SOME ISSUES OF ENVIRONMENTAL CONCERN IN KAMPALA, THE CAPITAL CITY OF UGANDA

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Abstract. Kampala, the capital city of Uganda is the administrative, political, commercial, industrial, educational and cultural centre of Uganda. The city has an area of 190 km^2 and is located 8 km north of Lake Victoria (the second largest fresh water lake in the world) and approximately 42 km north of the equator. The population varies from about 1.2 million during the day to perhaps 0.9 million at night. The anthropogenic activity of this population far exceeds the infrastructure capacity of the city, leading to the deterioration of the urban environment. This article highlights the major sources of environmental degradation and pollution in the city, which include solid waste, abattoir waste, sewage, sanitation, drainage, industrial pollution, traffic pollution, atmospheric pollution, urban agriculture, rapid urbanisation and water hyacinth.

Keywords: Kampala City, pollution, urban environment

1. Introduction

Kampala, the capital city of Uganda is situated 0°15′N and 32°30′E and is located 45 km north of the Equator (Figure 1). It has a total area of 190 km^2. The city centre is situated 8 km north of Lake Victoria, the second largest inland fresh water lake in the world. The city is 1300 m above sea level and receives a mean annual rainfall of 1200 mm. Despite its proximity to the equator, it has a tropical climate rather than a typical equatorial climate. This modified climate is to due the high altitude, long distance from the sea, relief and proximity to the large water mass of Lake Victoria (Matagi, 1998).

The topography of the city is characterised by a series of low lying hills with flat hill tops typical of the Buganda Region, of Central Uganda (Hickman and Dickens, 1981). These hills are surrounded by a network of wet valleys which are covered by papyrus swamps (MNR, 1992). Many of the papyrus swamps have been reclaimed and developed. They contain the central business district, slum dwellings and industrial zones. The hill tops have been reserved for institutional purposes such as universities and churches, prestigious buildings like State Lodge and other important installations like the Radio and TV masks, while the slopes have been utilised for various grades of commercial/official and residential buildings.

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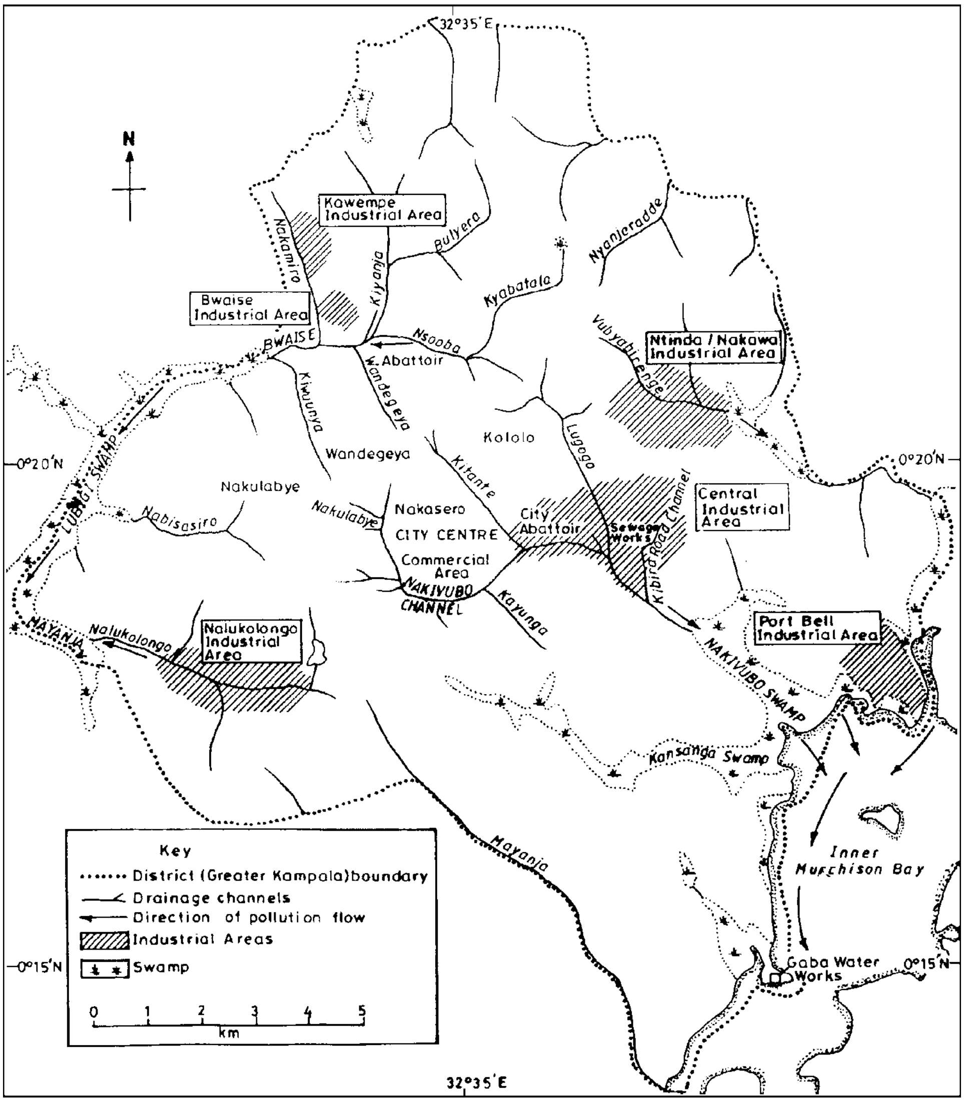

