UNU-IAS Working Paper No. 114

A Preliminary Integrated Assessment of Urban Environmental Health in Uganda: A Case of Malaria and Diarrhoeal Diseases in Kampala

Patrick Buyinza

February 2004
Abstract

Kampala city is not only an engine of national development but also a major source of environmental health hazards in Uganda. This is ascribed to a lack of sustainable policies for enhancing the quality of urban ecosystems and protecting human health. Rapid growth of population coupled with declining resources in this city has led to a deterioration of social and biophysical infrastructure services. Environmental conditions favorable for transmission of infectious and parasitic diseases have also emerged. Of these diseases, malaria and diarrhoea account for more than 40 per cent of hospital-based morbidity cases. Ill-health is aggravated by a lack of sound knowledge of urban ecology and environmental hygiene.

This paper is an attempt to assess the urban environmental health challenge in Kampala with a view to informing decision-making and integrated policy development for delivering health care. An evidence-based ecosystems approach (EA) is adopted because it is the only currently available way for organizing and assessing the complex interplay between health, environment and development. This reveals all the important and possible entry points for developing adequate policy strategies and synergies among health interventions. GIS analysis of the impact of urbanization on land use and cover, and a baseline epidemiological survey of malaria and diarrhoeal diseases conducted in Kampala helped establish the available evidence.

It seems evident that adopting integrated policy responses for delivering health care could prevent the burden of environment health in Kampala, Uganda.

Keywords: Urban ecology & income; Health; Malaria & diarrhoea; Ecosystems assessment; Policy responses
1. Introduction

Kampala is a low-income capital city of Uganda (UNDP, 2001; Population Reference Bureau, 2001). This city has experienced rapid population growth since 1960s due to rural-urban migration and nature increase (United Nations, 2001; Kampala Urban Study, 1993). This growth is also demographic rather than economic because it has not been accompanied with significant transformations in agricultural productivity and industrialization (Escallier, 1988; Clarke, 1993; Gould, 1998).

The burden of environmental health in Kampala is characterized by tropical, infectious and parasitic diseases (Brinkman, 1994; WHO/EHG/97.12, 1997). Of the tropical diseases, malaria is the most persistent and greatest health threat to the city (Murray and Lopez, 1994; World Bank, 1994). Malaria is caused largely by *Plasmodium falciparum*. This is the parasitic species associated with the most severe and fatal form of malaria (Najera *et al.*, 1998; Roberts *et al.*, 1997). Children and women in their first pregnancy are the most vulnerable to malaria (WHO, 1997).

Malaria accounts for over 30 per cent of hospital-based mortality cases in Kampala (Ministry of Health, Uganda, 2001). Malaria-causing parasites are increasingly becoming resistant to anti-malarial drugs such as choloquine and insecticides such as DDT as a result of genetic mutation (Sharma, 1996; Oaks *et al.*, 1991; Kidson and Indaratna, 1998).

Mosquitoes have also successfully adapted to urban ecosystems from their natural habitats. These vectors breed in water containers of urban households, solid waste dumpsites, impeded road drainage, water channels or open sewer systems (Najera *et al.*, 1998; McMichael, 1999).
Mosquitoes and other pests such as houseflies, cockroaches and rats thrive under a tropical climate (Gallup et al., 1998; Ministry of Health, Uganda, 2001).

The burden of malaria is exacerbated by diarrhoeal diseases that are associated with unsanitary environmental conditions of un-planned settlements in the city (Smith and Lee, 1993; Omran, 1971). Exposure of these households to environmental health risks arises because the provision of basic infrastructure and environmental services has not kept pace with rapid population growth (Rakodi, 1997; McGranahan et al., 2001). Crowded and squalid housing conditions in these settlements facilitate oral-faecal contamination of food and water. This causes diarrhoeal diseases, especially where there is a lack of good environmental hygiene (WHO, 1997; Miyagishima et al., 1998; McMichael, 1999). The city also lacks adequate policies to promote environmental health and safety (Canada, HHIP, 1999). This has created favorable health and environmental pathways for infectious and parasitic diseases (Gupta Dev., 2001).

The burden of environmental health is compounded a lack of sustainable policy frameworks to promote the integration of health concerns and safeguards in policies, development projects and programs in the different sectors of central and local governments. This has helped exclude environmental health from being an integrated policy determinant (Listorti, 1996). Yet the activities of these sectors directly influence health outcomes (WHO, 1997).

In addition, there is a lack of adequate knowledge of urban ecosystems and disease-cause-effect relations (Tukahirwa, 1992; WHO, 1997). To-date urban ecosystems are hardly studied (Collins et al., 2000). The relation between health and environment is also extremely complex (McMicheal, 1999; WHO, 1997). Hence, paucity of information has constrained
rational decision-making and sound urban ecosystem management in Kampala (UNEP/World Bank/World Resources Institute, 2000).

Consequently, basic health indicators in the city are appalling. Infant mortality is estimated at 120 per 1,000 live births, more than 45 per cent of the children (0 - 14 years) are stunted or undernourished, and life expectancy is 46 and 49 years for men and women respectively (Ministry of Health, Uganda, 1992).

In view of these indicators, environmental health in Kampala should be improved. The world is increasingly urbanizing (UN, 2001). As such, Kampala is expected to attract migrants from rural and other urban areas of Uganda because it provides agglomeration economies to enterprises and businesses (Fuchs, 1994; Rakodi, 1997; Fugita et al., 1999). Thus, improved health could stimulate economic productivity of the city (Pollitt et al., 1993).

At the same time, Kampala’s production, consumption and waste generation systems will correspondingly impact on human health and well being (Hough, 1990; Folke et al., 1997; McGranahan et al., 1999). This is because sustaining urban populations and good environmental health depends on continued productivity and functioning of ecosystems in the city-region and beyond (McMichael, 1999; Atkinson et al., 1996; Samuel et al., 1991).

This paper is an attempt to inform decision-making and integrated policy development for delivering health care. This will be achieved through assessing the interplay between health, environment and development or ecosystems approach (OECD, 1993). This provides a unique opportunity for revealing and highlighting all the important interactions and possible entry points for public health policy interventions and strategies (WHO, 1997). The evidence
base for the assessment was established through a geographical information system (GIS) and an epidemiologic survey of malaria and diarrhoeal diseases in Kampala, Uganda. This evidence has helped develop a deep and broad understanding of Kampala’s urban health and ecology (Breeze *et al*., 2001).

The paper is divided into five sections. Section two provides two conceptual frameworks or models for understanding the environmental health challenge in Kampala. These models suggest that Kampala city is still in the early stages of development. As such, infectious and parasitic diseases dominate the burden of urban environmental health. The ecosystems approach (EA) adopted for assessing the urban environmental health challenge along with the evidence base are described in section three. It is argued that EA is currently the most effective method that can help develop adequate integrated policy strategies for delivering health care. Preliminary evidence and discussions are presented in section four. Finally, some conclusions and policy recommendations are provided in section five.

2. **Conceptual Frameworks**

There are two conceptual frameworks (or models) for understanding the urban environmental health challenges in Kampala.

2.1 **Environmental Transition Theory**

This model describes the dynamic relationship between wealth (or income per capita) and environmental performance as human society is developed (Kuznets, 1955; McGranahan *et al*., 2001). It suggests that wealth (in terms of GDP) could be used to predict the environmental performance of cities (Kuznets, 1955; McGranahan *et al*., 2001). According to Kuznets (1955), for instance, the urban environmental problems worsen with the early
phases of industrialization and thereafter lessen with increased wealth. The Environmental Kuznets Curves (EKC) hypothesis is, in essence, empirical and predicts an inverted-U relationship between environmental damage and income per capita, plotted in two dimensions (Kuznets, 1955).

