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Environmental Impact of Household Garbage on Population And Groundwater: Case of the City of Ndjamena-Chad

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Research Article

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ABSTRACT

The objective of this work is to develop an Emergency Plan for the management of household waste, the implementation of which will contribute to the improvement of public health while respecting environmental, technical and socio-cultural concerns. The city of Ndjamena is confronted with important problems of the evacuation of the rainwater, because of an extremely flat relief, a network insufficient, deteriorated, badly maintained and gutters frequently obstructed, because of the excess of wind sands and voluntary waste disposal by the inhabitants. There is no sewerage system. The concessions have rudimentary latrines, consisting of a hole dug in the ground of the court. The discharge of excreta is often done directly on public roads. The City of Ndjamena produces about 600 tons of waste a day, of which only a small part (15 to 20%) is collected and then transported in the urban periphery to landfills. In May and June 2013, the manual drilling water, raw water from the Chadian Water Company (STE) of the city of N'Djamena was analyzed. The investigation revealed that 40% of the 52 boreholes equipped with hand pumps, classified by the JMP as improved sources, are contaminated by fecal bacteria (*E. coli* and/or *enterococci*). Furthermore, 23% of the raw water sampled from STE, which distributes water to the households, contained fecal bacteria. This situation is disastrous for the health of the inhabitants and the quality of their environment. It causes pollution of soil and groundwater and increases the proliferation of waterborne diseases, such as cholera, typhoid fever, malaria, diarrhoea, especially in children. The dispersion of the plastic bags generates a very detrimental visual pollution for the urban and physical image which is extremely dangerous for the animals. The various methods of waste management raise many questions about the health risks they may have, the measures taken to control them and the associated monitoring and monitoring mechanisms.

INTRODUCTION

The management of garbage remains a big challenge for the population and the municipality of Chad. Water supply and sanitation systems can impact the environment in many ways. Studies have shown that energy and chemicals consumption in the production of potable water cause global environmental impact [1-3]. The Mayor of N'Djamena is facing serious difficulties in assuring proper management of garbage, while the decentralization laws are given this responsibility. These municipalities are facing a strong population growth, as well as a change in consumption patterns that result in increased volumes of waste. This situation, whose effects are visible to all, generates significant nuisances for the inhabitants and has harmful consequences for the health of the population, the environment, and natural resources. Every day, garbage submerges us in our streets and homes and they are a daily plague dangerous to health, which must be solved immediately. It can often limit the use of these vital resources and in more extreme cases can harm human and other life [4]. In the search for these solutions, the different parties (populations, municipalities) each blame the responsibility. Currently, sanitary landfill represents a viable and the most commonly used method for solid waste disposal all over the world because it may achieve the reclamation of derelict land [5]. This raises the question of how, after five decades of independence, no beginning of solutions has yet been found by the city of N'Djamena, despite the fact that we are in the era of Technical progress.

The various studies in the city of N'Djamena show that mismanagement of household waste and wastewater undermines groundwater and surface water through infiltration by chemical and bacteriological substances. These polluted waters could be used later by human or animal people for various purposes. Also, it can be noted that there is a lack of texts for the management

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of urban household waste. This is due to the fact that several pharmacies and other services that rejects their untreated waste in the wild without prior checking by the authorities in charge. The finding reveals that compost, excreta from humans and animals are not well managed so much of this waste agronomically is very important for fertilizing the soil. There is no valuation policy for these.

MATERIALS AND METHODS

The methodology used for the realization of this article is made by combining a certain number of research techniques namely field observations, information retrieval and Bacteriological analysis of tap water and drilling in Ndjamena city. The literature search allowed us to consolidate the necessary information on the Ndjamena environment, which has been treated thoroughly in order to discover the truth that the documents cover. As for the field research, it allowed us to compare the oral and written information, this allowed us also to take some photographs of the urban environment of Ndjamena City.

