Full Length Research Paper

Water supply, sanitation and health risks in Yaounde, Cameroon

KUITCHA Dorice[1], KAMGANG KABEYENE Beyala Véronique[2], SIGHA NKAMJOU luc[1], LIENOU Gaston[3] and EKODECK Georges Emmanuel[3]

[1]Hydrological Research Center (HRC) Institute of Geological and Mining Research (IRGM), P. O. Box 4110 Nlongkak-Yaounde (Cameroon).
[2]Laboratory of Geology, Department of Biological Sciences, Higher Teacher training school, University of Yaounde I, P.O. Box 47, Yaounde (Cameroon).
[3]Laboratory of Geology of the Engineer and Alterology, Department of Earth Sciences, Faculty of Sciences, University of Yaounde I (Cameroon).

Population growth and rapid urbanization in Cameroon have led to major demographic changes in the urban centres, potentially resulting in serious environmental problems in the most populated cities such as Yaounde. In order to better understand the impacts on the hygiene conditions in certain quarters of this political capital, we carried out in March 2007, an investigation on the difficulties of water supply, sanitation and health problems. The investigation involved 1397 households distributed among 7 quarters with informal settlements. 17% of households only had a private connection to national company of drinking water distribution (CAMWATER) because of the lack of infrastructure and the high cost of the connection. The households which are unable to afford the cost of getting connected to CAMWATER network, exploit water from CAMWATER public paying fountain (56% of households), wells (17% of households), springs (4% of households), bore-holes (0.07% of household) and rivers (0.001% of household) to satisfy their needs. The majority of these water points (wells, springs and rivers) could be polluted, because of the informal nature of settlements which leads to proximity of habitats to latrines and to points of discharge of waste (solid and liquids). The health problems issuing probably from these potential polluted water points which at times occur as stagnant ponds around the dwellings is shown by the population of the zone of study in particular cases of malaria (100% of households), diarrhoea (24% of household), dysentery (24% of household), typhoid (0.07% of household), skin disease (0.07% of households). These results highlight the problems to which the authorities in charge of the environment and health must first bring a solution in a context to fight against poverty in Cameroon.

Key words: Environment, cleansing, drinking water, peri-urban zone, Yaounde.

INTRODUCTION

Population growth in urban areas is maintained by an increase in the births, international migrations and rural exodus (UNFPA, 2004). The endemic poverty of the African rural area pushes each day the populations towards the large city in the apparent search of a little more well being (Sadik, 1990; Coulibaly et al., 2004). Since 2004, the United Nations Fund for Population (UNFPA) intensifies its efforts of sensitizing the relationship which exist between poverty and the question of population (UNFPA,

2004). According to the experts of the UNFPA (2004), population growth is one of the principal causes of the increase in the needs as regards housing, water, hygiene, energy, health care, education, social services, food and difficulties of durable sanitation (Sadik, 1994). The need for providing adequate residences increases as the population increases, especially under the effect of the growth of the urban zones and the scarcity of land (Sadik, 1990). The disposal of industrial and domestic waste as well as waste water combined, with the large volume of urban detritus continues to increase (Ramade, 1974). There is a direct bond between the access to drinking water, the reduction in the incidence of epidemic diseases and infantile survival (Sadik, 1994). The con-

*Corresponding author: E-mail:dkuitcha@yahoo.fr.
Tel: (237) 99 83 88 13/(237) 99 20 67 15.

The concentration of industries and habitats in the same places multiplies the harmful effects more especially as the vast green space parks necessary for the purification of the atmosphere are continuously being exploited and reduced unceasingly (Ramade, 1974). Industry produces a multitude of non biodegradable substances which accumulate in the atmosphere, the hydrosphere and the ground disturbing the operation of the majority of the ecosystems (Ramade, 1974). Sanitation in African cities (60-95%) is generally unsewered (cess pools, septic tanks, latrines, etc.) (Strauss et al., 2000; Mpakam et al., 2006). The effluents of these on site sanitation systems are rich in total fecal coliforms, helminths, viruses, protozoa and in various chemical and physical pollutants (EPA, 1994). The intrusion of these polluted effluents in the aquifers or water distribution system can generate various diarrhoeal diseases in the human population (Adams and Moss, 1995; Mara and Feachem, 1999; Carr, 2001; Coulibaly, 2004).