Concomitantly, McGranahan et al., (2001) claimed that urban environmental burdens tend to be more dispersed and delayed in more affluent settings. Dividing cities into three income categories, they argue that the dominant environmental challenges in low-income cities are localized, immediate and health threatening. These challenges are largely related to household and neighborhood issues. Such issues constitute a significant portion of the “brown agenda”, especially in Africa. The brown agenda encompasses lack of safe water supply, inferior sanitation, solid waste accumulation, inadequate quality of housing, and occupation and degradation of ecologically fragile ecosystems and the interrelationships between these problems (Marcotullio, 2001; WHO, 1997; Listorti, 1996; World Bank, 1994).

The brown agenda issues decline in importance with increasing affluence but only to be replaced by those associated with rapid industrialization, such as SO2 emissions. The curve for SO2 assumes the “inverted U-shape” of the EKC (Kuznets, 1955). This relationship describes the decreasing environmental quality associated with rapid development, followed by increasing environmental quality, once some turning point is reached. The turning point is attained when effective environmental regulations and compliance monitoring systems are institutionalized, for example, in Japan (Sawa, 1997). In other words, the wealthy use more resources and create more waste, but also use part of their wealth to avoid personal exposure to unpleasant and hazardous pollutants (Kjellen and McGranahan, 1998).
Finally, environmental challenges in affluent cities are replaced by consumption-related burdens such as CO$_2$ emissions and waste production (McGranahan et al., 2001). Increased CO$_2$ emissions within cities are the partial result of a spectacular increase in automobile ownership and usage (McMichael 1999; Marcotullio, 2001). Waste production is closely associated with urban lifestyles and increased consumption on almost all levels. When these curves are overlaid one upon another they describe the relationships defined by the urban environmental transition (Marcotullio, 2001).

Since the relationships between affluence and urban environmental challenges are not straightforward, two key issues are worth mentioning (McGranahan et al., 2001). First, the urban environmental transition model reflects predisposing rather than predetermined outcomes. Second, affluence is only one factor, among many, impacting the environmental conditions in cities. Some cities, for instance, are better managed than others. Thus, all cities at the same income level do not experience the same levels of environmental degradation.

Consequently, environmental burdens are seen as the unintended consequences of human activity and the complex interplay of physical and socio-economic systems as opposed to the reflection of human preferences at different levels of development. The poor do not prefer environmentally degraded environments to better environments; rather their environmental conditions are unwanted outcomes of their everyday activities and the institutions that define their societies. While affluence affects the environmental quality of a city, there are political and social influences that play an important role (Marcotullio, 2001).
2.2 Epidemiological (or Risk) Transition Theory

This model articulates the complex change in patterns of health and disease. It also describes the interactions between these patterns, and their demographic and socio-economic determinants and consequences (Omran, 1971; Omran, 1982; Smith and Lee, 1993; Smith, 1997). It is based on five propositions.

1. Mortality is a fundamental factor in population dynamics. Using available data on England and Wales in the middle of the eighteenth century, cyclic rises and falls in population size were observed. The initial period of sustained population growth corresponded with two decisive changes in the death rate. First, the fluctuations in mortality became less frequent and less drastic. Second, the initial-slow and sometimes imperceptible decline in mortality gradually gained momentum and eventually stabilized at relatively low levels in the twentieth century.

2. During the transition, a long-term shift occurs in morbidity and disease patterns where the pandemics of infections are gradually displaced by degenerative and man-made diseases as the chief form of morbidity and primary cause of death. The degenerative diseases include radiation injury, mental illness, drug dependence, traffic accidents, occupational hazards and cardio-vascular (Omran, 1982), and adult diabetes and obesity (McMichael, 1999).

Typically, mortality patterns distinguish three major successive stages of the epidemiological transition. First, the age of pestilence and famine when mortality is high and fluctuating, thus precluding sustained population growth. In this stage, the average life expectancy at birth is low and variable, vacillating between 20 and 40 years. This stage, which is an extension of
the pre-modern or medieval pattern of health and disease, the major determinants of death are epidemics of infectious and parasitic diseases (such as tuberculosis and diarrhoea), famines, wars or “positive checks” Malthus (1960).

Second, the age of receding pandemics when mortality declines progressively, and the rate of decline accelerates, as epidemic peaks become less frequent or disappear. The average life expectancy at birth increases steadily from about 30 to about 50 years. Population growth is sustained and begins to describe an exponential curve.

Third, the age of degenerative and man-made diseases when mortality continues to decline and eventually approaches stability at a relatively low level. The average life expectancy at birth rises gradually until it exceeds 50 years. It is during this stage that fertility becomes the crucial factor in population growth.

3. During the epidemiological transition, the most profound changes in the health and disease patterns obtain among the children and women. The genuine improvements in survivorship that occur with the recession of pandemics are peculiarly beneficial to children of both sexes and to the females in the adolescent and reproductive age periods, probably because the susceptibility of these groups to infectious and deficiency diseases is relatively high. Child survival is significantly and progressively improved as pandemics recede in response to better living standards, advances in nutrition and early sanitation measures and is further enhanced as modern public measures become available.

4. The shifts in health and disease patterns characterizing the epidemiologic transition are closely associated with the demographic and socio-economic transition constituting the
modernization complex (or global economic growth and modernization). The decline in mortality that comes with the epidemiologic transition widens the “demographic gap” between birth rates and death rates and hence affects demographic change by bolstering the population growth. In a more subtle manner, the mortality transition affects demographic movements indirectly through its impact on fertility and population composition.

5. Peculiar variations in the pattern, place, determinants and the consequences of population change differentiate three basic models of the epidemiologic transition: Classic (or Western), Accelerated, and Contemporary (or Delayed). These distinctive core models help visualize the different matrices of determinants and the consequences associated with mortality (and fertility) patterns, and elucidate some of the fundamental population and health issues confronting policy-makers.

The classical model describes the gradual, progressive transition from high mortality (above 30 per 1,000 population) and high fertility (above 40 per 1,000) to low mortality (less than 10 per 1,000) and low fertility (less than 20 per 1,000) that accompanied the process of modernization in the most western European societies.

The accelerated model describes the accelerated mortality transition that occurred most notably in Japan in which the period taken for mortality to reach the 10 per 1,000 level was much shorter than that for the classical model.

The contemporary model describes the relatively recent and yet-to-be completed transition of most developing countries. Although slow, unsteady decline in mortality began in some of these countries shortly after the turn of the century, rapid and truly substantial declines in mortality have been registered only after World War II. Public health measures have been a
major component of the imported, internationally sponsored medical package that has played a decisive role in setting the stage for astronomic population growth in these economically handicapped countries. Thus, these programs have successfully manipulated mortality downward while leaving fertility at substantially high level.

Despite unmistakable gains in the survival of women and children, infant and childhood mortality remains excessively high in most of these countries and in some, females of reproductive age continue to have higher mortality risks than males in the same age group. Although, most countries in Latin America, Africa and Asia fit this model, important differences exist.

However, the theory of epidemiologic transition Omran (1971; 1982) postulated is contested. The ascription of the nineteenth century Western mortality decline to eco-biologic and socio-economic factors undermined the role of medical technology. According to Caldwell (2001), for example, over 65 per cent of total mortality decline between 1800 and 1871 in England and Wales, and 54 per cent in Sweden were most probably due to the reduction of infectious diseases. The decline in mortality in this period was largely propelled by improvements in personal hygiene, water treatment, provision of sanitation services, disposal of waste, and effective enforcement of laws against overcrowding. Besides, antiseptics and pasteurization, especially in the form of the home boiling of milk for babies, were introduced towards the end of the century. While medical doctors could have had only limited curative powers, they gave leadership in improving hygiene, midwifery training and childcare (Caldwell, 2001).
Further, there was little evidence that nutrition improved in Europe. Instead, the modest decline in mortality in the 18th-century was probably due to more effective government action to reduce famine peaks (Flinn, 1974).