Study Area

The study area covers the city of N'Djamena, the capital of Republic of Chad which is located south of Lake Chad between latitude 12° and 12.2° North and longitude 14.9° and 15.13° East **(Figure 1)** at the confluence of Chari and Logone River. N'Djamena is populated by around 1,174,531 peoples in 2012 (STE, 2013). The climate is Sahelian and the average annual temperature is 28°C. The average depth of the water table at N'Djamena is about 40 m. However, the depth of the wells rarely exceeds 25 m. It now extends over an area of 15,000 hectares for urbanized areas (Director of Urban Roads 2012). Administratively, the territory of the commune of N'Djamena is divided into ten (10) districts, which themselves are subdivided into quarters and squares. It is estimated that more than half (430,000) live in the flood-prone eastern areas of the city.

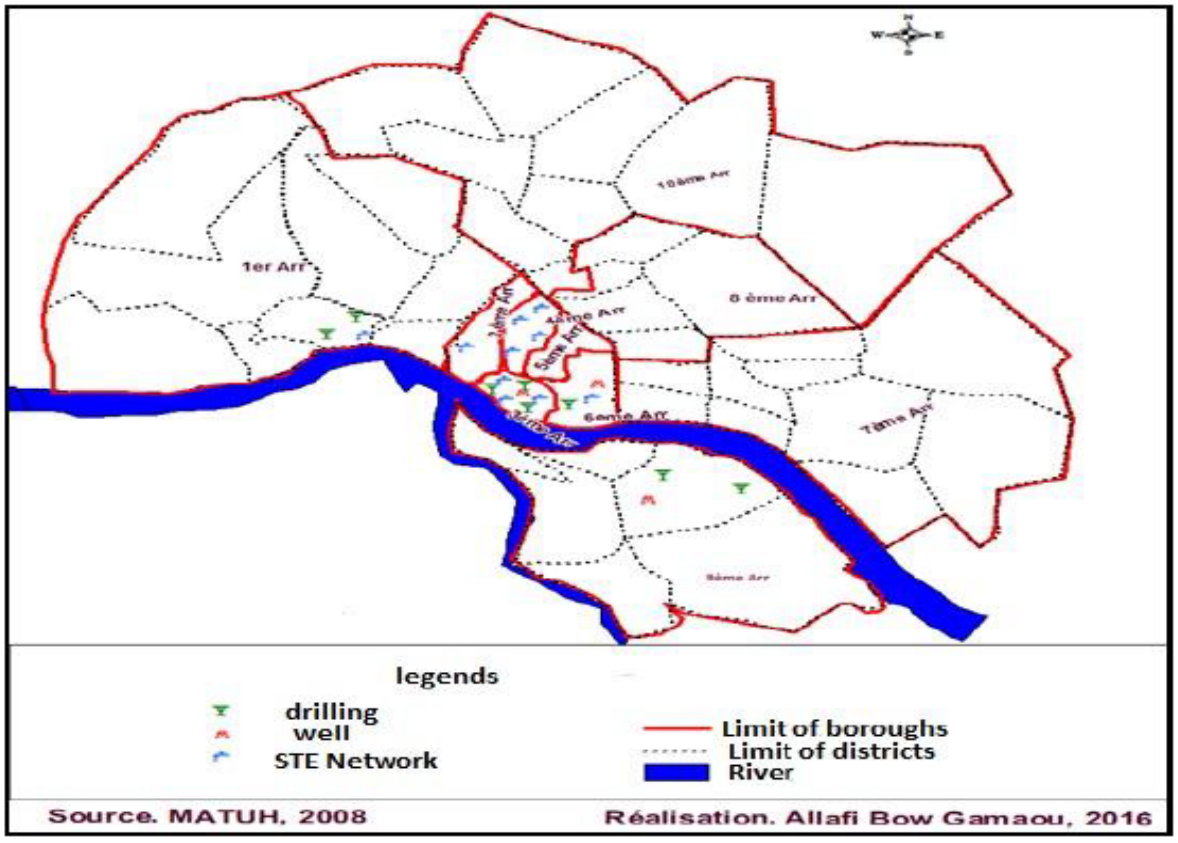

Figure 1. Location of the study area.