Figure 1. Kampala catchment and industrial zones.

Kampala has a unique administrative structure in Uganda. It is the only urban municipality, which is also designated as a district. The population in the 1991 census, was 775 000 (Census, 1991). While estimates from the Uganda Household Survey 1993–1994 gave a population of 924 677 (UNDP, 1996). The current population is now thought to be around one million residents with additional large numbers coming to work in the city daily. With a current growth rate of 4.9% per annum it is estimated that a total population of 1.5 million will be attained by the year 2004. In 1906, Kampala was gazetted as a township. It achieved municipality status in 1946 and became a city by the Royal Charter of 28 September 1962. The mandate of the City Council to handle environmental issues in the city is enshrined in the Urban Authorities Act of 1964, the Trade and Licensing Act of 1969, the Public Health Act of 1964, the Town and Country Planning Act of 1964 and Resistance Committees Statute of 1987. Therefore it is the duty of the City Council to maintain the cleanliness, hygiene and the beauty of the city (MNR, 1992; MLHUD, 1993). It is also the duty of council to ensure that the city be not polluted or degraded.

Kampala City like the rest of Uganda, has engulfed numerous problems due to the political turmoil that the country after the military coup of 1971. Nuwagaba (1999) notes that the political instability of the 1970's and 1980's brought about the decay of social services and infrastructure, the emergence of distortions (corruption, lack of essential commodities, inflation, smuggling), erosion of wages and increased impoverishment in the country. This resulted in slow economic growth, the break down of law and order, leading to total anarchy. Kampala City did not escape this mayhem. Nuwagaba further observes that the impact of the deterioration was more manifested in the rural areas where social services virtually ground to a halt and economic opportunities dwindled by the day (Nuwagaba, 1999). It was only in the urban centres that some semblance of social amenities and economic opportunity remained in place. This urban bias triggered waves of rural-urban migration leading to over population and slum development in the cities straining both the social and physical environment. Kampala offers the best rural-urban scenario. It currently accommodates 40% of all urban residents in Uganda (MLHUD, 1993). It was originally built on seven hills, but today encompasses 46 hills. This change in land-use from natural vegetation with only a small population to a city of a million people has exerted pressure on the environment. The major causes of environmental degradation in Kampala include, but are not limited to, poor solid waste collection, inadequate facilities for sewage and sanitation, drainage, increasing traffic and industrial pollution and urban agriculture. Unfortunately most of the pollution from the anthropogenic activities in the city end up in Lake Victoria through channels that drain the city. This article highlights some of the activities causing environmental degradation in Kampala City.

2. Solid Waste

2.1. Generation and Types of Solid Waste

The main types of solid waste are domestic refuse, market refuse, commercial/industrial refuse, abattoir wastes and hospital waste. It is estimated that approximately 25 000 tonnes of solid waste are generated in Kampala every month, an average of 800 tons day^{-1} (MLHUD, 1993). Only about 5000 tonnes are collected per month and transported by Kampala City Council, to the dumping site at Mpererwe. This service in 1996 only covered 20% of the generated waste. Almost 80%

TABLE I
Solid waste composition in Kampala skips, 1989

No.	Type of solid waste	Percentage
1	Organic matter and vegetables	73.8
2	Paper	5.4
3	Saw dust	1.7
4	Plastic	1.6
5	Metals	3.1
6	Glass	0.9
7	Tree cuttings	8.0
8	Street debris	5.5

Source: MLHUD (1993).

of the generated waste is not collected by Kampala City Council. As a result the unfortunate residents make their own arrangement to dispose of their waste. Some people bury it, others burn it, while others simply throw it on unauthorised sites like roadsides and public land. Some families have even established mini permanent dumping sites in their backyard or nearby locations. Such sites are often a source of littering, pollution and offensive smells and provide breeding grounds for rats, flies and mosquitoes (MLHUD, 1993; Kanyonyore, 1998).