In Africa in the South of Sahara, because of poverty, the populations of the large cities with modest incomes were pushed back towards the less developed sites (Coulibaly, 2004) in which promiscuities and poor living conditions lead to serious sanitation problems. Poor drainage of waste and rain water in these districts creates ponds which provide breeding ground for mosquito vectors of various diseases such as Malaria.

The principal objective of this work is to analyze the situation of sanitation in Yaounde, its impact on health and to see the level of participation of the households in the improvement of the access to drinking water. In our specific objectives, we want (1) to identify the various modes of water supply to the households; (2) to appreciate the water requirements of the populations in the studied quarters; (3) to analyze the situation of the sanitation of waste water, excreta and refuse; (4) to appreciate the level of incomes of households and their participation in the design, realization, management and the protection of water points used; (5) to assess the potential health risk of polluted water on public health.

MATERIAL AND METHODS

Site of study

The study was undertaken in seven quarters of the Northern sector of Yaounde (Cameroon). The urban zone covers a surface of approximately 256 km², ranging between 3° and 5° North and 11° and 12° East (Santoir and Bouopda, 1995). The population of Yaounde, evaluated at 1.500.000 inhabitants in the year 2000 (Honga-Makanda, 2003), undergoes a growth rate ranging between 3.5 and 6.2% per annum and its density varies from 3.2 to 5.69 inhabitants / km² (Santoir and Bopda, 1995). The hydrographic network constitutes a set of perennial rivers. The geological substratum is made of a set of fractured Precambrian formations, constituting exploitable aquiferous reservoirs through wells and boreholes (Nzenti, 1987). The climate is of the equatorial type with two rainy seasons (March-June and September-November) and two dry seasons (December-February and July-August), with an annual average rainfall of 1600 mm (Suchel, 1972).

In the framework of this work our investigations were carried out in the northern sector of Yaounde (Figure 1) and related to seven quaters Tongolo, Mbankolo, Etoudi, Nkomkana, Ngousso, Nkol-Eton and Nfandena.

Data-gathering

The data were collected in March 2007 from 1397 households (192-206 per quarter). The households were selected on the basis of a stratified sampling (Freese, 1984). The layers constituting the quarters were selected on the basis of three principal criteria: (1) the geographical criterion which made it possible to ensure a good space representativeness with the presence of the various geomorphologic agglomerations; (2) the socio-economic criterion, based on the necessary participation of the recipients to the future projects, which supposes that the selected households have at least a minimum income; (3) the urbanity criterion characterizing a screen of allotment. In each quarter, a route was followed in order to ensure a spatial covering of the quarter and to avoid the risks of repetition. The course was not done by squaring (because the type of material is not structured by the communication pathways) but by moving ahead in the quarter.

Each discussion was carried out in French and or local language for 10 to 20 min according to the household, based on investigation forms containing 45 questions divided into 4 groups. The first group of questions, relating to the knowledge of the household specifically about the marital status of the family, the number of people per habitat, the localization of the habitat, the quality of the house, the status of occupation of the house, the status of the guarantor, the year of installation in the quarter, the educational level of the household head, the size of the household, the sex of participants. The second group, relating to the water supply carried on the source of the water used in the household, the quantity of water used and the price to be paid, the contribution brought by the populations for the maintenance of the water point, the means of transport. The third group relating to the household refuse specifically concerned the mode of evacuation of the household refuse, the place of discharge of wastewater, the presence of the cleansing companies of in the quarter, food situations, and wastewater treatment stations in the quarter. The fourth group related to the types of facilities, excreta disposal systems, public health and the frequency of the diseases.

Statistical analysis

Data were treated using SAS (Statistical Analysis System) software Version 9.1. The averages were calculated thanks to the H-test of Kruskal Wallis. All the probabilities were appreciated with the threshold of 5%.