The General Situation

We need to replace the water that our body eliminates daily, but also to produce our food. That is why this resource deserves special attention [6]. Chad's health statistics show that lack of drinking water and poor hygiene are the main causes of mortality and morbidity in the population. The various surveys carried out at national or regional level make it possible to draw up a situation of the health status of the Chadian population in urban, semi-urban and rural areas. **Tables 1 and 2** summarize the main data collected during these different surveys.

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Table 1. Shows the types of water points used by people as sources of drinking water supply.

Types of water points	N'Djamena	Other cities	Urban ensemble	Rural	Ensemble
Tap in the dwelling/ year	21.0	4.5	11.6	0.2	2.8
Public fountain	8.4	14.2	11.7	4.2	5.9
Traditional well in the courtyard	26.8	21.7	23.9	7.6	11.4
Modern well in the courtyard	0.9	2.1	1.6	0.5	0.8
Public traditional well	3.7	17.7	11.7	50.6	41.5
Drilling	0.4	9.6	5.6	20.8	17.2
Surface water	0.0	3.3	1.9	14.7	11.7
Rainwater	0.0	0.0	0.0	0.7	0.5
Water seller	38.6	26.2	31.5	0.5	7.7
Other	0.3	0.6	0.5	0.3	0.3
Total	100	100	100	100	100

Note: Source: 1996-1997 Demographic and Health Survey

From this table, it appears that only 26% of the Chadian population obtains drinking water from a drinking water point. In rural areas, less than 20% of the population has access to a drinking water supply, while in urban areas around 30% of the population has access to it.

Table 2 presents the types of lavatories used by the populations. It can be seen from this table that in rural areas more than 88.5% of the population uses nature as a place of comfort; only about 11% use traditional or improved latrines. In urban areas, almost 80% of the population uses different types of toilets; however, about 21% of the population still use nature as a place of comfort.

Table 2. Types of lavatories use.

Types of water points	N'Djamena	Other cities	Urban ensemble	Rural	Ensemble
Hunting Water	2.1	0.2	1.0	0.0	0.2
Traditional latrines	52.5	48.9	50.4	10.6	19.9
Improved latrines	42.3	16.0	27.3	0.6	6.8
Nature	3.1	34.6	21.1	88.5	72.9
Other	0.0	0.3	0.2	0.3	0.2
Total	100	100	100	100	100

Note: Source: 1996-1997 Demographic and Health Survey

In addition, the dominant pathologies that constitute the public health problems are malaria, schistosomiasis, diarrhoea, meningitis, tetanus, measles, etc. The main diseases affecting children under five are malaria (49%), diarrhoea (44%), measles (25%), pertussis (12%) and cholera (5%). Many of these diseases are directly related to a lack of basic health infrastructure that induces lifestyle and lifestyle behaviors that are contrary to good hygiene and good health.

Garbage

Household waste is the waste resulting from the daily activities of households, domestic life, craftsmen, and tradesmen. The category of household waste:

There are three types of household waste:

• Garbage, such as food, non-recyclable plastics, soiled packaging.

• Newspapers/magazines and household recyclable packaging's, such as glass bottles, cartons, plastic bottles and flasks, cans and tin cans.

• Special household waste such as bulbs, batteries, batteries, paint pots.

However, human activities in the environmental degradation processes are at the same time direct, indirect and cumulative [7].