Finally, the three basic models of the epidemiological transition fail to grasp the global nature and the historical sequence of the mortality transition as it spread. It is possible there could be as many models as societies (Caldwell, 2001; Dalla Zuanna, 1996). These models also underestimate the flow around the world of ideas, behavioral models, education systems, public health approaches and medical technologies (Caldwell, 2001).

3. Methodology

3.1 Introduction

The development of adequate policy strategies for delivering health care requires a holistic assessment of the relationship between health, environment and development or the ecosystems approach (OECD, 1993; WHO, 1997). This assessment draws upon different data resources and techniques in order to develop a credible evidence base (Breeze et al., 2001). In this study, geographical Information system (GIS) and a baseline survey were used to establish the evidence base.

3.2 Assessing Environmental Health through an Ecosystems Approach

Urban environmental health is influenced by policies and programs of the local and central governments in Kampala (OECD, 1993). These policies determine trends in economic development, consumption patterns and population growth. They also determine the provision of basic social and infrastructure services through the implementing ministries,
departments or sectors. Hence, these policies or “driving forces” create conditions in which environmental hazards can develop or be averted.

At the same time, government policies impose “pressure” on urban ecosystem goods and services in such forms as waste from human settlements, manufacturing or transportation. These pressures lead to changes in the “state” of the urban environment, as seen when land use changes during urbanization or when discharges of untreated domestic waste and industrial effluents in water, air or soil occurs.

These changes in the urban ecosystem have an impact on human health and well-being depending on the degree of “exposure” to the environmental hazards. Exposure refers to the interaction between people and the environmental hazards. This interaction leads to a “dose” or the quantity of hazards actually absorbed by the human body.

This dose can lead to health effects through interacting with the genetic factors in causing disease. In this context, the ecosystems approach aims at highlighting the important links between different aspects of development, environment and health, and identifying effective strategies and actions to control and prevent adverse health effects (WHO, 1997).

3.3 Building an Evidence Base through GIS Analysis of the Impact of Urbanization on Land Use and Cover

Geographical Information System (GIS) provides a mechanism for integrating different data sets, analyzing the statistical and spatial components and modeling possible scenarios to support development planning (Business Trust, 2001). In this study, digital land use and cover maps of 1967 and 1997 for Kampala city were developed in PC Arc/Info GIS environment by digitizing the overlay transparencies, editing errors (such as arcs, overshoots,
undershoots, dangles), adding polygon labels, transforming the coordinates to Universal Transverse Mercator (UTM) system, and establishing polygon topology (Arc/Info, ESRI, 1992). This made the multi-temporal GIS layers compatible for overlay functions to be performed. These layers were exported to Arcview GIS environment for quick displays and spatial analysis of land use and cover change accompanying the urbanization process in Kampala.

In Arcview, the digital layers were overlaid with the administrative layer of Kampala city and map compositions developed. The polygon attribute table (or database file) of each layer was used to generate aggregated areas of land use and cover classes by a “summation” function. In this way, the land use and cover change between 1967 and 1997 of Kampala city was detected.

3.4 Building an Evidence Base through Conducting an Epidemiologic Survey of Malaria and Diarrhoeal Diseases

A baseline survey of the epidemiology of malaria and diarrhoeal diseases was conducted in Kampala with a view to collecting primary data on disease incidence, vector entomology, land use and cover, knowledge, behavior and practices of households (Appendix I). The predictions of malaria and diarrhoeal disease incidences in the survey were correspondingly based on the conceptual framework advocated by Martens et al., 1999 and Gupta Dev, 2000.

This baseline survey used a cluster (or area) random sampling technique. This was necessary because the urban population in Kampala is differentiated into high- and low-cluster categories (Rakodi, 1997). Planned settlements and unplanned dwellings (slums and shanty houses) in part reflect such socio-economic polarization.
As such, within each category of the (accessible) sample population, there was more homogeneity than across the theoretical population as a whole. Thus, clustering helped improve the statistical precision of the survey because of less-variance within the sub-groups of the sample population. This could strengthen the validity of the survey through effective translation of the theoretical constructs or concepts into legitimate inferences or conclusions.

In addition, cluster sampling allowed a comparative analysis in the provision of basic urban services between planned and unplanned settlements. This analysis helped establish the cause-effect relationship between basic urban services and determinants of environmental health. It also highlighted the differential provision of basic urban services between the rich and the poor settlements.

In each category of urban settlement or cluster, a random selection (randomized or true experiment) design technique was employed to assign a questionnaire to 100 households. Random assignment was justified because it provided an equal probability to each household in the sub-sample or cluster of being selected. This resulted in the sampled households being representative of the population in the respective clusters. It was also assumed that random sampling was more accurate and rigorous than its non-probabilistic counterpart. A total sample size of 200 households was used in the survey.

Finally, a questionnaire was used in the survey because it is a relatively inexpensive instrument. The response rate of the questionnaire was high (100 per cent) and allowed the researcher to evaluate the quality of response (Trochim, 1985; 2002).
4. Results and Discussions

A discussion of the available evidence aims at informing and influencing subsequent adequate health policy development for delivering health care in Kampala.

4.1 Improving Urban Land Management for Better Environmental Health

Available GIS evidence in Table 1 shows that in 1967, 6.22 per cent (12.25 Km$^2$) of Kampala’s total area was covered by a wetland ecosystem compared with 7.37 per cent (14.37 Km$^2$) in 1997. While agricultural land accounted for 62.01 per cent (122.12 Km$^2$) in 1967, it fell to 37.67 per cent (70.27 Km$^2$) in 1997. In the same period, the built-up area rose from 16.53 per cent (32.56 Km$^2$) to 41.37 per cent (81.50 Km$^2$).

Table 1: Impact of Urbanization on Land Use and Land Cover in Kampala (1967–1997)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest vegetation</td>
<td>5.52</td>
<td>2.80</td>
<td>5.22</td>
<td>2.65</td>
<td>-0.15</td>
</tr>
<tr>
<td>Grassland</td>
<td>7.95</td>
<td>4.03</td>
<td>8.46</td>
<td>4.29</td>
<td>0.26</td>
</tr>
<tr>
<td>Wetland</td>
<td>12.25</td>
<td>6.22</td>
<td>14.52</td>
<td>7.37</td>
<td>1.15</td>
</tr>
<tr>
<td>Agriculture</td>
<td>122.15</td>
<td>62.01</td>
<td>70.27</td>
<td>35.67</td>
<td>-26.34</td>
</tr>
<tr>
<td>Built-up area</td>
<td>32.56</td>
<td>16.53</td>
<td>81.50</td>
<td>41.37</td>
<td>24.85</td>
</tr>
<tr>
<td>Open water (Lake Victoria)</td>
<td>16.57</td>
<td>8.41</td>
<td>16.85</td>
<td>8.55</td>
<td>0.14</td>
</tr>
<tr>
<td>Impediments</td>
<td>0.00</td>
<td>0.00</td>
<td>0.19</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>197.00</strong></td>
<td><strong>100.00</strong></td>
<td><strong>197.00</strong></td>
<td><strong>100.00</strong></td>
<td><strong>0.00</strong></td>
</tr>
</tbody>
</table>

The analysis of land use and cover has important implications for the provision of basic infrastructure services and delivering health care in Kampala. Land cover, for instance, a wetland ecosystem provides a natural habitat for malaria-carrying mosquitoes in a tropical climate (Manson, 1898). Thus, urban households located in close proximity to wetlands are likely to be more exposed to malaria vectors than their distant counterparts (see Figure 1). It may also suggest that household sanitation facilities should be hygienically sound if the
burden of diarrhoeal diseases is to be prevented. In this respect, improved land management of Kampala is crucial to the prevention and control of the burdens of malaria and diarrhoeal diseases.