RESULTS AND DISCUSSION

Matrimonial status and a number of dependants

The study showed that in Yaounde and more particularly in the upstream catchment basin of Mfoundi, the distribution of populations into the quarters began in 1936, before the political independence of Cameroon (Kuete et al., 1991). The regrouping of these populations coincided with the beginning of the creation of the city by the colonialist's. Indeed, the installation of the road infrastructures and the residences by the colonialist's required a strong local labour organized within the quarters (Kuete
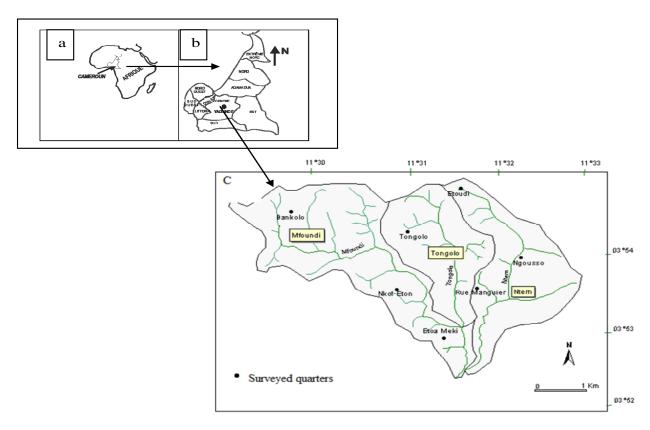
Figure 1. Localization of Yaounde: a) Cameroon in Africa. b) the area of Yaounde c) Surveyed quarters.

Table 1. Status of the people questioned in the households of 7 quarters with spontaneous habitats of the town of Yaounde.

Status	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Household head	31.00	37.00	58.25	42.50	32.99	50.52	52.97	43.60
Spouse	47.50	36.50	17.96	32.50	51.27	32.81	36.14	36.38
Others members of the household	16.50	20.50	11.77	25.00	13.71	9.90	6.44	14.83

N= 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202)

et al., 1991). The majority of the respondents were heads of households (44%); 36% were spouses and 15% were others members of households (Table 1). However, in Rue Manguier and Bankolo, the people having answered the questionnaires were represented much by the spouses (Table 1). The majority achieved secondary edu-cation (52.51%), and 21% reached the primary education level, 11% the higher level and 3% the nursery school. Ten percent of the respondents did not go to school. These results are contradictory to the national values, in Cameroon it is the primary education level which shows the highest rates of literacy (Honga-Makanda, 2003). This is explained by the fact that the respondents were mostly (80%) the heads of households and spouses. The responsibility of the head of household was held at 77% of the cases by men against 23% held by women. This

situation finds its origin in the local traditions which make the man the head of the family and the woman would ordinarily not proclaim important deci-sions (FNUAP, 1990).

In the surveyed quarters, the majority of the guarantors were married (66%), 24% only were unmarried and 10% widows (Table 2). These results are explained by the fact that the average age of marriage (18.5 years) in Central Africa is one of the lowest in the world (FNUAP, 1990). In this context, the young people launch out very early in search of an employment to provide the needs of their precociously made up families (Kuete et al., 1991).

The average number of people living in a household was 5.9 ± 3.5. This average value was slightly lower than that found by Mpakam et al. (2006) in the Bafoussam quarters, where 7 people on average live in the house-
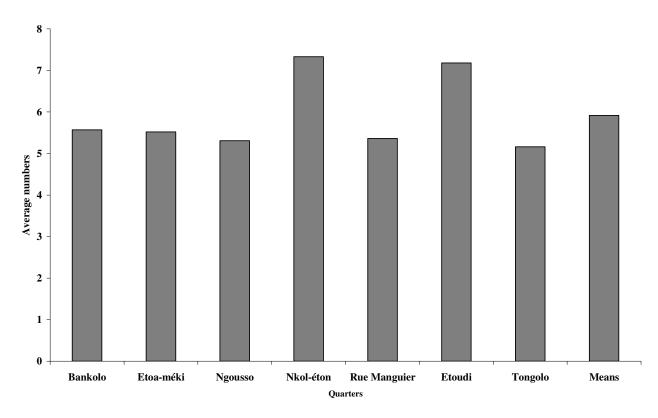
Figure 2. Average number of people per household in 7 quarters of Yaounde.

Table 2. Matrimonial status of the people questioned in the households of 7 quaters with spontaneous habitats of the town of Yaounde.

Status	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Maried	71.50	68.50	58.74	65.00	76.65	63.54	57.92	65.98
Single	21.00	23.00	31.55	22.00	17.77	22.92	28.36	23.80
Widow	4.50	7.50	9.22	13.50	6.09	14.06	12.38	9.61

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202)

holds. In Yaounde, the lowest averages were noticed in Tongolo (5.2 ± 3.1) and the highest in Nkol-Eton (7.3 ± 4.5 people) (Figure 2). The average obtained was close to the average number of children per African family which is one of the highest in the world (Populi, 1998). These average highlight the popular character of the surveyed quarters and the non-respect of the standards of family planning. Indeed, with 41 per thousand, Cameroon presents one of the highest birth rates of the world and only 2% of Cameroonian in population practices family planning (Sadik, 1992).