Garbage from the City of Ndjamena and Its Impact on the Environment

Waste management is a problem in Ndjamena, the Chadian capital and other major cities in Chad. The volume of waste is increasing and available space to store them safely and without contaminating groundwater decreases more and more [6]. Generally, household garbage piles up with street parties and other people at the avenues. In the city of N'Djamena, on the remark that there are no garbage bins for household waste. The waste is piled up and there in the middle of public roads. Sanitation committees are not sufficient to satisfy all municipalities. These committees are absent in certain districts, and there is also a

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complete absence of the concept of waste recovery. Through his studies and the reality of the field, one can say that there is no real political will of the authorities in charge of the possibilities and opportunities are also. On the one hand, the pre-collection of household waste is in the meantime ensured by several associations which are among others Association of the young for the cleaning and the protection of the environment of Miguel (AJAPED), Association Source of Progress (ASP etc. They are not responsible for these missions for lack of means. On the other hand, we find that there are enough human and material resources for pre-collection and collection **(Figure 2)**.

In addition, some wastewater streams also waste places of any kind. This behavior is with regard to environmental and hygiene consequences.

Figure 2. Household garbage in some neighbourhoods of Ndjamena.

Waste management is one of the major challenges of urban management in Sub Saharan African countries. The current difficulties in the management of solid waste are the result of poor mastering of concepts, approaches, and techniques [8]. In Chad, the aquatic environment is increasingly being subjected to voluntary discharges of human waste: urine, feces (toilet waters) and toilet waters and cleaning of soils and food (domestic wastewater). These waters are generally made up of degradable organic matter and mineral matter; these substances are in dissolved or suspended form. The gutters not scrubbed by the Municipality, particularly in the outlying districts, make us fear the worst. Filled with rubbish of all kinds, these gutters struggle to drain the rainwater into the Chari River. In general, water used for cooking and laundry is spread either in the concession, on the street or simply dumped into the rainwater drainage gutter. These gutters, open pit, are generally blocked by waste and can no longer ensure proper drainage. Toilet water in traditional neighbourhoods is collected near the street adjacent to the toilet. These waters are poured into a half-barrel of fifty liters which is emptied directly into the street by the users during the night. These waters overflow and invade the way to form, with the kitchen and laundry water, small ponds. This stagnation generates sites favorable to the proliferation of mosquitoes, flies and other vectors of diseases. A few families use sumps dug by the traditional technique. The dimensions are not studied taking into account the nature of the soil. There is no filter material either. We try to reach a sandy layer, unfortunately often in contact with an aquifer in which supplies the neighbouring well within the same concession. "Modern" facilities such as septic tanks exist only in residential neighbourhoods or among wealthy families (traders or high-level officials). Some pits are connected to a sump; this considerably increases the duration of the pit.

The final discharge of wastewater is usually done either by evaporation of the water spread on the ground or by flow to the river by open gutters when not blocked by garbage or other detritus. Wastewater receives no treatment apart from natural decomposition and any wastewater that is discharged into the river is in fact untreated **(Figure 3)**.

Figure 3. The gutters of N'Djamena mouths by household garbage.

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RESULTS AND DISCUSSION

Water Pollution by Fecal Matter

The increase in population leads to an increase in consumption and therefore an important work of the waste management [9]. In Chad, excreta are deposited in nature, or in "traditional latrines", in fact, simple cesspools or sumps. The duration of use depends on the depth of the pit and the number of users. The number of children in a dealership dramatically changes the life of the pit. The volume of excreta per person per year in the traditional environment is estimated at 0.1 m^3. This volume is to be verified when we know that a large part of the population practices ritual wet cleaning. In principle, the waters of this cleaning are collected separately, then mixed with greywater. Modern septic tanks are found only in residential neighborhoods and among some high-income civil servants and traders. The fight against the fecal danger remains a major problem for the Ministry of Public Health and the municipalities. Private cesspools, when they exist, are built without respect for "standards". These facilities are designed in practice as sumps and not as watertight pits, the bottom often reaches the level of the water table. The notion of a recommended minimum distance of 15 m between the well for drinking water and the cesspool is not known. Traditional pits and latrines are not immune to collapse, especially during the rainy season. In addition, the floods invade the concessions and cause the materials, causing a general contamination **(Figure 4)**. These pits are also accessible to insects, rats, and other disease vectors.

Figure 4. Fecal matter in the open air.

Figure 5. Fecal matter in the open gutter.

