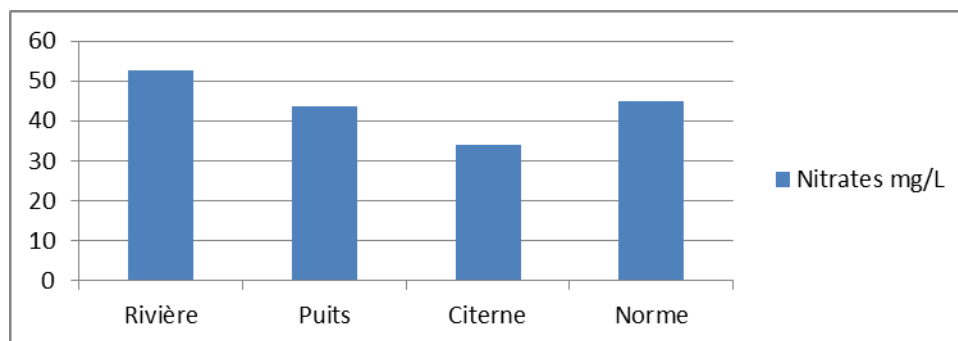
Source: Field survey November 2018

The ammonium content of the sampled water greatly exceeds the standard (0.5 mg / L), we can then conclude that the process of incomplete degradation of organic matter is very strong in the water supply sources of the town of Dassa -Zoumè.

**Nitrate**

The presence of nitrate in drinking water is mainly attributable to human activities (Health Canada, cited by Groupe Scientifique sur l'Eau, 2003).

Nitrates are indirectly toxic by the fact that they turn into nitrites. This poisoning, caused by the absorption of small doses of nitrates, is actually due to nitrites formed by reduction of nitrates under the influence of a bacterial action. The nitrate content of the water samples is shown in Figure 9



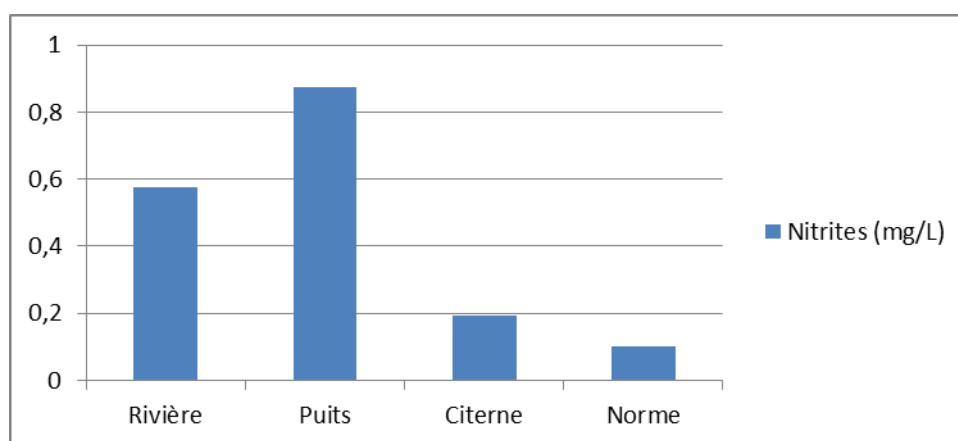
**Figure 9:** Nitrate content of sampled water

Source: Field survey, November 2018

River waters have a much higher than normal nitrate concentration (45 mg / l). You could say that there is a rapid transformation of ammonium into nitrate. This shows an incomplete degradation of organic matter in these waters. The other water samples have a low nitrate content. This means that the degradation of organic matter is low in these waters.

### Nitrites

In the nitrogen cycle, nitrites are considered to be intermediate ions between nitrates and ammonium. This explains the low concentrations encountered in the aquatic environment (Aminot and Chaussepied, 1983). In the absence of pollution, there is very little nitrites in the waters. The nitrite content of the sampled water is illustrated in Figure 10.



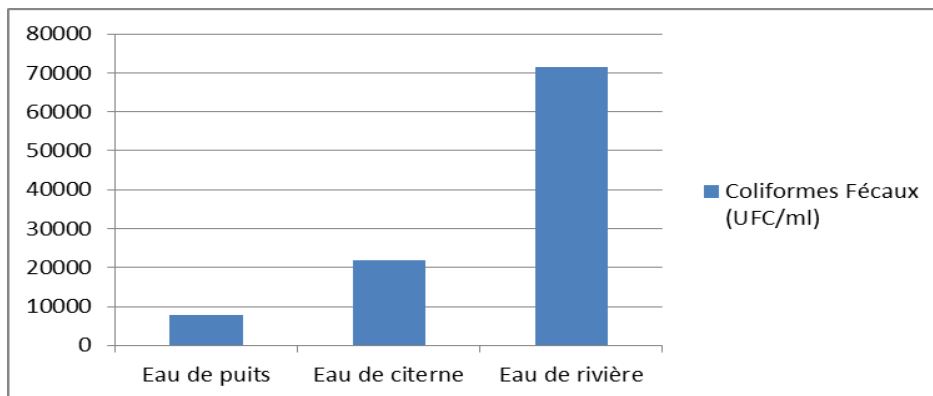
**Figure 10:** Nitrite content of sampled water

Source: Field survey, November 2018

All waters have a nitrite content far above the norm. This indicates the pollution of these waters. According to Rôdier (2009), water containing nitrite is considered suspicious because it is often associated with a deterioration in microbiological quality. The presence of nitrate and nitrite in the waters is a threat to the health of the populations of the commune of Dassa-Zoumè.

