Human Settlement, Land Management and Health in Sub Saharan Cities

H.B. Nguendo Yongsi

Abstract—An epidemiological cross sectional study was undertaken in Yaoundé in 2002 and updated in 2005. Focused on health within the city, the objectives were to measure diarrheal prevalence and to identify the risk factors associated with them. Results of microbiological examinations have revealed an urban average prevalence rate of 14.5%. Access to basic services in the living environment appears to be an important risk factor for diarrheas. Statistical and spatial analyses conducted have revealed that prevalence of diarrheal diseases vary among the two main types of settlement (informal and planned). More importantly, this study shows that, diarrhea prevalence rates (notably bacterial and parasitic diarrheas) vary according to the sub- category of settlements. The study draws a number of theoretical and policy implications for researchers and policy decision makers.

Keywords—Cameroon, diarrheal diseases, health risk factor, planned and spontaneous settlement, urban policy, urbanization.

I. INTRODUCTION

URBANIZATION has become irreversible since the turn of the last century. To understand this urban phenomenon, it is important to note that in 1950, less than one-third of the world's population was urban, this means that 740 millions urban dwellers for about 1.8 billion rural [1]. This proportion of those living in urban areas is greater than half of the total world population. The figure will approach 5 billion by the year 2030 given an estimated 180 000 people that are being added to the existing urban population daily [2].

More intriguing than these global figures is the rapid and spectacular process within developing countries in general and Africa in particular. Urbanization in Africa has been phenomenal and puzzling with a rapid shift from a rural proportion of about 80% in 1960 to estimates of 52% urban currently [3]. It is estimated that by 2030, the continent may attain 80% urban proportion.

This phenomenal growth has been qualified variously as "galloping" and "wild"[4] to express not only the uncontrolled nature of urban growth, but also the ecological and social and sanitary consequences often associated with the growth and the implications they may have on human health and well-being. Health and well-being concerns of inhabitants of Sub-Saharan Africa are linked to –or associated with- the unplanned urban centres [5].

H.B. Nguendo Yongsi is with the University of Chicoutimi, 555, Chicoutimi, Canada. He also works with the Laboratory of Sustainability of the University of Montreal-Canada. (Phone: 1.905.817.1523; e-mail: blaise_nguendo-yongsi@uqac.ca).

Three main factors explain the existence of unplanned cities in Africa: (a) sustained and rapid demographic growth experienced since the last century, (b) rural exodus, and (c) natural increase leading to disproportionate expansion [6]. For example, Yaoundé, the capital city of Cameroon since 1909 has grown from 3 830 ha in 1974, to 12 300 ha in 1990 and to about 18 000 ha in 2000 [7]. In most cases, policy-makers in Yaoundé did not plan or anticipate the spatial expansion. Consequently, urban dwellers spontaneously settled in a random and unordered manner. In order to bring this random growth of the city under control, local authorities have attempted to reorganize land occupation by planning housing in certain parts of the city.

Infectious diseases have been found as a permanent feature of both informal and planned settlements in Yaoundé i.e. informal and planned settlements [8]. In their quest to gain access to land for residential and other purposes in the city, urban dwellers in the informal category often end up in a precarious health conditions. Focusing on spatial health disparities in urban settings, this paper assesses urban health (diarrhea) determinants in Yaoundé, a Francophone African capital city.

II. MATERIAL AND METHODS

A. Conceptual framework

Fast-growing population, extreme poverty of large numbers of urban households, and persistent deterioration of living conditions are some of the challenges facing cities of the developing world [9]-[10]. For at least four decades, a wide–ranging research effort has investigated the cost-benefits of providing safe and convenient living conditions to households in the developing world [11]-[12]. Most of the work has focused on housing conditions, notably on the relationship between water, sanitation and disease [13]-[14]. Research notes that water supply, sanitation, housing and health are closely related. It is also evident that each year, poor hygiene, inadequate quantity and quality of drinking water and lack of sanitation facilities in most houses contribute to the death of millions of the world's poorest people from preventable diseases [15]-[16], namely from diarrheas [17]. It is estimated that 1.8 million people die worldwide every year from diarrheoal diseases (including cholera). Amongst them, 90 % are children under 5 mostly in developing societies. Diarrheal diseases account for 4.3% of the total global disease burden (62.5 million DALYs). An estimated 88% of this burden is

attributed to unsafe drinking water supply, inadequate sanitation, overcrowding and uncomfortable houses, and poor hygiene [18]-[19]. These risk factors do not evenly threaten urban districts as slums and informal settlements are more vulnerable to communicable diseases [20].

Despite the quantity of studies carried out, relatively little is known about the key contribution of town planning in diarrheal incidence. In particular, households' settlement --- measured in terms of *land settlement and availability of basic services* --- has rarely been examined. Among the regions of the world, Sub-Saharan Africa needs to fill the research gaps in the area, especially because the region has the fastest growing urban population and the majority of city dwellers have least access to urban equipments. This paper aims at demonstrating the link between health outcomes (with reference to diarrheas) and human settlement in a Sub-Saharan African capital city (Yaoundé).

From the geography of health stand point, urban and rural areas do not experience health hazards with an equal magnitude [21]. So for, we argue that prevalence rate of diarrheal diseases in Yaoundé vary according to types of land management and human settlements. Human settlement and health are key concepts in this paper. Human settlement refers to urban land use management. This management is generally characterized by the physical and human traits of the neighborhoods which the settings comprise [22]. This explains why the notion of neighborhood is often used in urban literature.