Faecal pollution of recreational water can lead to health problems because of the presence of infectious microorganisms **(Figure 5)**. These may be derived from human sewage or animal sources. Fecal contamination of water bodies is a concern primarily due to the potential for pathogenic organisms to be transmitted by contaminated water. There are a wide variety of pathogenic organisms that can survive and remain infectious in the aquatic environment.

The Health Impact of Water Pollution on Fecal Matter

Health issues related to waste are complex and gives rise to numerous debates [10]. In May and June 2013, the manual drilling water, raw water from the Chadian Water Company (STE) of the city of N'Djamena was analyzed. The investigation revealed that 40% of the 52 boreholes equipped with hand pumps, classified by the JMP as improved sources, are contaminated by fecal bacteria (*E. coli* and/or *enterococci*). Furthermore, 23% of the raw water sampled from STE, which distributes water to the households, contained fecal bacteria. There is potential to use a relatively new approach such as microbial source tracking (MST) to trace the origin of fecal coliform [11,12].

Total coliform and E. coli

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Thirty-seven tubewells out of a total of 52 tested (71%) were contaminated by total coliform, which indicates contamination by human and animal feces **(Figure 6)**. Since some coliform bacteria also derive from other sources, *E. coli* is a better indicator of pollution of the drinking water points with human and animal feces. Out of the 52 water points, five (9.6%) show the presence of *E. coli* **(Figure 7)**.

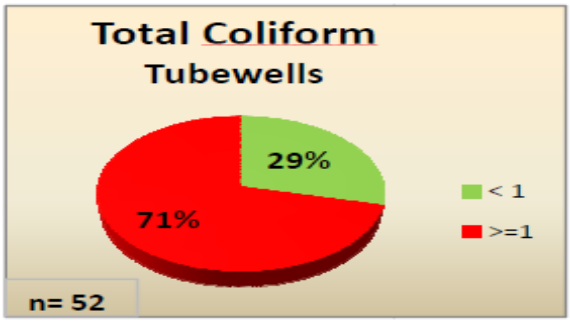

Figure 6. Pie chart showing the proportion of total proportion of total coliform bacteria detected in 52 tubewells in N'Djamena.

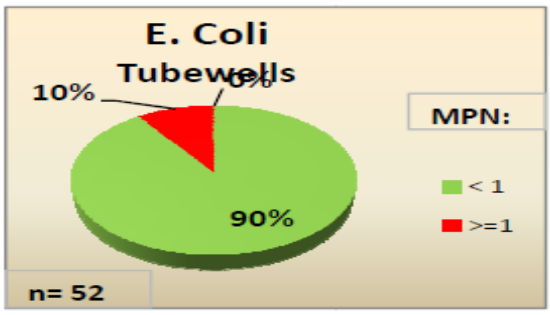

Figure 7. Pie chart showing the E. coli bacteria detected in 52 tubewells in N'Djamena.

From the 13 tested drinking water wells of the water supplier STE, four wells (31%) show the presence of total coliform **(Figure 6)** and one well (8%) shows also presence *E. coli* **(Figure 7)**.

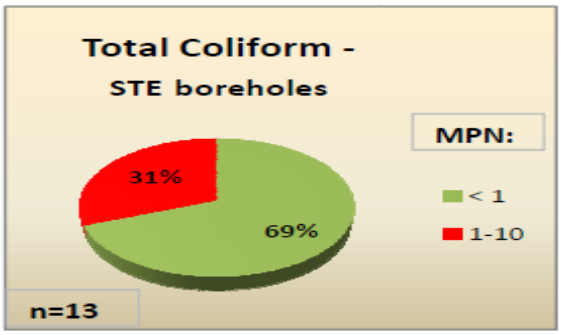

Figure 8. Pie chart showing the proportion of total coliform.