**Figure 1: Water and Wetland Ecosystems that Provide a Natural Habitat for Water-Borne Diseases, Especially Malaria and Diarrhea**

![Map of Kampala](image)

Improved land management in the city could be achieved through equipping the available agricultural land (70 Km$^2$) with basic infrastructure such as water and sewer systems, drainage, electricity and access roads (Kidokoro, 2000). Once developed, this land could be leased to the public for residential, industrial and commercial development. This strategy has the advantage of lowering the initial investments costs and allowing low-income residents to make incremental development when financial resources become available. It could also facilitate the universal phenomenon of urbanization (Yokoyama et al. 1999). It is also a sound strategy for preventing the burden of environmental health because as much as 44 per cent of the burden of disease is amendable to investments in urban infrastructure and services (Listorti, 1996).
In order to accelerate the process of converting agricultural land to built-up area in Kampala, it may be necessary to levy property in agricultural areas in the same manner as in the
residential settlements. Hence, promoting a switch to a more urban type of land use (Kidokoro, 2000). This strategy help streamline land administration in Kampala by bringing forward un-developed land for development, re-development or densification, and guiding future developments. It could also help control the illegal occupation and expansion of spontaneous settlements into wetland ecosystems. Hence, prevent or reduce the burdens of malaria and diarrhoeal diseases. Besides, the planned road network in the new areas could improve the provision of environmental services for solid waste collection, transportation and safe disposal.

Ultimately, Kampala city needs an integrated land information system with adequate capacity for feedback and scenario modeling interfaces based on a GIS planning (Acioly, 2001). This system could be designed to capture primary data, integrate and analyze, and reliably report on all elements of the ecosystem approach (OECD, 1993). In this respect, improved urban land management could play an important role in the prevention of the burden of environmental health in Kampala.

4.2 The Role of Women in Promoting Environmental Health

As presented in Table 2, males and females in the survey accounted for 44.40 and 55.60 per cent, and 36.20 and 63.80 per cent of the residents in planned and unplanned settlements respectively. On average, females accounted for 59.6 per cent of the accessible (sample) population in Kampala.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>44.40</td>
<td>36.20</td>
</tr>
<tr>
<td>Females</td>
<td>55.60</td>
<td>63.80</td>
</tr>
<tr>
<td>Total</td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
A high proportion of females have strategic implications for integrated health policy development and action. Females, particularly women play key roles in homes with respect to the basic living conditions. These include maintaining household hygiene and sanitation, solid waste collection and disposal, and provision of safe water and food to the family (WHO, 1997). If women gained access to good environmental hygiene education, it could be one of the effective means of preventing the burdens of diarrhoeal diseases such as cholera and typhoid fever in household environments (US Department of Health and Human Services, 1980). Access of women, for example, to family planning services and other reproductive programs, could assist them in avoiding unwanted or unplanned pregnancies. This is does not only help control rapid population growth but also improves their health and well being.

In addition, engaging women in identifying and prioritizing key environmental problems in their households and neighborhoods could be effective in preparing and implementing action plans. In do doing, broad-based and effective public participation of women in decision-making processes that affect their daily life is also promoted (UNCHS, 1995). This also empowers women so that they own the responsibility for delivering health care. Hence, sustaining public health policy interventions (WHO, 1997).

In view of the important roles they play in managing household environments, and the fact that they out number men, it is suggested that health policy strategies should target women if the burden of environmental health is to be effectively prevented in Kampala.
4.3 Adequate and Safe Water Supplies are Key to Health Promotion

As shown in Table 3, about 95.7 per cent of the respondents in wealthier households compared with 80 per cent of their counterparts in slum dwellings were reached by the water supply system in Kampala.

Table 3: The Distribution and Quality of Urban Water Supply Systems

<table>
<thead>
<tr>
<th>Water source</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped-borne</td>
<td>95.70</td>
<td>80.00</td>
</tr>
<tr>
<td>Well</td>
<td>3.30</td>
<td>14.30</td>
</tr>
<tr>
<td>Pipe-borne and well</td>
<td>1.10</td>
<td>5.70</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Water safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe</td>
<td>6.50</td>
<td>3.80</td>
</tr>
<tr>
<td>Not safe</td>
<td>93.5</td>
<td>96.20</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

In both settlements, 87.1 per cent of the respondents reported piped water as the primary water supply system. The wealthy households have access to in-house piping while the low-income areas of the city rely on public standpipes as their drinking water source. Approximately 4.0 and 14 per cent of the respondents in formal and informal households respectively depend on both pipe-borne water and well water sources. About 94 and 96 per cent of the respondents in the formal and informal households respectively claimed that water sources were not safe for drinking without prior treatment. These statistics seem to reveal that Kampala’s water supply systems are not adequate, safe or uniformly distributed among the population.

Clean and safe water is an absolute necessity for human health and a productive life (WHO, 1997). Wealthier households have better access to water service because they can pay for the cost of water and enjoy government-subsidized water tariffs (WHO/UNICEF, 1996). The
location of wealthy household is an added advantage over the informal settlements. This is because water becomes more costly the more it is transported (White, 1989). Thus, more investments in water infrastructure, for instance, are required to reach the low-income households in the metropolitan hinterland than the central business district where the wealthy settlements are found.

This also implies that informal households not reached in-house piping connected to overhead storage containers, require water storage containers such as drums, earthen pots, jerricans, metal or plastic basins. These containers facilitate microbial contamination of drinking water with diarrhoeal bearing pathogens (Benneth et al., 1993; Faechem et al., 1983). As a result, these households are more susceptible to the burden of environmental health than the wealthy counterparts in the city unless good environmental hygiene is practiced.

Well water and other fresh water sources in Kampala are important because they supplement the erratic pipe-borne water supply systems (see Figure 3). Erratic water supply occurs because of a lack of electricity at the water works, adequate purifying chemicals for water (such as chlorine), or foreign exchange to import capital goods and materials for maintaining the water infrastructure. These factors have been exacerbated by economic stagnation and political instability in the country in the past two decades (Kampala District Environment Profile, 1994).
As a result, the quality of pipe-borne water has been affected by not only leakages in the water distribution system but also biofilm formation or growth of micro-organisms inside the wall of water pipes during erratic water supply as reported by 93.5 and 96.20 per cent of the respondents in formal and informal settlements respectively (Mara et al., 1995; USEPA, 1992).

Well water in Kampala is not safe for drinking because of uncontrolled discharge of untreated domestic waste and industrial effluents into fresh water sources such as Lake Victoria (Kampala District Environment Profile, 1994). This lake is both the principal source of water and destination of wastewater for the metropolis. It is an ecosystem that is also threatened by surface run-off from agricultural fields treated with herbicides and pesticides. This is leading to accumulation of toxic hazards into surface water supplies and ground water. Besides, open dumping of solid waste hazardous residues including biomedical wastes and emissions of toxic gases pose serious environment and health risks. Hence, a combination of physical,
biological and chemical agents has rendered freshwater sources in Kampala unsafe for drinking without prior treatment (WHO, 1997).