We adopt the WHO definition of health that stipulates that health is a "complete state of physical, mental and social wellbeing, and does not consist only in an absence of disease or disability" [23]. Typical health measurement includes indicators like mortality, morbidity and life expectancy. For this study, we have chosen morbidity, and more precisely morbidity attributed to diarrheal diseases. Diarrhea is generally characterized by the frequent occurrence of watery stools. In a technical sense, however, it is more difficult to define because the suggested elements which are asymptomatic of the definition of diarrhea vary according to the objectives of each study [24]. Following clinical signs, we have considered diarrhea as the sudden and frequent occurrence of abundant and consistently abnormal watery or mucus stools more than three times a day and more than 300g per stool [25]-[26]. The stools should be mixed with a phlegm-like substance or blood, and are associated with dysentery. To indicate its acute character, the episode must last for about 14 days.

Since diarrheas are an inter-human communicable disease for which population density is of great importance in its diffusion process, we posited that human settlement and land management might be a risk factor associate to the development of diarrheas here.

B. Study area

The study area is Yaoundé, the capital city of Cameroon in Central Africa. Yaoundé is located 3°52′ north of the equator.

The city covers over 256 Km^2 and experiences a typical Equatorial climate with four seasons: two dry and two rainy seasons. Yaoundé is experiencing very rapid urbanization With an estimated annual growth rate of 4.5 per cent since 1980, urban population has grown from 812,000 inhabitants in 1987 to 1,500, 000 inhabitants in 2000, and to about 2, 100, 000 inhabitants in 2006 [27]. But, this population growth has not been monitored by the local authorities. Consequently, neighborhoods have not been provided with adequate utilities, services and infrastructure. Therefore, city dwellers are facing difficulties such as access to safe drinking water, sanitation and to comfortable housing. Under this backdrop, this paper examines health outcomes in the context of rapid urban population growth without adequate accompanying services and infrastructure. Our focus is on infectious diarrheas with particular reference to housing in Yaoundé as we've said is lacking basic services as well as many urban settings in Sub-Saharan Africa..

C. Data collection and management

The data used in this work were obtained from an interdisciplinary survey carried out in Yaoundé in 2005 through the ''Populations et Espaces à Risques Sanitaires'' (PERSAN) research programme. The survey covered neighborhoods and households in Yaoundé, and used a stratified random sampling procedure based on two stages to select targeted neighborhoods. First, 20 neighborhoods were selected out of the 105 that make up the city. This was necessary to derive a sample seize sufficient for the scientific validation of the results. In the second stage of the survey, we selected 3,034 households. Households were selected on the basis of having a child of less than 5 years of age as they appear to be more vulnerable to infectious diseases.

The survey was conducted by a team of final year students of the Faculty of Medicine and Biomedical Sciences and by surveyors specialized in population studies of the Cameroonian National Institute of Demography. The team visited the selected households to collect data using structured questionnaires drawn up to respond to the two dimensions of this study; namely (i) the socio-demographic and environmental dimension which aimed at identifying and characterizing living conditions within the selected districts, and (ii) the medical dimension. Approved by the National Ethics Committee of Cameroon, this dimension targeted children of less than five years in the sampled households. Besides appraising children medical history, this dimension also aimed to detect cases of diarrhea in children within the selected households. Thus, when a case of diarrhea was reported, a stool sample was taken and dispatched to the bacteriological, virological and parasitological laboratories of the Cameroon Pasteur Institute within the accepted requirements, for confirmation and identification of the causal germs. Each positive sample was linked with the household's housing living conditions data.

These data files were spatially analysed using the Geographical Information System method. Bivariate statistical

analyses and tests of significance were carried out to verify the level of association between the two main variables, i.e. diarrheas and land settlement. The software used were *Epiinfo3* (for raw data recording, verification, and validation of the data collected), *SPSS 10.0* (for statistical analysis and tabulation) and *Arc Info 8.2* (for spatial analysis and modeling).

III. BACKGROUND: A CONTRASTED LANDSCAPE; SPONTANEOUS SETTLEMENTS VS PLANNED SETTLEMENTS

Before the arrival of the German explorers in 1889, the present site of Yaoundé was occupied by pigmies followed by the Bane and the Ewondo, all belonging to the Beti ethnic groups who had been in this site since 1790 [28]-[29]. Towards the end of the 19th century, the "Ewondo country" (henceforth known as Yaoundé) progressively declined in favor of the German military station of "Yaunde Station". It is around this "German nuclei" that Yaoundé was established. The establishment of a military post brought to an end the mission of the German military leadership "Kund and Tappenbeck". A plan was outlined for the city in 1891 by Von Zimmerer. The German territory constituted an area known as "Imperial Territory" which kept the natives out of the demarcated belt. This demarcated zone of Yaoundé became the first urbanized nuclei of the European model. On the eve of the First World War, the Germans were expelled from Cameroon.