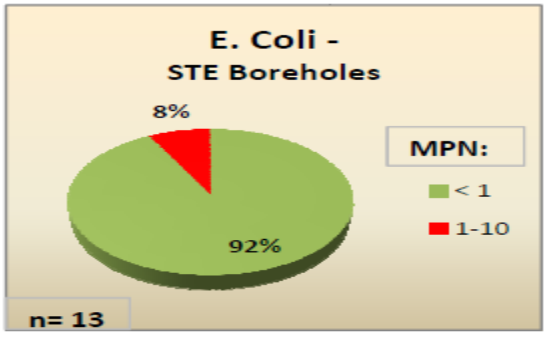

Figure 9. Pie chart showing the proportion of total coliform. bacteria detected in the raw water of 13 boreholes of the STE bacteria detected in the raw water of 13 boreholes of the STE **(Figures 8 and 9)**.

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Enterococci

A total of 22 tubewells out of 52 (42%) showed the presence of *enterococci* bacteria **(Figure 10)**. From the 13 tested enterococci bacteria a clear indicator for human and animal feces contamination boreholes of the STE, three (23%) show the presence of enterococci bacteria **(Figure 11)**.

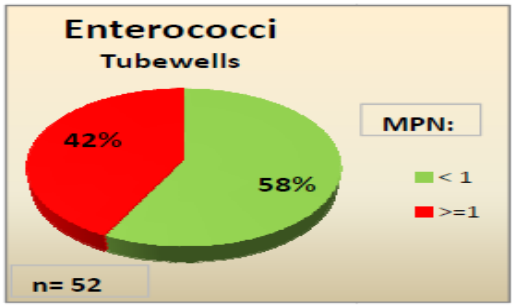

Figure 10. Pie chart showing the proportion of total enterococci bacteria detected in 52 of tubewells in N'Djamena.

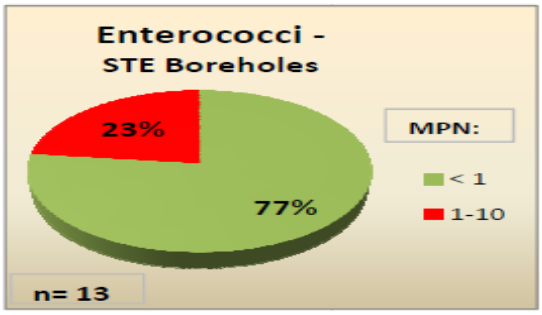

Figure 11. Pie chart showing the proportion of enterococci bacteria detected in the raw water 13 boreholes of the STE in N'Djamena.

In general, the content of enterococci was higher than *E. coli* bacteria. It can be explained by the fact that enterococci are more resistant to a wide range of environmental conditions than *E. coli*. The following **Figure 12** shows the spatial distribution of contamination by total coliform and/or fecal bacteria in N'Djamena.