From the foregoing discussion and in view of the anticipated water demands arising from urbanization in Kampala new policy strategies may be adopted to prevent the burden of environmental health (CSD, 1992). The ageing water supply infrastructure needs dire renovation to improve the quality of pipe-borne water. This renovation entails substantial investments in the water-carriage system commonly operated in conjunction with the multi-stage wastewater treatment. To avoid erratic water supply, inter-sectoral collaboration between the Directorate of Water Development and the Electricity Company should also be strengthened. This will ensure a reliable power supply at the city’s water works.

At the same time, effective water management should be promoted through safe re-use of water; introducing realistic water pricing by removing pervasive water subsidies; applying best available water saving technologies in industry; and undertaking desalinization (Gleick, 1993).

Given that water supply systems are not adequate and safe, significant investments are needed to expand and maintain the water infrastructure in both formal and informal settlements of Kampala. These investments are worthwhile because safe water supply and hygienic sanitation reduce diarrhoea mortality by 65 per cent (Esrey; 1996; WHO, 1995).

### 4.4 Hygienic Sanitation Facilities Promote Environmental Health

As indicated in Table 4, pit latrines are common in low-income households (68.60 per cent) while flush toilets dominate the wealthier households (84.8 per cent).
Table 4: On-site Household Sanitation Facilities by Category in Formal and Informal Settlements

<table>
<thead>
<tr>
<th>Sanitation facility</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flush toilet</td>
<td>84.80</td>
<td>30.50</td>
</tr>
<tr>
<td>Pit latrine</td>
<td>14.10</td>
<td>68.60</td>
</tr>
<tr>
<td>Other</td>
<td>1.10</td>
<td>1.00</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

On-site sanitation management has critical health implications for households (WHO, 1996). This is because excreta contain pathogens responsible for diarrhoea, worm infections and enteric fevers (Feachem et al., 1983). Besides, urine causes schistosomiasis in a tropical climate (WHO, 1997).

While pit latrines are popular in low-income households, they are a major source of contamination of surface, sub-surface and underground water sources with sullage under different soil types and climates in cities of sub-Saharan Africa (Abiodun, 1997). This is particularly true for Kampala given that about 7.37 per cent (14.52 Km²) of Kampala’s total area is covered by a wetland ecosystem (See Table 1). This topography is also closely associated with a high water table coupled with seasonal flooding. Besides, pit latrines are commonly constructed on the upper slopes of valleys adjacent to the wetland ecosystems (Kampala District Environment Profile, 1994). Thus, Kampala could easily experience a pandemic of cholera if *Vibrio cholerae*, for instance, were introduced into its population as was the case in Peru and Zaire in 1990 and 1994 respectively (WHO, 1996).

In view of these health risks, pit latrine usage is considered inappropriate in Kampala both in the short- and long-term (Kgathi, 1998). Instead, the urban authority should make adequate investments in the expansion and maintenance of a citywide central sewer system and
wastewater treatment plants (WHO, 1996; Milne, 1983). This should be accompanied with adequate environmental hygiene education programs (ACGIH, 1999). These investments could be more effective if they were an integral part of a large-scale effort to improve socio-economic and environmental conditions in the city (Timaeus and Lush, 1995). In this way, a sustainable policy strategy for preventing the burdens of diarrhoea and other water-borne diseases in the metropolis could be achieved.

4.5 Disease Prevention through Provision of Adequate Environmental Services

As presented in Table 5, 83.70 and 51.00 per cent of the respondents in formal and informal households respectively reported to have access to environmental services for collecting solid waste by Kampala City Council (KCC).

<table>
<thead>
<tr>
<th>Service provider</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kampala City Council (KCC)</td>
<td>83.70</td>
<td>51.00</td>
</tr>
<tr>
<td>Households</td>
<td>14.1</td>
<td>31.70</td>
</tr>
<tr>
<td>Slum Health Project (NGO)</td>
<td>0.00</td>
<td>15.30</td>
</tr>
<tr>
<td>Other</td>
<td>2.20</td>
<td>2.00</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access to asphaltic road</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000 meters</td>
<td>90.20</td>
<td>40.40</td>
</tr>
<tr>
<td>More than 1,000 meters</td>
<td>9.80</td>
<td>59.60</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Road drainage</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision</td>
<td>92.10</td>
<td>56.80</td>
</tr>
<tr>
<td>No provision</td>
<td>7.90</td>
<td>41.20</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

About 31.70 per cent of the residents in informal dwellings compared with only 14.10 per cent of their counterparts in planned households manage their own solid waste. Informal settlements were also being served by the Slum Health Project (NGO) as reported by 15.30
per cent of the respondents in the survey. About 90.2 per cent of the respondents in the planned areas have access to asphaltic road network compared with 40.4 per cent of the respondents in the informal settlements. About 92.10 per cent of the respondents in the formal households reported adequate drainage structures on the road network compared with 56.80 per cent or 41.0 per cent of the respondents in informal areas without any provision for road drainage.

Regular, safe collection and disposal of household solid waste is one of the most effective ways for preventing the burden of environmental health. Since the bulk of Kampala’s household wastes are largely crop and vegetable residues, they are organic and biodegradable. As they decompose or decay, they promote growth and proliferation of diarrhoea-bearing pathogens, among others (see Figure 4).

Figure 4: Solid Waste Disposal Adjacent a Wetland Ecosystem that Facilitates the Burden of Environmental Health

They also provide a rich feeding stock for pests such as houseflies, mosquitoes, cockroaches, rodents, and other animals. These pests thrive in a tropical environment where high temperatures combine with high rainfall. They are also potential carriers of enteric
pathogens such malaria (*Plasmodium falciparum*), malaria filariasis (dengue), (schistosomiasis (yellow fever), and leishmaniasis (rabies) (WHO, 1997). If allowed to accumulate, solid waste may obstruct storm water run-off (see Figure 3). This could result in flooding or creation of significant water bodies, which become habitats and breeding places for malaria-carrying mosquitoes (UNEP/IETC, 1996). Thus, the close proximity of low-income households in environments that provide no protection from pollution caused by solid waste accumulation creates favorable conditions for rapid spread of infectious diseases (WHO, 1992).

**Figure 5: Solid Waste Is Dumped in a Water Drainage Channel. This Leads to Impeded Drainage and Provides a Favorable Habitat for Disease Vectors Such as Mosquitoes and Houseflies.**

While approximately 65 per cent of the respondents reported Kampala City Council (KCC) as the environmental service provider, its capacity for solid waste management is limited. About 25 per cent of the solid waste generated in the city per month is known to be regularly collected, transported and disposed of by KCC. This has encouraged urban households and
communities to adopt various strategies to dispose of sold waste (White, 1989). The waste is burnt, buried or dumped on unauthorized sites or disposed of in backyards of some households (Kampala District State of Environment, 1997).

KCC also lacks adequate road construction and maintenance equipment. This possibly why many roads are not passable by the waste collection trucks due to potholes, manholes, seasonal floods or impeded drainage. In many settlements such as such as Mulago II, Katwe and Kisenyi, access roads are not available as reported by 40 per cent of the respondents in the survey. This has further curtailed solid waste management in the city (Kampala District State of Environment, 1997).

Public health is not protected at KCC’s solid waste disposal sites such as Mperelwe and Wakaliga. These dumpsites are not effectively controlled, located remotely from human settlements, their boundaries confined or sealed to prevent fresh water sources from being contaminated by infiltration of leachate or surface run-off. This has also helped expose “human scavengers” to ill health and possibly a shortened life expectancy (Kungshulniti et al., 1991).