The French colonial administration was established which reinforced the existing spatial segregation. In 1923, the French administration relocated all buildings belonging to the natives and allowed the Europeans to demolish all villages owned by natives around the European settlements on 'hygienic' ground [30]. Administrative centre spread from the French residential zone with the development of indigenous commercial activities along new roads linking the north and the south. This was the genesis of a bipolar structure in place that juxtaposed administrative and commercial centers in Yaoundé. Adjacent to this bipolar structure with improved hygiene, were "dispersed African villages and quarters harboring populations that were subjected to steady forced displacement for space, justified on hygienic reasons" [31]. Faced with frequent rejections and displacement from the European urban perimeter, the indigenous population colonized the risks-prone hills using poor building materials.

After the Cameroon independence in 1960, this hilly colonial development model continued under the new national administration. Yaoundé expanded rapidly without a clear urban development plan. In fact, since 1960, other neighborhoods and land uses have emerged. This is the case of Essos neighborhood and Kondengui prison that led to the expansion of the town eastward. The administrative role of the centre town was secured with the creation of government departments. Further, the creation of Ngoa Ekelle University Campus gave a new and mixed character to the south west zone of the town which until 1965 was the hub of spontaneous neighborhoods such as Melen and Obili. Concurrently, the

growth of industrial development continues to the south and southeast of the town close to the airport. In the mid 1970s, most of Yaoundé urban functions were reinforced thanks to a five-year development plan. Many spontaneous densely populated neighborhoods grew as specialized labour reservoirs around the city centre [32].

In the 1980s, faced with the increase number of informal settlements, urban planners attempted to bring under control the sprawling urbanization in two key ways: creation of a land office (under the Ministry of Finances in order to manage land tenure), and a Town Planning Department (under the Ministry of Equipment whose mission was to monitor architecture and building controls). In spite of these measures, the town continued to stretch out as new migrants kept on settling. This led the public authorities to draw up an urban development plan [33]. Also, the urban council put in place a number of operations aimed at releasing land for urban settlement. In the mid 1980s, the government created MAETUR (*Mission Mission d'Aménagement et d'Equipement des Terrains Urbains et Ruraux*) to improve planned and serviced land for newly recruited civil servants. To contain the informal growth, a state owned real estate company was formed along with the creation of public hosuing estates under the management of SIC (*Société Immobilière du Cameroun*). Several housing estates (commonly known as Cité SIC) were developed such as Cité Verte and Mendong in Yaoundé.

Legend

Non residential areas
Spontaneous urban fabric
Planned urban fabric

Scale: 1: 80 000
Projection: Gauss Krugger
Ellipsoid: Clarcke 1880

Source: Yaoundé digital map
Operation and designing methods:
1. "Neighborhoods" analysis method following a movable surface using «Focal mean» and «Focal Variety» functions tools
2. Combinatory analysis using the «Reclass» function tool
3. Validation through "Flield - Laboratory"method
Software used: ArcGis 8.3 - ArcInfo Grid
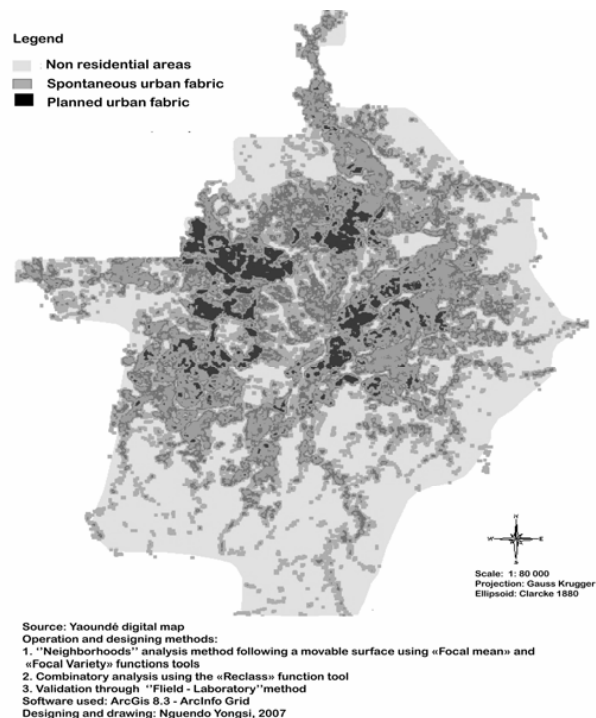Designing and drawing: Nguendo Yongsi, 2007

Fig. 1 Spatial Modeling of the Yaoundé Urban Fabric, updated from the land occupation mode

Faced with the liberalization of the economy in the 1990s, the privatization of public land has slightly improved land

management in some well located urban areas. The new urban management strategy (i.e. land release) in the 2000s has its merits such as the emergence and spread of new wealthy residential neighborhoods known in its French acronym as "Villas". Such well planned neighborhoods with luxurious modern houses include Ngousso, Nkomo/Biteng and "Koweit City" districts. They belong to the oligopolistic private sector property developers linked up to the existing political system.

In short, these different modes of settlement by urban dwellers on one hand and land use planning by the state authorities on the other, have combined to give Yaoundé a double and contrasting urban settlement landscape: spontaneous and planned settlements (Fig. 1).

Sub types and major characteristics of these settlements modes are given in the box below.