Typology of the habitat

In spite of the prevalent poverty of Cameroonian households (Honga-Makanda, 2003), 86% of households in Yaounde were owners of their housing, the tenants accounted for only 14% of the sample. However, many of these houses were situated in environmentally risky zones (Table 3): 31% of constructions were constructed on slopes, 35% in hollows and 25% in marshy zones (Table 3). This arrangement would be an indicator of poverty. This distribution of habitat also confirms the morphology of the town of Yaounde which is known in the name of city with "7 hills", made of a succession of thalwegs or low marshy bottoms and mountains being able to culminate to 1095 m at the level of the Mount Fébé (Kuete, 1977).

The level of the built framework was less diversified and we noticed an absence of modern architecture in these quarters because, the majority of the houses were semi hard (partly, cement, block-built) (47% of households), 29% only were built out of final materials, 13% in board, 8% in wood and 2% in beaten ground. The quar-

Table 3. Site of construction of the habitats of the households of 7 quarters with spontaneous habitats of the town of Yaounde

Site	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Slope of the hill	31.00	27.00	38.35	0.50	50.25	44.27	28.71	31.44
Low bottom	11.50	43.50	38.83	63.00	13.20	19.79	50.99	34.40
Marshes	20.00	17.50	17.48	36.00	33.50	35.42	14.36	24.89

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202)

Table 4. Structure of the habitat in the households of 7 quarters with spontaneous habitats of the town of Yaounde

Structure	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Final materials	31.50	32.00	21.84	23.50	27.41	44.27	19.80	28.62
Semi-hard	42.00	29.50	57.77	56.00	46.70	34.90	64.36	47.32
Board	14.50	27.00	11.65	5.00	14.72	9.38	9.90	13.16
Carabote	9.00	8.00	5.85	3.50	11.17	10.42	5.45	7.63
Beaten ground	0.00	0.00	0.97	12.00	0.00	0.00	0.00	1.85

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202).

Table 5. Water carriers in the households of 7 quarters with spontaneous habitats of Yaounde

Structure	Bankolo	Etoa-Meki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Children	52.50	34.00	23.79	51.00	37.06	47.40	55.45	43.03
Women	14.50	10.00	13.11	4.00	10.66	12.50	3.96	9.82
Men	8.00	8.00	11.17	13.50	6.60	6.25	19.31	10.40
All	10.50	19.50	42.72	27.50	41.12	41.15	17.33	28.55

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202).

houses built with modern material profited from the proximity of the presidency of the republic which imposed to the bordering populations' a certain behaviour as regards construction. The beaten ground houses were present only at Ngousso and Nkoleton (Table 4) and belong to the landowners especially.

Access to drinking water in the town of Yaounde

The study showed that drinking water is not yet accessible to all in the quarters with spontaneous habitats of the town of Yaounde (Honga-Makanda, 2003). In fact, 17% of the surveyed households had a private connection to the national company of drinking water distribution (CAMWATER). The households which are unable to pay for pipe-borne water, had access to water either (1) by using water coming from CAMWATER public paying fountains (56% of households); (2) either by supplying itself from alternative water sources. With regard to these alternative sources, wells (17% of households) are the most used. We noticed a very weak use of the springs (4% of households), bore-holes (0.07% of household) and rivers (0.001% of household) which represent represent unhealthy water points that more than 50% of households users chlorinate before consumption. These

results showed that the underground water resources are again highly exploited by the Yaoundé populations, and this could have consequences on the water table if nothing is done by the government to avoid overexploittation. Chlorination is the most advised method in the strategies of water sanitation in the African area, but, a small proportion of households also practised, boiling, filtering and the use of cooking salt. All the water points (CAMWATER, spring, wells, bore-holes and rivers) have multiple uses: body, linen, crockery, kitchen or drinking (90-100%F of households). In the quarters deprived of drinking water points (CAMWATER) the supply is hard (Honga-Makanda, 2003). In this context, the water drudgeries are especially ensured by the children (43.03% of households). 28.55% of households use indifferently children, women or the men to assure. 9.82% use only the women and 10.40% use only the men (Table 5). Our results corroborate those of Honga-Makanda (2003), however for this author; it is especially the women and the children who ensured the water drudgery.