In protecting public health, there is need for planned space for a large sanitized solid waste disposal on a citywide scale possibly for a 20-year period (White, 1989. This plan could also help prevent any conflicts with the surrounding district jurisdictions, such as Wakiso and Mukono. But locating waste disposal sites strategically away from the metropolitan core leads to astronomical increases in costs for more vehicles, fuel and personnel (White, 1989).
Alternatively, some of the organic solid waste collected could be turned into an opportunity. This waste can be sorted from the rest of the refuse and composted into green manure. Once converted, it could be applied, for instance, in the cultivation of fruits and vegetables in some sub-urban and peri-urban spaces of the metropolis or rural hinterlands. It can also serve as a nature fertilizer for the horticulture and tree nurseries for domestic, avenue, ornamental planting or greening open corridors in the city. This could also save KCC some scare foreign exchange for importing commercial fertilizers.

There is also a need to promote broad-based and effective participation of diverse actors and shareholders such as private sector, NGOs, CBOs, communities and households in urban management. Referring to Table 5, NGOs such Slum Health Project, are increasingly playing roles in solid waste management, particularly in low-income settlements. This could offer new opportunities and forms of cooperation for the urban population and non-government organizations for addressing the daunting health and environment issues (Wekwete, 1997).

This evidence seems to reveal a positive relationship between solid waste accumulation and a lack of adequate management and control of urban planning in Kampala (Mbuyi, 1989). In this respect, there is need for improving the urban land management system. This will not only provide land and housing prepared with basic living environment but also facilitate the delivery of environmental services for solid waste management. The provision of environmental services in Kampala tend to highlight the fact that cities are modifiers of ecosystems in the city-region and beyond. This is reflected in the production and consumption of goods and services, and generation of waste (Hough, 1990; McMichael, 1999). This may also imply that regional planning of urban infrastructure and services is
necessary if the burden of environmental health is to be prevented. Thus, KCC should engage the neighboring district jurisdictions in urban planning and infrastructure developed.

4.6 Communicating Effectively about Health and Environmental Hygiene is Essential for Disease Prevention

As presented in Table 6, about 85 per cent of the respondents in the formal settlements have access to the mass media compared favorably with 73.1 per cent of their counterparts in unplanned areas.

Table 6: Community Outreach and Environmental Hygiene via Mass Media and Health Workers and Its Impact on Health Behaviors

<table>
<thead>
<tr>
<th></th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization coverage</td>
<td>92.30</td>
<td>94.20</td>
</tr>
<tr>
<td>Hygiene education</td>
<td>85.70</td>
<td>73.10</td>
</tr>
<tr>
<td>Radio/TV/Print media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health worker</td>
<td>2.20</td>
<td>8.70</td>
</tr>
<tr>
<td>Other</td>
<td>12.10</td>
<td>11.20</td>
</tr>
<tr>
<td>Total</td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>Water treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiling</td>
<td>97.80</td>
<td>100</td>
</tr>
<tr>
<td>Other</td>
<td>2.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>Use of treated mosquito bed nets</td>
<td>72.80</td>
<td>55.80</td>
</tr>
<tr>
<td>Drainage of stagnant water</td>
<td>4.30</td>
<td>4.80</td>
</tr>
<tr>
<td>Use of insecticides</td>
<td>6.50</td>
<td>21.20</td>
</tr>
<tr>
<td>Curative care</td>
<td>1.10</td>
<td>1.90</td>
</tr>
<tr>
<td>Other (combinations)</td>
<td>15.30</td>
<td>11.50</td>
</tr>
<tr>
<td>Total</td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

About 2.20 and 8.70 per cent of the respondents in planned and unplanned settlements respectively receive health communication messages from community health workers. All water sources (piped and fresh water) are boiled (97.8 per cent and 100 per cent), treated mosquito bed nets are used (72.80 per cent, and 55.80 per cent), insecticide sprays are used (6.50 per cent and 21.20 per cent), and stagnant water is reportedly drained (4.30 per cent and 4.80 per cent) respectively in planned and unplanned households.
This evidence tends to suggest that community outreach through communicating about health and environmental hygiene via the mass media and community health workers plays an essential role in disease prevention. This is because effective communication messages promote changes in health behaviors (US Department of Health and Human Services, 1980).

Boiling water for drinking is indispensable because the available water supply systems in Kampala are not safe. This household practice has helped reduce or prevent the burden of diarrhoeal diseases in the city. Increasingly, urban households are using some form of mosquito control including treated mosquito bed nets, aerosol and spray insecticides.

Access to bed nets by low-income households may be constrained by the cost of the material. In this regard, it may be necessary for local and central governments to consider providing subsidies on mosquito bed nets. This could help low-income households gain better access to bed nets. This could help not only prevent one in four child deaths but also save one-fifth of household income spent on anti-malaria drugs, mosquito coils and insect repellents (Wirth and Cattani, 1997; WHO, 1997). In case of adults, malaria prevention could increase economic productivity through saving of up to ten days of absenteeism due to morbidity (WHO, 1999).

In sustaining health promotion against malaria, health communication messages via the mass media and health workers should encourage effective use of both disease control and preventive strategies for adoption by the urban households. This also requires effective participation and collaboration of the central and urban governments, private institutions, NGOs, CBOs, local communities and urban households.
4.7 One-day Prevalence of Malaria and Diarrhoeal Diseases

As shown in Table 7, the one-day prevalence of malaria and diarrhoeal diseases in planned households were 2.20 and 2.30 per cent compared with the 10.70 and 4.90 per cent in informal settlements respectively.

Table 7: One-day Prevalence of Malaria and Diarrhoeal Diseases in a Dry Season of a Tropical Climate

<table>
<thead>
<tr>
<th>Disease</th>
<th>Formal households (%)</th>
<th>Informal households (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>2.20</td>
<td>10.70</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>2.30</td>
<td>4.90</td>
</tr>
</tbody>
</table>

These results also suggest a relative risk of 4.86 and 2.13 for malaria and diarrhoea respectively. It may also indicate that malaria is no longer a rural problem as there are equally severe problems in informal settlements in the sub-urban and peri-urban zones of the metropolis (UNCHS (Habitat), 1996). This is because malaria-carrying mosquitoes have successfully adapted to urban environments from natural habitats (Najera et al, 1999). Low-income households seem to experience higher morbidity and possibly mortality rates than the wealthy. Hence, poverty is a predictor of poor health and ecological degradation (Songsore, 2000).

The relatively low disease prevalence of malaria could be attributed to growing awareness of the urban households and communities through the mass media on disease prevention and health promotion (US Department of Health and Human Services, 1980). This appears to have had a positive impact on community behaviors with respect to environmental hygiene and management. It is also because the survey was conducted in the March at the end of a 4-month dry spell in Kampala. Perhaps some of the mosquito breeding habitats, especially stagnant water may have dried up through evapo-transpiration. The urban households may
also have burned some of the wetland vegetation such as papyrus reeds. These factors could have helped reduce the mosquito density and host-parasite exposure (Martens et al. 1999). This also demonstrates that environmental conditions play an important role in determining the distribution of vector-borne diseases, such as malaria (WHO, 1997).

The low incidence of diarrhoeal diseases could be ascribed to a four-month dry season could have helped drain some of the accumulated solid waste at the dumpsites. When solid wastes dry, urban households are encouraged to burn them. This helps destroy some of the potential habitats for houseflies and other pests in the neighborhoods. In a tropical climate, the dry season could have helped lower the water table of the wetland ecosystems through evapotranspiration. This may have prevented microbial contamination of surface and sub-surface water resources such wells with sullage from pit latrines or surface run-off. Hence, providing a natural process for improving the quality of fresh water sources for low-income households not adequately reached by the pipe-borne waster supply system.