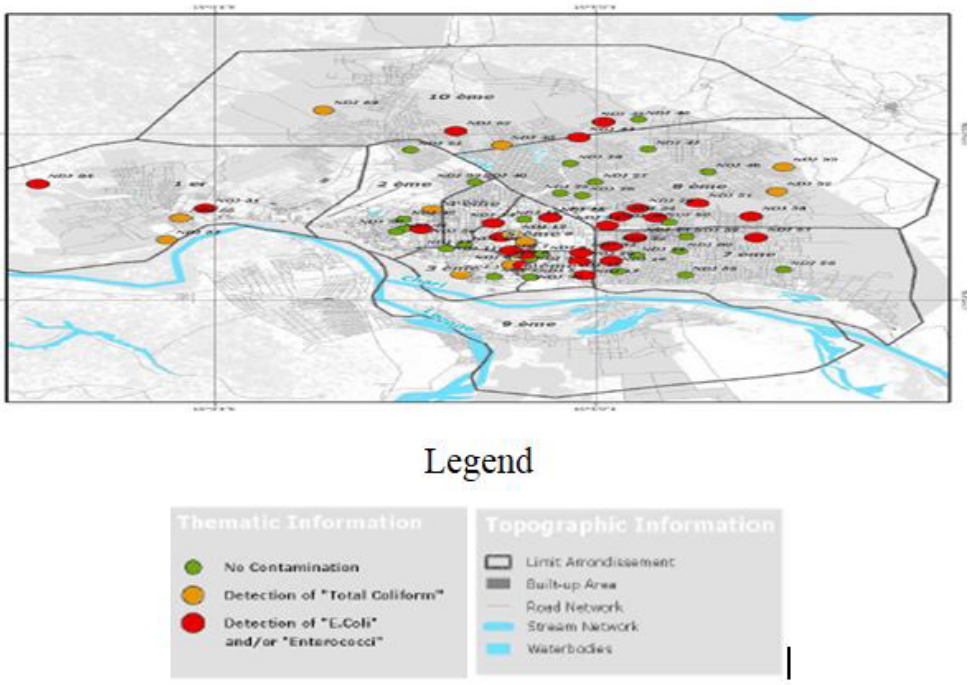

Figure 12. Map showing the detection of coliform total, E. coli and enterococci bacteria in N'Djamena.

Figure 12 shows that the contamination of tubewells by fecal bacteria appears scattered over the city area. Altogether

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21 to the boreholes (40%) equipped with hand pumps classified by the JMP as improved sources are contaminated by fecal bacteria (*E. coli* and/or enterococci). Furthermore, three from 13 (23%) raw water sampled from STE contain fecal bacteria. It is supposed that the contamination of the groundwater aquifer in N'Djamena by *E. coli* and enterococci is due to the direct pollution of the water points. Reasons are either the infiltration of sewage from nearby located latrines or drainage of greywater, the bad constitution of the boreholes (leaking tubewells), the application of manure on agriculture land close to the borehole, and leakage of contaminated surface water (e.g. near the canal or refuse pits). It has to be mentioned that the presence of total coliform, *E. coli* and enterococci are determined based on a single sampling campaign. In order to identify a systematic contamination of the Quaternary aquifer of N'Djamena, the water points should be sampled repeatedly and in different seasons. In addition, the dominant pathologies that constitute the public health problems are malaria, schistosomiasis, diarrhea, meningitis, tetanus, measles, etc. The main diseases affecting children under five are malaria (49%), diarrhea (44%), measles (25%), pertussis (12%) and cholera (5%). Many of these diseases are directly related to a lack of basic health infrastructure that induces lifestyle and lifestyle behaviors that are contrary to good hygiene and good health. The very rapid growth of large developing cities has resulted in a huge demand for urban services. Low-income populations are concentrated in the peripheral areas of the city, in popular neighborhoods with uncertain land and precarious housing. In such neighborhoods, the demand for water and sanitation services is strong, and even solvent, but large concession companies do not know how to answer them correctly and above all at a reasonable cost. There are virtually no sewage disposal systems in Chad. The evacuation of dirty water in cities poses an acute problem. Due to the lack of space and the total absence of sewage collection networks throughout the territory, the discharge of all water is, in urban areas, poorly compliant with hygiene recommendations. As for greywater (toilets, dishes, laundry), they are simply recovered separately (so as not to fill too quickly the cesspool) and rejected at night in the street.

In the cities, feces and urine are still deposited in considerable proportions in any open space, following the customary practices of the villages. The lack of space makes the operation more difficult in urban areas than in the countryside, especially for women. One of the most challenging aspects of the sanitation sub-sector is behavior change, which remains dependent on the literacy level of the population and health education. The newly settled populations in the cities keep their ancestral practices. The same behavior is observed among hospitalized rural people: in city hospitals, they do not use latrines even when they exist. In addition, health centers and hospitals rarely have equipment in perfect working order for the treatment and disposal of biomedical waste.