### Fecal coliforms

Typically, groundwater is free of pathogens. The presence of pathogens in well water can be the result of seepage of sewage. However, their presence in surface water is linked to animal droppings and human faeces which are released there. Figure 10 shows the presence of fecal coliforms in drinking water in the town of Dassa-Zoumè.



**Figure 11:** Content of water and vegetable sampled in faecal coliforms

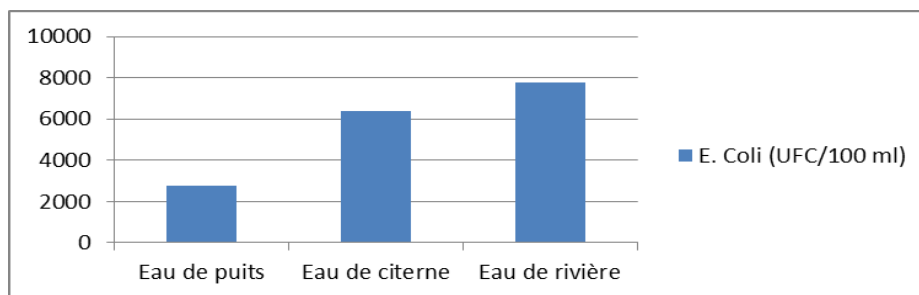
Source: Field survey results, November 2018

Analysis of Figure 11 shows that all of the sampled waters contain large numbers of fecal coliforms. These numbers greatly exceed the Beninese standard which is 0 fecal coliform per 1 ml of water. The presence of these coliforms in the sampled waters indicates heavy pollution of the environment of the town of Dassa-Zoumè by faeces, which constitute the main source of faecal pollution (Gomez et al, 2009).

The highest levels of fecal coliforms are those of river and cistern waters. Faecal contamination of these waters is said to be due to excreta left in the open air which pollute water sources.

**Escherichia coli**

The presence of E. Coli in water and food indicates not only recent contamination with faeces, but also the likely presence of pathogenic bacteria and protozoa (Health Canada, 2006). It is then the best indicator of faecal pollution. The E.Coli content in the sampled waters is presented in Figure 12.



**Figure 12:** Content of water and vegetable sampled in E. Coli

Source: Field survey results, November 2018

Taking into account the bacteriological criteria of the Beninese standard which fixes at 0/1 ml of water, all the sampled waters contain E. Coli whose number is much higher than the standard.

The presence of faecal coliforms indicates faecal contamination without specifying whether this contamination is old or recent. However, the presence of E. Coli indicates that the pollution is recent or ongoing. Looking at Figure 12, the number of E. Coli at the water sources of the town of Dassa-Zoumè is very important. This high rate of fecal coliforms and E. Coli in these samples reveals the lack of hygiene in homes and around water sources as shown in photos 1 and 2.



**Photo 1:** Well installed in a  
Unsanitary environment in Bêtou  
**Shooting:** LANDEOU, December 2018



**Photo 2:** Well installed in  
unsanitary environment Bayadère  
**Shooting:** LANDEOU, December 2018

In addition to the unhealthy surroundings of the wells, the women remain on the edges of the wells to draw water sometimes with shoes on their feet, thus rejecting in the wells the waste drained by their shoes.

The results of laboratory analysis therefore justify the proliferation of hydrofecal diseases in the commune of Dassa-Zoumè and confirm the work of Yéhouenou (2005) who concludes that the raw waters in Benin are all contaminated, however to varying degrees.

The diarrheal diseases commonly recorded in the town of Dassa-Zoumè are: cholera, febrile diarrhea, other diarrhea and gastrointestinal complaints. In 2011, the commune of Dassa-Zoumè alone recorded 186 cases spread over the entire commune. This number only takes into account the cases declared and treated in the health centers. Many other cases go unreported in rural areas and the victims are dead. As for gastrointestinal infections, the Dassa-Glazoué zone hospital records more than 900 cases each year from the commune of Dassa-Zoumè. This prevalence of gastrointestinal infections proves that there is poor management of excreta and wastewater in the town. This pollutes drinking water which in turn infects the health of populations.

#### **4. CONCLUSION**

Environmental problems in most cases require a lot of resources to resolve them. The present study is a contribution to a better understanding of the consequences linked to the poor management of excreta and wastewater in the municipality of Dassa-Zoumè.

Surveys and observations carried out in the commune show that the rules of hygiene and sanitation are not respected by the populations. Almost all the villages and city districts of the commune are marked by poor waste management, an absence of excreta and wastewater disposal system forces the populations to dump this water in the street and put themselves comfortable in nature. However, waste, excreta and wastewater contribute to pollution of the water table and pollution of surface water. The results of the physico-chemical and bacteriological analyzes of the water samples taken show that the main sources of water supply for the populations of the town of Dassa have properties that make this water unfit for consumption. These analyzes revealed a strong presence of fecal coliforms, and E. coli. It is therefore obvious that pollution of water sources and food is responsible for the prevalence of diseases linked to hydrofecal danger.

Given the vulnerability of populations to environmental pollution by wastewater and human excreta, it is important to provide them with sanitation and drinking water supplies.

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