Given the burden of malaria, Kampala and the adjoining wetland ecosystems need a vector surveillance and control program (Farid, 1998). This will determine where malaria risks are greatest so as to permit timely, preventive and cost-effective control strategies to be carried out (WHO, 1997).

To be effective, the control program requires sound knowledge of urban epidemiology or technical details about malaria parasites, vectors, local communities, site-specific environmental conditions (Farid, 1998; WHO, 1996). This is fundamental because malaria is a disease with specific climatic and topographic conditions (WHO, 1995).
In addition, the program needs to draw on a multi-disciplinary and inter-sectoral coordinated effort. This will provide scope for input outside of the health sector in promoting and maintaining environmental health. It is also a cost-effective means of formulating environment and health policies by ensuring that priorities across sectors are coherent with those of individual sectors. Thus, skills and competencies of sanitarians, epidemiologists, entomologists, environmentalists, medical personnel, urban managers and administrators are critical to the program. The Ministry of Health, for instance, could treat cases and keep records, which epidemiologists and environmentalists use them to monitor progress made by the program. At the same time, health policy and decision-makers are briefed on the crosscutting nature of health issues (Birley et al., 1996).

This program also requires political support and commitment to sustain its activities. Communities most-at-risk should also be mobilized and encouraged to effectively participate in control interventions. Sustainability in this regard implies that, when progress has been made in the control of malaria, the achievements are maintained. Hence, demanding a change in behavior and attitudes at all levels so that every urbanite understands and appreciates, and is motivated toward carrying out the requirements of the vector control program (WHO, 1995).

The vector control program underlines a need to promote health impact assessment (HIA) as an integral part of environmental impact assessment (EIA). This ensures that environmental safeguards and health issues are effectively integrated in development policies, plans, programs and dialogue of actors and stakeholders (Birley et al., 1996). This allows potential health impacts to be addressed at the outset to avoid costly environmental health problems that ensue at a later stage (ACGIH, 1999). In this context, EIA could help deliver integrated
policy development in Kampala where environmental health, safety statutory and regulatory infrastructure is not effective or in place.

Of great necessity is an environment and health information system to support decision-making and implementation of the control program. This system will help highlight the critical ways in which health and well-being are influenced by human-nature interactions. It will also help clarify the extent to which health hazards are attributed to environmental conditions and/or to activities of the sectors other than the health sector. This will improve the knowledge base of environment and health linkages and facilitate health interventions (CSD, 1997; ACGIH, 1999). In this context, environmental health should be promoted on the agendas of every sector and actor in the urban ecosystem.

5. **Preliminary Conclusions and Recommendations**

On the basis of foregoing discussions, some preliminary conclusions and policy implications may be brought out. Given that urban ecosystems provide potential economies of scale not found anywhere else in Uganda, Kampala will continue to attract rural-urban migrants. This will place additional pressure on the urban infrastructure and services. This may further degrade the quality of environmental conditions with serious health effects if adequate policy strategies are not developed and implemented.

Available evidence seems to suggest that low-income households are the most vulnerable to the burden of environmental health hazards and risks because of lack of adequate basic urban services and environmental hygiene. Poverty is perhaps a basic indicator of disease and environmental degradation in Kampala.
In mitigating the burden of health, many policy responses are necessary in Kampala (see Table 8). This is because many factors interact to generate a compounded impact on human health and well-being. Policy interventions may range from improving urban land management, empowering women, expansion and maintenance of infrastructure and services at city-wide and regional levels, effective health communication and education, malaria disease vector surveillance and control, to operationalizing a decision-support health information system, among others.

Table 8: Health Impact Assessment Matrix for the Burden of Environmental Health in a Low-income City

<table>
<thead>
<tr>
<th>Driving forces</th>
<th>Pressures</th>
<th>State/quality</th>
<th>Exposure</th>
<th>Impact</th>
<th>Policy responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid population growth</td>
<td>• Overcrowding • Excreta and urine • Solid waste • Housing and shelter facilities • Environmental hygiene • Coverage of environmental services and infrastructure • Coverage of safe water supply and sanitation systems • Health care delivery systems • Lack of reliable data for planning</td>
<td>• Land use and cover change • Higher incidences of mortality and morbidity • Differentials in provision of urban services • Degraded quality ecosystems goods and services • Changes in housing standards • Changes in personal and household hygienic standards</td>
<td>• Food-, water-, and soil-borne infections • Vector-related diseases • Overcrowding-related diseases • Squalid living environments (informal dwellings and neighborhoods) • Acute respiratory infectious</td>
<td>• Diarrhoeal diseases • Anemia • Schistosomiasis • Stomach cancer • High DALYs • Loss of economic productivity • Increased environmental degradation</td>
<td>• Family planning services • Environmental hygiene education • Investments in environmental improvements • Investments in social and infrastructure services • Integrated regional and rural development • Inter-sectoral policy coordination and action • Job creation opportunities • Improved access to land • Sustained monitoring and assessment of urban ecology and health • Regularized census</td>
</tr>
<tr>
<td>Urban management and policies</td>
<td>• Uncontrolled developments and settlements including encroachment on fragile ecosystems such as wetlands</td>
<td>• Increased deterioration and depletion of ecosystem goods and services, including seasonal flooding and contamination of water supplies • Higher incidences of infectious and parasitic diseases • Lack of infrastructure and environmental services</td>
<td>• Mosquitoes • Houseflies • Rats • Cockroaches • Other pests • Helminths • Toxins of pathogens</td>
<td>• Malaria (Plasmodium falciparum) • Dengue (Malaria filariais) • Diarrhoea (Cholera &amp; Typhoid) • Anemia • Schistosomiasis • Bilharzias • Rabies (Leishmnaniasis) • Loss of economic productivity • Increased environmental degradation</td>
<td>• Capacity building for urban planning and development • Improved access to land • Enforcement of building standards • Conservation of fragile ecosystems • Environmental hygiene education • Inter-sectoral policy development and action</td>
</tr>
<tr>
<td>Water supply and sanitation systems</td>
<td>Solid waste management</td>
<td>Land use and cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated domestic waste and industrial effluents</td>
<td>Uncollected household, community and institutional refuse</td>
<td>Uncontrolled developments and settlements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agro-chemicals</td>
<td>Pests (houseflies, mosquitoes, cockroaches, rats and other animals)</td>
<td>Seasonal flooding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POPs</td>
<td></td>
<td>Urban drainage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofilm formation</td>
<td></td>
<td>Social and infrastructure services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaseous emissions</td>
<td></td>
<td>Changes in land use and cover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes in quality of fresh water sources and pipeborne water supply systems</td>
<td>Converge of environmental services</td>
<td>Mortality and morbidity rates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eutrophication</td>
<td>Road access to households</td>
<td>Life expectancy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological demand for oxygen (BOD)</td>
<td>Remoteness of dumpsites from settlements and water sources</td>
<td>Coverage of urban services and access to health education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water coverage</td>
<td>Financial and technical capacity for waste management</td>
<td>Contagious and parasitic infections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available water for personal hygienic use</td>
<td>Land use and cover changes</td>
<td>Contaminated water, food or soil environments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to environmental hygiene (or health) education</td>
<td>Acute respiratory infections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food-, soil- and water-borne infections</td>
<td>Food-, water-, and soil-borne infections</td>
<td>High incidences of malaria and diarrhoeal diseases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhoeal diseases (Cholera - <em>Vibrio cholerae</em>; Typhoid fever)</td>
<td>Offensive order</td>
<td>Anemia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Disease vectors and pests</td>
<td>Schistosomiasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dracunculiasis</td>
<td>Helminths</td>
<td>Dengue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachoma</td>
<td>Injuries and burns during scavenging</td>
<td>Poliomyelitis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anemia</td>
<td>Loss of economic productivity</td>
<td>Integrated city region and rural development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of economic productivity</td>
<td>Water conflicts</td>
<td>Improved road design, maintenance and drainage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased pollution</td>
<td></td>
<td>Investments in social and infrastructure services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family planning services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacity building for urban planning and management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inter-sectoral policy coordination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laws and regulations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>City-wide and regional environment assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrated health care delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expansion and maintenance of safe water supply systems and sewerage without bias for the wealthy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Realistic water pricing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removal of pervasive subsidies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental hygiene education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promotion of sustainable water management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water standards and regulations including “polluter pays principle”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improving access to developed land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strengthen technical, financial and managerial capacity for urban government</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environment health education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental monitoring and assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promotion of waste recycling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improve access to developed land</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Given that the activities of the different government sectors and stakeholders (such as private institutions, NGOs/NPOs, CBOs, academia, citizenry, UN Agencies and development partners) affect outcomes, coordinated and integrated policy responses are keys to delivering health care. This facilitates the incorporation of health concerns and environmental safeguards in policies, programs, projects and activities of the sectors and stakeholders. In so doing, health impact assessment (HIA) is promoted as an integral part of environmental impact assessment (EIA) or a mainstream part of decision-making and adequate integrated policy development. In other words, the health sector serves as a guide partner or plays an advocacy role at policy development and implementation by highlighting key inter-linkages between human health and ecology (see Figure 6).