Biomedical Waste

Africa is estimated to have 67, 740 health facilities and produce approximately 282, 447 tons of medical waste every year [13]. However, the rest contains 15% of infectious wastes (e.g., wastes from cultures and stocks of infectious agents, infected patients, contaminated blood and its derivatives, discarded diagnostic samples) and anatomic wastes (recognizable body parts and carcasses of animals); and about 5% made-up of sharps, toxic chemicals and pharmaceuticals and radioactive wastes **(Figure 13)**. In practice, this composition varies across countries depending upon the advancement of biomedical waste management in the country [14]. In Chad, Hospitals and different health centers do not have well-functioning facilities (incinerators, processors, etc.) or well-established "procedures" for treating and disposing of biomedical waste. Often, this waste is found in the streets, within the reach of children or any individual who can "recover". Wastewater from health facilities is only rarely treated and is released into the environment, often in natural streams. In some cases, they are reused for various uses (watering small garden gardens, etc.).

Figure 13. Biomedical waste in N'Djamena.

The environment does not benefit from a clean and explicit National Strategy, so that, in terms of priority, it is weakened in relation to the sectors: Water, Rural Development, and Food Security, with which it is nevertheless strongly linked. As an indication, the sewage treatment plant of the General Hospital of N'Djamena has never been really functional. All wastewater produced by the hospital, containing microbes, bacteria, chemicals, etc., is discharged into the river without prior treatment [15,16]. This practice presents obvious risks to human health and the environment in general.

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CONCLUSION

Today, intensive and abusive use of resources and the release of waste into the environment has worsened our environment. This change has an impact on society, human health, the economy, living species, food production, tourism, and ecology. Human health is increasingly at risk, but we do not care about it. Since we do not directly see the consequences of our actions, we do not care about them. That's why we will not be able to reduce waste as long as we do not exploit resources in an intelligent way and prevent wasteful waste. Garbage without a title in volume in the city of N'Djamena. Waste, initially organic, completely biodegradable, has given way to a complex, heterogeneous more or less degradable. Domestic water is rich in organic waste, cooking water, mineral matter (bath water) and hydrocarbon, nitrogen, phosphorus, and potassium, which pollute the water. Laundry releases minerals in water, phosphate, and algal blooms. This study, regarding environmental problems in Ndjamena, has allowed us to address the environmental issue of the capital city of Chad. The various forms of pollution, garbage, fecal matter, biomedical waste, human activities are the main cause of these problems as well as natural phenomena, without forgetting the ineffectiveness of government policies.

RECOMMENDATIONS

Depending on the problem we are looking at, the solutions are sometimes different, but the cause of all the problems is always the same: the HUMAN BEING and its impact on the environment.

So the main solution is to reduce this impact, and the ways to do this are multiple:

- Do not throw out medications that are no longer needed in the washroom or in the open, take them back to the pharmacist.
- Solvents, paints, oils must not be emptied in the toilet or sink, or even in the trash: they must be returned to the collection point. Otherwise, they end up straight in the sewage!
- The batteries must also be placed in the bins specially designed for this purpose (usually in large supermarkets).
- Do not abandon our packaging and waste in the wild, especially near the rivers, which they will pollute.
- Avoid chemical fertilizers during our gardening sessions and prefer organic fertilizers, which will not pollute the groundwater.
- Limit the use of household products: they also contaminate wastewater and can very well be replaced by natural products, such as alcohol, white vinegar, baking soda, etc.
- Regularly empty the septic tank (every five years or so) to prevent it from contaminating the water.
- To curb the loss of biodiversity: decrease the destruction of natural habitats, deforestation, etc.
- To reduce pollution (air, water, soil ...), reduce polluting activities, increase all recycling and waste reprocessing...
- Develop a waste recovery industry.
- Find local solutions for liquid and solid waste: Proposal for a collective policy.
- Awareness of the whole population will promote good garbage collection and the emergence of Chad's policy.
- Introduce selective bins and the emergence of credits for good practices.
- Reduce the import of plastic bags by introducing biodegradable packaging.
- We ask municipal and administrative authorities and civil society to make some effort to find the right ways to reduce the consequences that are no longer to be demonstrated (health, the proliferation of insects, waterborne diseases, degradation environment etc.).

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