The sanitation in the town of Yaoundé

In Yaoundé, the sanitation is primarily autonomous. 72.75% use the WC on pile (Table 6). The use of the

Table 6. Sites of deposit of faeces in the households of 7 quarters with spontaneous habitats of the town of Yaounde.

Structure	Bankolo	Etoa-Meki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Latrines	0.00	7.50	4.37	39.50	10.15	6.25	12.87	11.52
WC on pile	83.00	74.00	75.73	51.00	77.16	77.08	71.29	72.75
WC with hunting	11.50	11.00	13.11	8.00	9.64	12.50	11.88	11.24
Around houses	0.00	0.50	0.00	0.00	0.00	0.52	0.00	0.15

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoudi = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202)

Table 7. Sites of domestic garbage dumps in 7 quarters with spontaneous habitats of the town of Yaounde

Structure	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Means
Open air	1.50	11.50	11.17	6.50	13.20	14.58	0.50	8.42
Refuse vat	63.50	30.00	54.37	27.50	52.79	30.21	78.71	48.15
Pit	15.50	2.50	4.37	1.50	4.57	24.48	2.97	7.98
Fields	10.50	2.00	12.14	3.00	9.64	7.81	1.49	6.65
Springs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.07
Around the house	0.50	1.50	0.49	1.00	0.00	5.73	0.00	1.32
River	16.50	50.00	2.91	60.50	21.83	16.67	17.33	26.53

N =1397 households (Bankolo=200, Etoa-Méki=200, Etoudi=192, Ngousso=206, Nkoleton=200, Rue Manguier=197, Tongolo=202).

latrines (11.52%) and of the modern systems such as the WC with water system (11.24%) is rare. These results are close to those of Mpakam et al. (2006) obtained in Bafoussam. This mode of sanitation would be typical to developing countries (Coulibaly et al., 2004) because the establishment of the drainage systems is very expensive for these countries and especially to the communities with low incomes (Coulibaly et al., 2004). The defecation in nature (in the surrounding of the houses) is even rare, it accounts for only 0.15%. This practice which relates only to the quaters Etoa-Meki and Etoudi facilitates the fast biological pollution of surface water (Djuikon et al., 2006).

Majority of latrines are aged from 20 to 40 years (this is in relation to the installation of the populations in the quarters) and is used by the households not connected to the network of drinking water. Domestic waste water is primarily discharged in to gutters (77.24% of households), in the yards (6.80% of households), around the houses (2.36% of households), in the rivers (12.74% of households) uphill of springs (0.21% of households) and in abandoned wells (0.43% of households).

In the majority of households, refuse is emptied in the vans of HYSACAM (48.15%) (Table 7). 26.53% do use rivers. However, the rivers are the major disposal sites in Nkoleton (60.50%) and at Etoa-meki (50%). The disposal of the refuse is rare in open air (8.42%), in septic tanks (7.98%), in fields (6.65%)), in wells (0.07%) and in the neighbourhood of houses (1.32%). These results are contrary with those of Bafoussam where drains (30 - 50%) and fields (30 - 60%) are the main sites of refuse

evacuation (Mpakam et al., 2006). Contamination of water by organic matter poses serious problems to the aquatic ecosystem. Molluscs are particularly sensitive to the biodegradable pollutants and are used besides as indicators of the pollution of water by organic matter.

Problems of health

All the participants (100%) in the investigation already suffered from malaria which was the most frequent disease. In 95% of households, one could contract the disease 1 -20 times during a period of one year. The African continent would be the historical cradle of malaria (Molez, 1999) and its strong frequency in the studied quarters would be related to its endemic character (Molez, 1999). Less than 25% of the households complained about cases of amoebic dysentery (24% of the households), diarrhoea (24% of the households), skin diseases (0.07% of the households) and typhoid (0.07% of the households). However, these percentages could reach 66% for diarrhoea in Tongolo and 44% for amoebic dysentery in Etoa Méki. These water- borne diseases are common to the majority of developing countries. In Niamey, in Niger, analysis made by 322 people showed the presence of the Amoeba parasites at 53.6% of this population (Julvez et al. 1998). The prevalence of these diseases is the result of biological pollution of water which poses serious problems of public health (Kebiche et al., 1999). The disposal of untreated waste water and the indiscriminate disposal of solid wastes lead to the proliferation of favourable environments for vectors (mos-

Table 8. Structure of management of the water points in the households of 7 quarters with spontaneous habitats of the town of Yaounde.