In the current or traditional health policy framework, the central government, in particular the health sector or ministry is the sole maker of the health policy in Uganda. This model makes no provision for harnessing resources inputs outside of the health sector. This is considered inadequate because the burden of environmental health continues to escalate yet the resource base of the health ministry is dwindling. In contrast, the proposed policy framework attempts to cause (coordinated) action within government sectors and institutions outside the government by incorporating health and environmental safeguards while planning and implementing any policy, development project, program or activity. These sectors and institutions internalize health concerns and issues in decision-making through a constructive policy dialogue, similar to a public hearing in an environmental impact assessment for a project or strategic impact assessment for a policy or program.

At every stage of policy dialogue, the health sector concerns itself principally with informing the participating sectors and institutions about the health and environmental interactions and their potential positive and negative health outcomes. This aims at influencing subsequent decision-making and policy development and action. It is also envisaged that promoting the profile of health will allow sustained investments in improvements to health to be made.
outside the health sector. Besides, the new framework underscores the need for a credible evidence base on disease cause-effect relationship (or toxicology).

**Figure 6: Health Policy Development Framework**

A: **Current framework**

B: **Proposed framework**
Concerning colours in the policy frameworks, a “brown shade” has been chosen to reflect or represent the “brown agenda issues” or the burden of environmental health that arises basically from a lack of development i.e. inadequate basic social and infrastructure services in the urban households of Kampala. In the proposed policy framework, the inner ring around citizens has two colours. The upper half of the ring is brown while the lower half is green in colour. The green shade represents improved health outcomes that are expected to result from sustained and compounded impacts of integrated policy responses for delivering health care in Kampala. Accordingly, the brown agenda issues will be replaced by modern health hazards and risks, thus a switch from brown to green. The second or outer ring over citizens, as shown with a pointer “environmental performance”, suggests that the quality of environment is a key determinant of disease or brown agenda. This also implies that actors and stakeholders when engaging a policy dialogue for delivering health care should pay special attention to the ecology and hygiene of households and communities if the burden of disease. This way, an integrated environmental health service could be operationalised in Uganda.

In essence, an integrated environmental health service is a health care system that seeks to improve human health and ecology, and stimulate economic productivity through:

a. largely preventive (long-term) policy measures that reduce or eventually eliminate disease in the transmission pathways in the ecosystem;

b. promoting inter-disciplinary, multi-professional and inter-sectoral teamwork; and

c. encouraging and sustaining effective household and community participation in disease prevention or health promotion.
Appendix I: Baseline Survey Instrument

QUESTIONNAIRE TO ASSESS ENVIRONMENTAL HEALTH IN KAMPALA CITY MARCH 2002

PART I: GENERAL INFORMATION

1.1 Division: .................................
1.2 Parish: .................................
1.3 Respondent №: ........................

PART II: DEMOGRAPHIC PROFILE

2.1 Sex: M [ ] F [ ]
2.2 Age: 18-25 [ ] 26-40 [ ] 40-60 [ ] >60 [ ]
2.3 Number of people in the household: <4 [ ] 4-6 [ ] >6 [ ]

PART III: WATER SUPPLY AND PRICING

What is your main source of water for household use?
............................................................................................................................

3.2 Is the water safe for drinking? YES [ ] NO [ ]
3.3 If NO, how do you treat water before drinking it?
............................................................................................................................

3.4 Is water affordable for your daily use? YES [ ] NO [ ]

PART IV: SANITATION AND WASTE MANAGEMENT

4.1 Do you use a pit latrine (PL) or flush toilet (FT)? PL [ ] FT [ ]
4.2 Is there a wetland/swamp nearby? YES [ ] NO [ ]
4.3 If YES, how far is it? Far [> 1 km] Near [< 1 km]

Who collects your household refuse? KCC [ ] Other [specify]
............................................................................................................................

PART V: INCIDENCE OF MALARIA AND DIARRHOEA

5.1 Is any member of your household currently having malaria? YES [ ] NO [ ]
5.2 What do you think causes malaria? .................................................................
............................................................................................................................
5.3 How do you prevent malaria in your home? ...................................................
............................................................................................................................

Is any member of your family currently suffering from diarrhoea? Y [ ] N [ ]

What do you think causes diarrhoea? ............................................................
............................................................................................................................

41
How do you prevent diarrhoea in your home? .................................................................
........................................................................................................................................

PART VI: ACCESS TO HEALTHCARE AND OUTREACH

6.1 Can you afford the cost of medical services in this area? YES [ ] NO [ ]

6.2 Do you receive immunization and family planning services? YES [ ] NO [ ]

How do you get information on malaria, diarrhoea and how they can be prevented?
........................................................................................................................................

PART VII: FOOD MARKET AND HYGIENE

Where do you often get food for your household?
Supermarket [ ] Open market [ ]

7.2 If open market, is food including meat being delivered to the market first inspected by a health worker? YES [ ] NO [ ]

PART VIII: URBAN PLANNING

Are you living in a rented house or own house?
Rented house [ ] Own house [ ]

Did the city/local authority approve the plan for the house you are living in? YES [ ] NO [ ]

8.3 Is there an access road to this house? YES [ ] NO [ ]

8.4 If YES, does it have structures for water drainage? YES [ ] NO [ ]

How far is the access road from your house? Far (> 100 m) Near (< 100 m)

THANK YOU FOR YOUR TIME
References


ACGIH. (1999). TLVs and BELs - Threshold Limit Values for Chemical Substances and Physical Agents; Biological Indicator Indices.


Arc/info and Arcview GIS, ESRI. (1992). Environmental Systems Research Institute, Redlands, California, USA.


Canada (Handbook on Health Impact Assessment). (1999). Roles for the Health Practitioner within EIA.


USEPA-United States Environmental Protection Agency. (1992). “Control of biofilm growth in drinking water distribution systems”, seminar publication, Cincinnati, USA


49