# GROUNDWATER POLLUTION IN SHANTYTOWNS OF COTONOU: WHICH STRATEGIES TO LIMIT WATERBORNE DISEASES RISKS?

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## Background / Rationale

Cotonou is the most 6populated town of the coastal sedimentary basin of Bight Benin and the most polluted, especially its shantytowns with 74 % of them located in unsuitable marshy zones. Most of inhabitants of these areas use water from wells of which the depth varies between 0.5 and 1.0 m and often located less than 5 m distance of septic tanks. Moreover, inadequate hygienic sanitation facilities reduce the self-purification capacity of water system and pollute groundwater. The deterioration of water quality explains the occurrence of diseases, such as bacillary dysentery, cholera, gastrointestinal infections and diarrhoea that affects poor health in the slums of Cotonou. Safe drinking water would be assured only by promoting adequate hygienic system and sustainable water source management.

## Objectives / Hypotheses to test

This study aims at: (1) to analyze factors and process leading to groundwater pollution in the shantytowns of Cotonou; (2) to propose strategies of groundwater protection and reduction of population vulnerability to risks related to the consumption of unsafe water in the slums of Cotonou.



To reduce population vulnerability to diseases related to the water quality in the shantytowns of Cotonou, it is important to control the environmental factors and to take into account socio-economic factors which determine drinking water availability.

## Methodology

The selected shantytowns are: Ladji, Ahounsori Tohouéta, Vossa, Djidjé, Sègbèya, Yénawa, Avotrou, Enagnon, Placodji and Hindé installed in the marshes or peripheral marshes of lake Nokue, the lagoon of Cotonou and the Atlantic ocean.
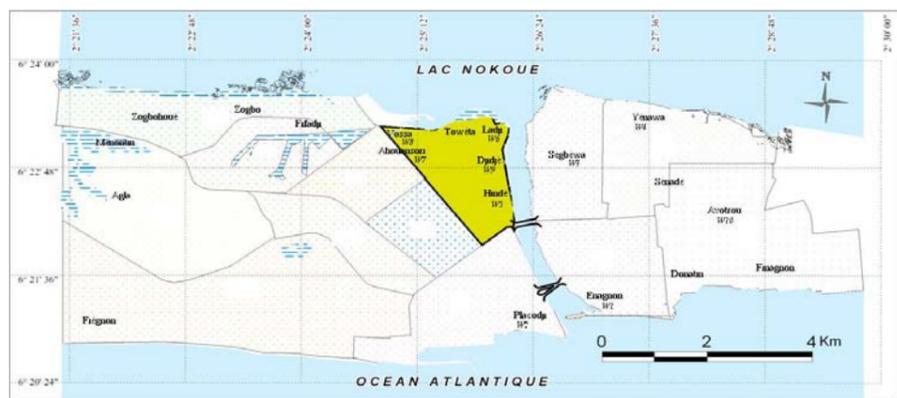


### Data

Physicochemical and bacteriological parameters, frequency of bacillary dysentery, cholera, gastrointestinal infections and diarrhea, and other environmental components are collected.

### Choice of shantytowns

The shantytowns are selected based on site, level of unhealthiness, distance between water bodies and sources of pollution as well as their situation with Lake Nokue and lagoon of Cotonou.

### Water pollution assessment

The quality of water consumed is appreciated from the quality standards of WHO and depending on the environmental health. Analysis of physicochemical and bacteriological parameters of ten water samples is carried out in the National Laboratory of Water Quality in Benin. Chemical parameters are compared to the Maximal Allowable Concentration and the bacteriological parameters are compared to the Maximum Allowable Value. The sources of water pollution are evaluated through a direct observation on each area investigated and by analyzing the origin of all ions identified in water samples.

### Assessment of waterborne diseases risks reduction strategies

Factors of water pollution processes are the basis of specific strategies developed in the population of the shantytowns of Cotonou. Focus groups and individual discussions with various actors such as specialists in water management, in public health, sociologists, environmentalists, geographers, local authorities, etc.) contributed to develop strategies of groundwater and health protection in the slums of Cotonou.

## Results

Groundwater quality analysis show a high level of pollution (physicochemical and bacteriological parameters). These parameters are superior to water quality standards of WHO, the Maximal Allowable Concentration and the Maximum Allowable Value.