Types of settlement	Sub types	Major characteristics
	- Wealthy residential neighborhoods	Recently built areas, low population density, comfortable individual houses, households' affordability to health care services, availability of and easy access to sanitation facilities (waste water and garbage collections), electricity and water supply infrastructure,)
Planned/Formal settlement *20% of the urban space and comprise 30% of the urban population*	- Housing estates	Old and less dense areas, houses are made up of apartments, households' affordability to health care services, and well equipped areas with access to all utilities.
	- Communal plots	Very old areas (before 1970), high population density, uncomfortable individual houses, no affordability to health care services, little access to urban equipment such as water supply infrastructure and sanitation facilities.
	- Semi rural neighborhoods	Neighborhoods developed on peri-urban lands, recently considered as part of the town, very low population density, individual houses built with woods/mud/cardboards, neither structured nor equipped with utilities like water supply infrastructure, electricity, sanitation facilities, hospitals, clinics, schools, etc.
Spontaneous /Informal settlement *80% of the urban space and harbor about 70% of the city dwellers*	- Peri urban fringes neighborhoods	Recently built neighborhoods, less-dense and less-equipped areas, limited access to health care services, drinkable water, electricity and to sanitation facilities
	- Sub-central spontaneous neighborhoods	Old neighborhoods developed near the city centre, very high population density, little equipped but structures are old and most of them are out of use. Consequently, there's a poor access to water supply infrastructure and to sanitation facilities. However, easy geographical access to schools, clinics and health care services
	- central spontaneous neighborhoods	

IV. RESULTS AND COMMENTS

In Africa, urbanization has triggered a number of health risks [34]-[35]-[36]. In Yaoundé, these risks can be correlated with settlement that we define as all of the housing conditions such as land occupation, land management and housing utilities. As mentioned above, Yaoundé displays a contrasting landscape i.e. with planned settlements on one hand and spontaneous settlements on the other. This contrast is clearer when inequalities in health status and conditions are considered herein illustrated by diarrhea cases diagnosed among the children used in the survey for this study (Table I).

TABLE I
PREVALENCE OF DIARRHEAS IN THE TWO MAIN TYPES OF SETTLEMENT IN YAOUNDE

Types of settlement	Households Surveyed		Diarrhea cases identified	
	Number	Percentage	Number	percentage
Planned	814	26.8	84	19.2
Spontaneous	2 220	73.2	353	80.8
Aggregate	3 034	100	437	100
Average urban prevalence rate : 14.4%				

Source: PERSAN Study

Table 1 shows that more than 80% of all diarrheal cases occur in spontaneous settlements with about 16% prevalence rate. This is higher than the overall urban prevalence rate (14.4%) suggesting a spatial cluster of diarrhea around informal settlements. However, factors explaining human settlement patterns in Yaoundé are as varied as the range of actors involved. One therefore observes differentiations in the general organization of the resulting types of settlements.

We adopted the definition of the urban space based on the mode of land occupation and use, houses density, and functionality as a whole of the town. This has enabled here to bring out the existence of urban sub areas (i.e. neighborhoods) with health features quite different from one neighborhood to another. Thus, seven sub categories were further derived: three subcategories of planned settlements and four of spontaneous settlements which differ from one another spatially, socio economically and in terms of density and access to services. This is highlighted by the bivariate analysis that correlates distribution of diarrheal diseases to these neighborhoods in Yaoundé (Table II).

TABLE II
DISTRIBUTION OF DIARRHEAS ACCORDING TO SUB THE OF SETTLEMENTS IN YAOUNDE

Types of settlement	Households Surveyed		Diarrhea Cases identified	
	Number	Percentage	Number	percentage
Planned settlement				
- Wealthy residential neighborhoods	158	05.2	12	07.6
- Housing estates	352	11.6	31	08.8
- Communal plots	304	10.2	41	13.5
Spontaneous settlement				
- Semi rural neighborhoods	235	07.7	26	13.7
- Peri urban fringes neighborhoods	342	11.3	57	16.3
- Sub-central spontaneous neighborhoods	1 164	38.3	176	18.4
- central spontaneous neighborhoods	479	15.7	94	21.6
Aggregate	3 034	100	437	100

p < 0.05
Source: PERSAN Study

As shown on figure 2, the results of this correlation (where

X^2 calculated (24,13) > X^2 observed (3,84) with p <0.05 at ddl1) demonstrate a direct and positive relationship between neighborhoods that are regularly parceled and equipped with basic services such as water and sanitation and cases of diarrheas in such neighborhoods. To understand these disparities, a socio-geographic examination of each type of habitat was carried out.
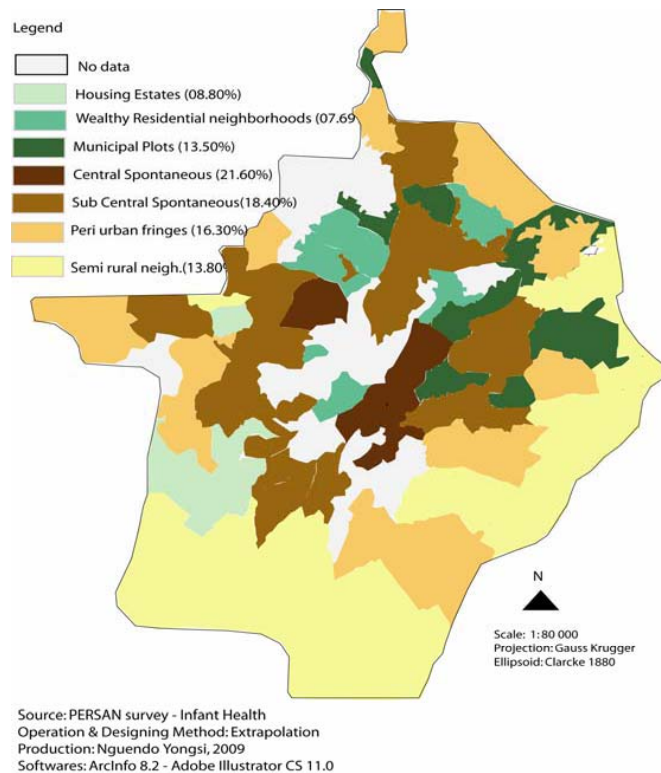