Structure	Bankolo	Etoa-Méki	Ngousso	Nkoleton	Rue Manguier	Etoudi	Tongolo	Moyenne
Town hall	27.00	46.00	44.66	27.00	27.92	40.63	50.00	37.60
Association	28.00	23.00	36.89	55.50	26.90	43.75	31.68	35.10
Private individual	25.00	22.50	14.08	15.50	31.98	11.98	13.37	19.20

N = 1397 households (Bankolo = 200, Etoa-Méki = 200, Etoud = 192, Ngousso = 206, Nkoleton = 200, Rue Manguier = 197, Tongolo = 202)

quitoes, flies, cockroach and rodents) as well as odours nuisance (Mwaguni, 2002). In the opinion of household, the diseases stated above are likely to lead to significant disabilities, great expenditure and even death. Indeed, an analysis of the data resulting from the service of epidemiology and endomo-epidemics from the Ministry of health (Direction of Community health) showed   that, the risks of water-borne diseases are high in the town of Yaounde, without distinction to urban fabric, particularly in the households bordering rivers and the zones with stagnant waste water (Bemmo et al., 1998b; Wethe et al., 2003).

Social regroupings and participative managements of the environment

In the 7 studied quarters, 41% of the households belonged to association. This constitutes a good indicator when one seeks to know if a population can potentially carry on successful collective actions (Npakam et al., 2006). Such associations are voluntary group of individuals brought together to face the more or less unforeseen expenditure (funerals, expenses, trade, construction, disease, birth). Part of this money goes at times to the adjustments of the community (management of waste or cleansing). 43.62% of the households agreed to take part in the maintenance of the collective accesses to water. This perception was stronger in Nkoleton (84.34%) and weaker in Bankolo (24.62%). 76.75% of the households were ready to take part in the financing of a collective installation giving drinking water. In this case, they wish that management be entrusted to the council (37.60%) or to an association (35.10%). 19.20% only wished that management be given to a private individual (Table 8).

As in Bafoussam (Mpakam et al., 2006), the households which were ready to take part financially in the realization or the rehabilitation of a Community water point were ready to contribute a share of 500 FCFA (0.90€) to 3000 FCFA (5€) per household. This confirms the idea that the inhabitants know that the problem of water and sanitation must be regulated in a collective manner by the participation of all.

Conclusion

The town of Yaounde is under the threat of an endemic pollution. In the quarter with spontaneous habitat, the sanitation is primarily autonomous. There is poor management of liquid and solid waste which leads to persis-

tent problems of public health. Because of the high density of habitat the majorities of the water points are close to the dwellings and consequently are thus very close to the latrines. To avoid these various problems, the following solutions were proposed:

- To increase the educational level of the populations.
- To inform and educate the households on the different techniques of sanitation and environmental protection.
- To sensitize and inform the populations on hygiene and the medical risks due to polluted water.
- To implicate the populations in the projects of development and the reinforcement of the dialogue between all the actors concerned.
- To make access to drinking water and the sanitation a priority.

ACKNOWLEDGEMENT

REFERENCES

Adams MR, Moss MO (1995). Food Microbiology, Royal Society of Chemistry, Cambridge. Book review.

Bemmo N, Njine T, Nola M, Ngamga G (1998b). Impact des différents dispositifs d'évacuation des eaux de vidange, des eaux usées, des excrétas humains et des déchets solides sur les ressources en eau, la santé et l'environnement : cas des quartiers denses à habitats spontanés et des zones périurbaines de Yaoundé-Cameroun. Proposition de systèmes appropriés tenant compte des contraintes locales. Rapport de recherche.

Carr R (2001). Excreta-related infections and the role of sanitation in the control of transmission. Water Quality : Guidelines, Standards and Health. WHO. Ed. Frewtrell L. and Bartram Journal, London, UK. 28: 89-113.

Coulibaly L, Diomandé D, Coulibaly A, Gourène G (2004). Utilisation des ressources en eaux, assainissement et risques sanitaires dans les quartiers précaires de la commune de port-bouët (Abidjan; Côte d'Ivoire). VertigO 3 (5), décembre 2004.