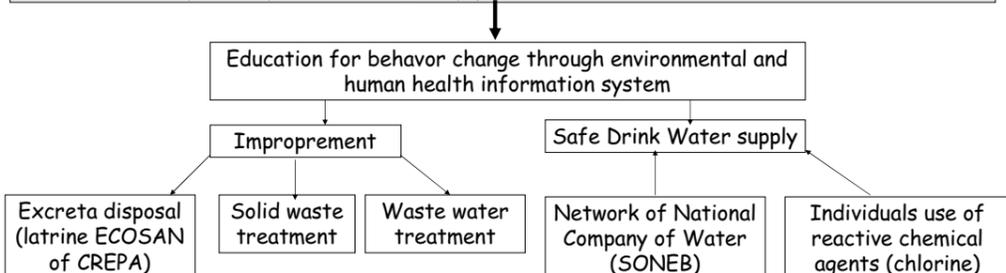| Parameters / Wells | Faecal coliforms, Shigella and Salmonella | Enumeration of Total coliforms | Enumeration of Escherichia coli after 48 H with 44°C | Staphylococcus after 48 H with 37°C |
|---|---|---|---|---|
| W1 | Positive | 3300 | 1300 | 500 |
| W2 | Positive | 2000 | 1250 | 2300 |
| W3 | Positive | 2400 | 1400 | 650 |
| W4 | Positive | 3300 | 1400 | 750 |
| W5 | Positive | 4000 | 800 | 550 |
| W6 | Positive | 6200 | 3800 | 150 |
| W7 | Positive | 5400 | 2200 | 450 |
| W8 | Positive | 5000 | 3000 | 2050 |
| W9 | Positive | 4350 | 1750 | 1050 |
| W10 | Positive | 2800 | 1800 | 640 |
| Standards WHO | Negative | 0/100 ml | 0/100 ml | 0/100 ml |

The keys determinants of groundwater pollution in Cotonou is its location in the lowest coastal sandy plain under the sea level, between the Atlantic ocean, lagoon of Cotonou and Lake Nokue, porosity higher than 40% (Maliki, 1993). High water temperature (>25°C) accelerate microbial proliferation. Rainfall and temperature variability induce rapid decomposition of waste, from which faecal pollutants flow into surface-and groundwater water because of inadequate sanitation equipment.

Moreover, rapid population growth, unstructured land occupation resulting in ill-management of the city, create huge environmental problems including waste management especially and uncontrolled sanitation in the shantytowns.


Inadequate excreta disposal

Latrines ← Less than 5m → Well

According to 98% of inhabitants, the most significant faecal contamination of groundwater effects are occurrence of bacillary dysentery, cholera, gastroenteritis and diarrhoeal diseases.

**Strategies of groundwater quality protection and reduction of health risks**

Education for behavor change through environmental and human health information system

Improprement — Safe Drink Water supply

Excreta disposal (latrine ECOSAN of CREPA) — Solid waste treatment — Waste water treatment — Network of National Company of Water (SONEB) — Individuals use of reactive chemical agents (chlorine)

According to WHO, prevention of microbial and chemical contamination of water sources is the first barrier against drinking water contamination of public health concern

## Discussion

The pathogenic microorganisms concentration are very high, compared to those observed in 1983 (GIGG, 1983), in 1992 (Aïssi, 1992) and in 1995 (Comlanvi, 1995). Sagbohan (2003) shows that water of lake and lagoon in relationship with groundwater, is already affected by an organic pollution due to dissolved total solids (over 1999) and oxygen dissolved (2.75 mg/l to 7.5 mg/l).

Inadequate septic tanks located at less than 5m from wells of which depth varies between 0.5 and 1m are the key sources of groundwater pollution. WHO (2004) explains that where latrines and septic tanks are poorly sited, they can lead to contamination of drinking water sources with nitrate. But this is the real residence context of the shantytowns of Cotonou where lack of town planning lead to permanent environmental pollution case.

## Conclusions

1. The keys determinants of groundwater pollution in the shantytowns of Cotonou are : underground flow between the lake Nokue, the lagoon of Cotonou and water table, the weak depth of groundwater (less than 1 m), high soil porosity (more than 40%), unhygienic behavior in household, inadequate sanitation equipment, lack of appropriate waste management, etc.
2. The main impacts of groundwater pollution are waterborne diseases affecting human health like bacillary dysentery, cholera, gastroenteritis and diarrhea.
3. The strategies for sustainable groundwater protection and coping with health risks are the development of an participatory and ecological approach of pollution factors and process control, and the improvement of adequate sanitation equipment adapted to the actual need of people, their livelihood, and according to WHO standards.

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