Source: PERSAN survey - Infant Health
Operation & Designing Method: Extrapolation
Production: Nguendo Yongsi, 2009
Softwares: ArcInfo 8.2 - Adobe Illustrator CS 11.0

Fig. 2 Spatial Distribution of Diarrheal Diseases Following Types of Settlement and Neighborhoods

A. Planned settlements: low risks urban areass

With a 19.2% of diarrhea rate, planned settlements have a low diarrheal prevalence as compared to spontaneous settlements. However this 19.2% is merely an observed mean because clear disparities exist within neighborhoods making up this type of settlement as shown in Figure 3.

Wealthy residential neighborhoods, low risks areas of diarrheas (7.6%): Planned neighborhoods have emerged from land given by the state to individuals with a high bargaining power or to property developers to build houses that are within town planning norms. Planned neighborhoods have some common characteristics. They have an orderly layout and with a regulated space occupation. Plots were secured as they all have title. Land parcels are larger, up to 1500 m² allowing its occupants to build spacious houses supplied with electricity and pipe borne water [37]. They have a good sewage system, sealed secondary roads, and domestic waste are daily collected [38]. Structure density of houses is low (40 houses/ha). All these characteristics give the residents better living conditions

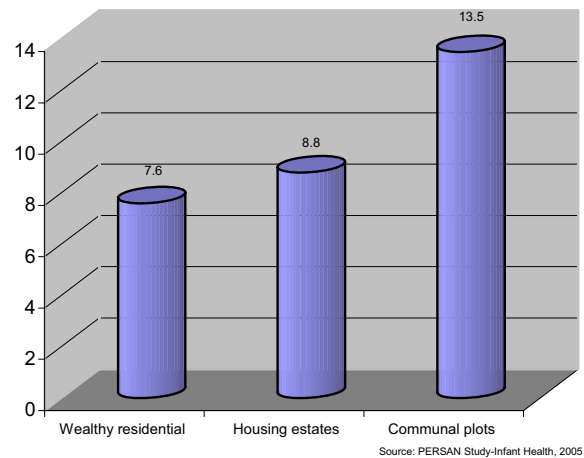which account for the low incidence and prevalence of diarrheal diseases.

Source: PERSAN Study-Infant Health, 2005

Fig. 3 Diarrheas inequalities among planned neighborhoods

Housing estates neighborhoods, moderate risks areas of diarrheas (8.8%): Housing estates are provided by the Cameroon real estate company *"Société Immobilière du Cameroun (SIC)"* and by the ''Mission for the planning and Equipment of Rural and Urban Domains (MAETUR)''. SIC and MAETUR are the two main pillars responsible for the state's current urban land management strategies. They provide housing and land of highly uniform characteristics to the public. MAETUR land parcels have surface dimensions ranging from 300 to 600 m² or more. Houses are built using solid and permanent material such as cement block walls, concrete slabs, corrugated iron sheet or platform roofs, cement or marble material. Houses are often equipped with electricity, self connected piped water and good sewage systems. Some have functioning water purification stations and a network of tarred roads. As a whole, houses are comfortable, well equipped with facilities that result in low risk of infectious diseases, notably those requiring feco-oral transmissions.

Communal plots neighborhoods, high risks areas of diarrheas (13.5%): Despite their classification under planned settlement category, communal plots neighborhoods have a significant high prevalence rate (14.4%). One of the reasons is because over time, city council efforts were limited on land (plots) distribution to urban dwellers, notably to persons displaced from the city center. Thus, land use and management was left to plot owners who build their houses independently from the urban town planning/building rules. This explains the poor quality of houses mostly made with poor quality building materials, resulting in much higher levels of diarrhea where there was weak connection to the drinking water network (12.90%, n=158), lack of adequate sanitation (13.40%, n=158), and a local road network dominated by tertiary level non surfaced roads. Waste and sewage disposal facilities and channeling storm water are also serious problems in these

neighbourhoods. In short, these communal neighborhoods are less hygienic. Diarrheal diseases are more common. They are found in 13.5% of the households, likely to be the result of poor space layout and low level access to basic services resulting in poor quality living environments.