Djuikom E, Njiné T, Nola M, Sikati V, Jugnia LB (2006). Microbiological Water quality of the Mfoundi at Yaounde, Cameroon, as inferred from indicator bacteria of fecal contamination. Environ. Monitoring and Assessment 122: 171-183.

EPA (1994). Water quality standards Handbook, second edition.

Ford LA (1994). Detection of *Aeromonas salmonica* from water using of filtration method. Aquaculture 122:1-7.

Freese F (1984). Statistic for land managers. Paeony Press eds, Allerley Brae, Jedburgh, Scotland.

Honga- Makanda D, Melingui A, Moukam J, Moutcheu S et Noupewou S (2003). Education civique et morale. Hatier International.

Kebiche M, Benabid C, Adjal F (1999). Pollution des eaux superficielles dans un climat semi-aride: la région de shétif (Algérie). Sécheresse 2(10): 137-142.

Kuete M, Melingui A, Mounkam J, Nguoghia J et Nofiele D (1991). Nouvelle Géographie. Edicef Cedex Frances.

Kuete M (1977). Etude géomorphologique du massif de Yaoundé. Thèse de Doctorat 3eme Cycle Université de Bordeau III. p.279.

Mara DD, Feachem RGA (1999) Water and Excreta-related diseases: Unitary environnemental classification. J. Environ. Eng 125 (4).

Molez JF (1999). Les mythes représentant la transmission palustre chez les indiens d'Amazonie et leurs rapports avec deux modes de transmission rencontrés en foret. Cahiers Santé 9: 157-162.

Mwaguni SM (2002). Public heath problem in Mombassa District. A case study on sewage management. M S thesis.University of Nairobi, Nairobi, Kenya.

Mpakam Hernanie Grelle, Kamgang Kabeyene BV, Kouam Kenmogne GR, Tamo Tatietse T, Bemmo N et Ekodeck GE (2006). Accès à l'eau potable et à l'assainissement dans les villes des pays en développement: Cas de Bafoussam (Ouest-Cameroun). Vertigo 7(2),

Nzenti JP (1987). Pétrogenèse des migmatites de Yaoundé (Cameroun) : éléments pour un modèle géodynamique de la chaîne pan-africaine Nord-Equatoriale. Thèse Doctorat nouveau régime, ; Université de Nancy 1, France. p. 140.

Olivry JC (1986). Fleuve et rivières du Cameroun. Collection Monographie Hydrologie, MESRE/ORSTOM.

OMS (1985). Manuel de l'aménagement de l'environnement en vue de sa démoustication. Organisation Mondiale de la Santé, Genève.

Populi (1992). UNFPA.

Ramade F (1974). Elément d'Ecologie Appliquée. Ediscience.

Sadik N (1990). Etat de la population mondiale. FNUAP.

Sadik N (1992). Etat de la population mondiale. FNUAP.

Sadik N (1994). Etat de la population mondiale. FNUAP

Santoir C et Bopda A (1995). Atlas régional Sud-Cameroun. - ORSTOM, Paris.

Strauss M, Heinss U, Montenegro A (2000). On-site sanitation: When the pits are full. Planning for resource protection in feacal sludge management. Proceedings, Int. Conference. Bad, E., 1998. Schriftenreihe des Vereins für Wasser-, Boden- und Lufthygiene, 105: Water, Sanitation & Health - Resolving Conflicts between Drinking-Water Demands and Pressures form Society's Wastes (I. Chorus, U. Ringelband, G. Schlag and O. Schmoll, eds.). IWA Publishing House and WHO Water Series. ISBN No. 3-932816-34-X.

Suchel JP (1972). La répartition et les régimes pluviométriques au Cameroun. Travaux et document de géographie tropicale N° 5. CEGET-CNRS, Bordeau.

UNFPA (1990). La revue de l'UNFPA.

UNFPA (2004). Rapport annuel. UNFPA.

Wethe J, Radoux M et Tanawa E (2003). Assainissement des eaux usées et risques socio sanitaires et environnementaux en zone d'habitats planifiés de Yaoundé (Cameroun). VertigO 4(1).

Yongeu-Fouateu R (1986). Contribution à l'étude pétrographique de l'altération et de faciès de cuirassement ferrugineux des gneiss migmatitiques de la région de Yaoundé. Thèse Doctorat, 3eme cycle, Université de Yaoundé, ;Yaoundé, Cameroun. p. 214.