B. Spontaneous settlement: high risk areas (80.8% of the prevalence rate).

Table 2 shows that spontaneous settlement has the highest diarrhea proportion (80.2 %) though prevalence rates are unequal among neighborhoods (Figure 4). This is not surprising as these areas are densely populated, with mostly socially deprived city dwellers who live in precarious conditions: poor sanitation, uncomfortable lodging facilities (an average of 3 persons per room, about 250 houses per ha, unsafe building materials), absence of piped borne water and improved toilets, and crowded houses. These features are directly and indirectly linked to the emergence and amplification of diarrheal diseases in developing countries [39]-[40]-[41]. However, some inequalities have been observed among neighborhoods confirming that even when neighborhoods may be spatially contiguous, they are far from being homogenous in health outcomes [42]-[43]. These spatial disparities between neighborhoods and households result from factors such as space location, date of creation, morphology, land use and land control, population density, level of basic social amenities, income, education levels of mothers, hygiene behavior, etc

Central spontaneous neighborhoods, areas more highly vulnerable to diarrheas (21, 6%): With a surface area of 540.2 ha in 1990, these neighborhoods are made of the former indigenous villages that developed right around the 'European city center' [44]. They are marked by a total occupation of the land for residential uses. Population density is very high, at times 305 inhabitants per square kilometer like in Mvog Ada district. Land occupation mode is compact and irregular. Houses are generally smaller, built with sub-standard materials (e.g.: mud, soft woods, cardboard) and most of them are lacking basic amenities (e.g. schools, clinics, stand pipe water). Like in many developing cities, environment is generally unhealthy [45]. Internal movements are through the highly degraded and poorly maintained tertiary roads. Sewage and water supply networks are old, degraded or inexistent. These conditions are favorable for the rapid development and spread of diarrhea in these areas

Sub central spontaneous neighborhoods, areas slightly highly vulnerable to diarrheas (18. 40%): These neighborhoods have developed around the central spontaneous districts. They extend on more than 1000 ha and have double aspects: (i) They are often located on top of the hills surrounding Yaoundé and their physical aspect is similar to the central spontaneous districts. They are less densely populated, about 200 to 250 inhabitants/ha. Houses are randomly laid out offer poor living conditions particularly overcrowded rooms and poor sanitation. Melen, Elig Effa, Etoa Meki, Anguissa (Emombo), Obili, Mballa are example of these

neighborhoods. (ii) In the outskirts, space is relatively less densely populated. Vacant lands and plots are found between houses. Population density varies between 150 to 200 inhabitants/ha. Concentration of houses, limited access to basic services and poor living condition are common features. Obobogo, Nsam, Etoug Ebe II, and Oyom Abang districts illustrate these neighborhoods

Periurban fringes neighborhoods, spontaneous areas highly vulnerable to diarrhea (16.30%): Peri-urban fringes are transitional areas between the rural setting and the urban environment. Land use is shared between urban and rural activities. The human density is low and varies between 50 to 150 inhabitants/ha. Settlements are dispersed and often lay out along the main (unpaved) road. These neighborhoods have poorly services such drinking. Inhabitants use wells, spring water and communal standpipes which are predisposing factors for the occurrence of the pathogens that cause diarrheal diseases and their prevalence.

Semi rural setting, spontaneous area moderately vulnerable to diarrheas (13.80%): This setting corresponds to suburban villages in their integration process to the urban environment. Their overall morphology shows housing units surrounded with vegetation. This is the case with Ekombitié in the northern part of the city, Febe and Oliga in the North-West, Nkolkoumou in the west, Simbock in the south and Bitotol, Awaé Mvog Manga, Momebelengal and Essessalazok in the Eastern side. These areas are sparsely occupied with few social amenities. Here, houses are found under the vegetation or scattered over the hills. They are made of materials taken from the surrounding natural environment (e.g. mud for the walls, veins and raffia leaves for the roofs). Population density is very low (10-15 inhabitants/ha). In some neighborhoods, home lighting is by means of oil lamps. There are no street lighting. Drinking water is collected from the wells, springs and other natural means. Domestic waste is dumped in the local environment as there is no formal waste collection service. Thus the relative advantage of these semi rural settings related to their low density is annihilated by the absence of clean drinking water supply networks. We believe that diarrheas diagnosed here are due to those shortages.

V. CONCLUSION

Towards an improvement of the urban environment, a good health guarantee

From the above analyses, several lessons can be drawn. From a *conceptual point of view* on the urbanization process, we can state that if the current African urbanization is due to many failures in ongoing policies, it is time to articulate urban policies that strike a balance between socio-economic situations of urban dwellers and cultural local realities. The existence of this gap in African local urbanity was mentioned in Abidjan- Ivory Coast [46]. Moreover, these policies must also extend services in order to reduce disease risks in less equipped districts. In combination with healthy settlements, the adequate distribution of services can reduce the occurrence and diffusion of diseases. From a *methodological point of view*,

analysis of the settlement as a risk factor associated with diarrheas is a proof that a health geographical study at urban districts scale can be relevant in urban settings as whole. Such study is urgently required to disaggregate urban health information into smaller and manageable districts so as to guide local decision making on urban health. This study also illustrates that the phenomenon of uncontrolled growth of developing cities possess far reaching implications for disease occurrence. The contextual level of analysis allows us to show that levels of diarrhea differ across the city. For example, figure 3 shows that diarrheal risk factors and their prevalence vary across the city neighborhoods. From these intra-urban variations, the learning objective is that, contrary to the existing literature on African urban environments, all the poor are seldom at the same risks in an urban neighborhood. In health planning, such knowledge can be useful for setting suitable and effective strategies disease and health intervention strategies that are able to adequately address neighborhood health determinants.

We think that, if willingness and policy commitment exist, we can come over this rapid urbanization that negatively affects city dwellers health. In fact, the study underscores that health risks to which Yaoundé dwellers are exposed have social determinants. Solutions geared towards improving population health must take into account the critical importance of the provision of basic urban infrastructure like quality housing, access to water and sanitation.

From our field observations, four constraints curtail the city's future development: (a) the demography whose rapid growth attenuates urban authorities' efforts to meet the need of a growing population; (b) the fact that land tenure is not clearly defined and consequently prevents individuals as well as local authorities from developing urban infrastructure; (c) the absence of a urban development policy; and (d) lack of vision, of funding and of implementation. Thus, to develop a coherent management of developing country cities, policy makers must take into consideration the following two main aspects: (i) developing appropriate town planning responses (clear land tenure regulation, formulation and implementation of a housing policy and standard, upgrading existing spontaneous settlements), and (ii) involving city-dwellers in the daily management of their city

Finally, it must be emphasized that as a short- and medium-term measure, the physical features of the city environment are major determinants of urban dwellers' health. The relevant features of the urban-human habitat such as access to safe drinking water and sanitation contribute to the explanation of the occurrence and proliferation of pathogens and vectors associated with the infectious and parasitic diseases including diarrheal diseases. Environmental upgrading and improvement in terms of adequate provision of these facilities is therefore capable of creating conditions for a dramatic reduction in morbidity and mortality due to infectious diseases as witnessed in the late 19th and early 20th for developed nations [47].

REFERENCES

[1] United Nations. 1995. World Urbanization Prospects: The 1994 Revision. New York.
[2] United Nations Population Fund (UNPF). 2007. State of world population 2007- Unleashing the potential of urban growth. [Accessed
[3] UN-Habitat. 2004. The State of the World's Cities, globalization and Urban Culture. UN-Habitat/Earthscan and Unicef.
[4] R. Sietchiping, Geographic information systems and cellular automatabased model of informal settlement growth, PhD Dissertation, School of Anthropology, Geography and Environmental Studies, University of Melbourne, 2003.
[5] S.A. Bashir, ''Home is where the harm is: inadequate housing as a public health crisis'', American Journal of Public Health, vol. 92, no 5, pp. 733–738, 2002.
[6] C. Peralta. 2006. Rapid urban growth threatens African cities. [Accessed March 28, 2008 at http://wwww.planetizen.com.
[7] Communauté Urbaine de Yaoundé, Yaoundé, une ville en plein essor. Yaoundé: Imprimerie nationale, 2002.
[8] H.B. Nguendo Yongsi .2000. Urbanization and communicable diseases in Cameroon. University of Paris X-France, Msc thesis.
[9] S.A. Esrey, ''Water, waste, and well-being: a multicountry study'', American Journal of Epidemiology no143, pp 608–623, 1996.
[10] H. Frumkin, ''Cities, suburbs, and urban sprawl: their impact on health'', in N. Freudenberg, S. Galea, D. Vlahov (eds), Cities and the health of the public, Vanderbilt university press, pp. 143-175, 2006.
[11] J. Hardoy, S. Cairncross, D. Satterthwaite. 1990. The Poor Die Young. London: Earthscan Publications Ltd.
[12] T. Harpham, M. Tanner, Urban health in developing countries: progress and prospects, Earthscan Publications, London, 1995.
[13] S.Cairncross, D.O.Neill, A. McCOY, Health, environment and the burden of disease: a guidance note, Department for International Development, 2003.
[14] UN-HABITAT, Meeting development goals in small urban centers: Water and sanitation in the world's cities, Earthscan Publication, London 2006.
[15] A. Pruss, D. Kay , J. Fewtrell, J. Bartram, ''Estimating the burden of disease from water, sanitation, and hygiene at the global level'', Environmental Health Perspectives, vol. 110, no 5, pp. 537-542, 2002.
[16] S. Cairncross, ''Health Impacts in Developing Countries: New evidence and new prospects'', Journal of the Institution of Water and Environmental Management, vol. 4, pp. 6571 – 6577, 1990.
[17] M. Black, B. Fawcett, The Last Taboo: Opening the Door on the Global Sanitation Crisis, Earthscan publications, 2008.
[18] H.B. Nguendo Yongsi, B.K. Delali Dovie. 2006. 'Diarrheal diseases in the history of public health', Archives of Medical Research, 38: 159-163.
[19] J. K.Tumwine, J. Thompson, M. Katua-Katua, M. Muiwajuzi, I. Johnson Porras, Diarrhea and effects of different water sources, sanitation and hygiene behavior in East Africa, Trop Med Int Health, vol. 7, no 9, pp. 750-756, 2002.
[20] I. Kawachi, L.F. Berkman, ''Neighbourhoods and Health'', New York: Oxford University Press Inc, 2003.
[21] T.A. Laveist, J. M. Wallace, ''Health risk and inequitable distribution of liquor stores in African American neighbourhood'', Social Science and Medicine, vol. 51, pp. 613–617, 2000.
[22] A. Duany, E. Plater-Zyberk, R. Alminana. 2003. New Civic Art: Elements of Town Planning. Rizzoli International Publications, Inc.
[23] World Health Organization. 2007. The world health report 2007. A safer future.[Accessed 25th August at http://www.who.int/whr/2007/en/index.html].
[24] A.H. Baqui, R.E. Black, M. Yunus, A.R. Hoque, H.R. Chowdhury, R.B. Sack. 1991. 'Methodological issues in diarrhoeal disease epidemiology: definition of diarrhoeal episodes', International Journal of Epidemiology 20:1057-1063.

[25] J. Gascon, M. Vargas, D. Schellenberger and al., ''Diarrhoea in children under 5 years of age from Ifakara,Tanzania: a case-control study'', J. Clin. Microbiol. Vol. 38, pp 4459-4462, 2000.

[26] K. Molbak, N. Wested, N. Hjlying and al., ''The aetiology of early childhood diarrhoea: a community study from Guinea-Bissau'', J. Inf. Dis., vol. 169, pp. 581-587, 1994.

[27] National Institute of Statistics. (2007) CAVIE : Enquête sur le cadre de vie des populations de Yaoundé et Douala. [Accessed 27th August at http://www.statistics-cameroon.org].

[28] E. Mveng. 1963. Histoire du Cameroun. Paris : Présence Africaine

[29] J.M. Essomba. 1992. Civilisation du fer et sociétés en Afrique centrale. Paris: l'Harmattan.

[30] G.C. Medou. 1973. Yaoundé à l'époque coloniale (1887-1960). Essai de monographie urbaine. University of Yaoundé, department of geography, MA thesis.

[31] F.P. Akongwie. 1999. Spontaneous settlements in marshy areas around Yaoundé: case study of Mfandena quarters. The University of Yaoundé I, department of geography, Bachelor degree dissertation.

[32] E. Tazo. 1988. Le tissu spontané de Yaoundé. Dynamique spatiale, dégradation de l'environnement urbain et recherche de solutions. Liège : Département des sciences géographiques, Doctorat NR.

[33] R.K. Mukoro. 1990. Housing in Biyem Assi I & II. University of Yaoundé, Department of geography, DIPES II Dissertation.

[34] R.E. Stren, R. W.Rodney. 1998. African Cities in Crisis: Managing Urban Growth. Boulder, Colorado, Westview Press.

[35] G. Salem. 'Les Problèmes de santé dans les villes : une urgence négligée', Médecine Tropicale 59 : 31-33, 1999.

[36] G. Mcgranaham, J. Songsore, ''Wealth, Health and the Urban Household''. Environment, vol. 36, no 6, pp 4–11 and 40–45, 1994.

[37] J. Doumé Yondo. 1983. Étude géographique d'un quartier chic de Yaoundé : Bastos. Université de Yaoundé, Departement de geographie, MA thesis.

[38] R. Zo'o Eyindanga. 1992. Le niveau d'équipements en voies et réseaux divers à Yaoundé (Cameroun). Université Michel de Montaigne-Bordeaux III, PhD Dissertation.

[39] A.C.Yeager Beth, C.F. Lanata, F. Lazo F. et al. 'Transmission factors and socio-economic status as determinants of diarrhoeal incidence in Lima, Peru', Journal of Diarrhoeal Diseases and Research 9 (3):186-193, 1999.

[40] M.N. Manun'ebo, P.A. Haggerty, M. Kalengaie et al. 'Influence of demographic, socio-economic and environmental variables on childhood diarrhoea in a rural area of Zaire', Journal of tropical Medicine and Hygiene 97: 31-38, 1994

[41] E. Messou. 'Water supply, excrement disposal and diarrhoeal diseases in rural zones of Ivory Coast', Medecine Tropicale 55: 225-230, 1995.

[42] J. Thomson, U. Goswami. 2003. 'The effect of neighborhood density on phonological awareness in dyslexic and normally-developing readers'. Poster presented at First Workshop of the Centre for Human Communication, 7 April, UCL, London, UK

[43] C.E. Ross, J. Mirowsky. 'Neighborhood disadvantage, disorder, and health', Journal of Health and Social Behavior 42:258-76, 2001.

[44] L. Abah. 1990. Étude d'aménagement de Mvog Ada et de Nkolndongo. Université de Yaoundé, Department de geographie, MA thesis.

[45] S. Huttly. 2002. The Impact of Inadequate Sanitary Conditions on Health in Developing Countries. London, London School of Hygiene and Tropical Medicine, Maternal and Child Epidemiology Unit.

[46] R. Blary. 'Urbanité et quartiers précaires', Revue canadienne d'études du développement 26 (1) : 55-87, 2000.

[47] D. N. Valhov, F. Freudberg, D. Proietti, A. Ompad, .Quinni, V. Nandi and S. Galea. 'Urban as a Determinant of Health', Journal of Urban Health 84(3), 2007.

H.B. Nguendo Yongsi earned his Bachelor in Education at Laurentian University (Sudbury-Canada), his M.sc. at the University of Paris X (Paris-France), and his PhD at the same institution in 2004. He has a longstanding interest in Developmnt geographies at the local and micro-scales. Given this interest, it seemed natural to him that he would become interested in questions of health and the body, since public health is a major part of local government in Developing countries. His work in health geography has focused on communicable diseases. Empirically, he has focused on the spatial dsparities of diarheal diseases in Tropical urban settings. Nguendo Yongsi teaches classes in Epidemiology, biostatistics, health geography, and canadian studies. Nguendo Yongsi may be contacted at blaise_nguendo-yongsi@uqac.ca