3. Solid Waste Characteristics

3.1. Domestic Refuse

Kampala generates an average domestic refuse of 4211 kg km^{-2} day. Each person is estimated to generate 0.53 kg person^{-1} day^{-1} (Humphrey and Water, 1990), which results in an average daily volume of 1777 m^3 day^{-1}. Table I shows the solid waste composition in Kampala City (MLHUD, 1993). The waste has a relatively high moisture content, relatively dense and with a density of 450 kg m^{-3}. Organic matter and vegetables make 73.8% of the waste composition. More than 58% of this waste comes from low-income residential areas (MLHUD, 1993). The City Council spends US$ 3.4 per capita or US$ 3 400 000 per year to deal with the problem. This is an under funding and only 355 m^3 day^{-1} or 167 tonnes day^{-1} of solid waste is collected, representing 20% of the waste generated. The dumping is done at a landfill opened in 1996 at Mpererwe, which was built at a cost of US$ 600 000. The council has 475 skips and a fleet of 20 trucks. On an average 12 trucks are operational at any one time because of financial problems. Each truck makes on average 7–8 trips at a cost of US$ 13 per ton. Every day US$ 3900 is spent to collect 355 m^3 day^{-1}. To deal with the whole problem would require a recurrent outlay US$ 10 400 per day. The uncollected garbage has reached a crisis level. Hardly a week passes without the press highlighting garbage complaints from city residents (Kanyonyore, 1998). There is littering of garbage, leading to offensive smells from the refuse dumps, which attracts of flies, scavengers ranging from stray dogs and cats to Marabou Storks. The littering makes Kampala an unsightly city that normally shocks visitors. According to Professor Derek Pemeroy who has been studying the breeding ecology of Marabou Storks in Kampala for the last 30 yr the breeding population has increased from ten nests in 1968 to 500 nests in 2000 (Pomeroy, 2000). This rise has been attributed to the excessive food found in the city refuse dumps scattered throughout the city. The Marabou Storks, which has a home range of 1000 miles starting from the equator ending in Southern Sudan, no longer need to migrate following the rainfall pattern because there is enough food in the city refuse dumps and litter. This behavioural change is a classical example of how man's anthropogenic activities have changed the behaviour of wildlife. Pomeroy (2000) further notes that Marabou Storks together with other scavenger birds like the ubiquitous Black Kite, Hooded Vulture and Pied Crow devour several tons of refuse every week, hence saving the City Council having to dispose what would otherwise be a health hazard. Because of this the Marabou Stork now enjoys a 'senior citizen' status in the city after conservationists succeeded in a campaign to stop the City Council from poisoning them in order to reduce their numbers!

3.2. Market refuse

Analyses of solid waste generated in 56 municipal markets scattered throughout the city indicate that they have a high content of uncooked vegetable matter. An estimated 0.15 kg^{-1} $person^{-1}$ day^{-1} of market refuse is generated daily (ML-HUD, 1993). Only 25 markets are equipped with containers. However, most of the markets with or without bins are littered with refuse.

3.3. Commercial/industrial solid waste

Until recently industrial waste was not a problem. Most industry had collapsed or was operating under capacity due to the political turmoil the country faced in the seventies and the eighties. However, a projected estimate of 0.2 kg^{-1} $person^{-1}$ day^{-1} was recommended as projected future refuse volume (MLHUD, 1993). In 1995, 1996 there were many reported incidences of imported expired pharmaceutical products, radioactive powder milk, expired and leaking dry cell batteries. Because of lack of waste handling facilities these were dumped and ended up in the environment. In future disposing of industrial wastes will be a problem because the KCC landfill at Mpererwe was not designed to handle industrial waste.

TABLE II

Waste generation at Kampala's abbattoir, 1991–1992

No.	Type of waste	Weight/tonnes
1	Horns	346.8
2	Calves/hooves	26.1
3	Blood	520.6
4	Ingester/Offal's	1402.6
5	Total	2296.1

Source: Matagi (1993, 1996, 1998).

3.4. Hospital waste

None of the six hospitals in Kampala has a satisfactory solid waste management system. Aborted foetus, pancreas, amputated limbs and used syringes are at times thrown into the city skips. Most of the incineration facilities at the hospitals are no longer operational. Also clinical waste from the estimated 1200 private clinics, pharmacies and drug shops end up in city skips (Jenkins *et al.*, 1996).

3.5. Abattoir waste

Kampala City has three abattoirs, two in the central industrial area, which belong to the Kampala City Council and Uganda Meat Industries Ltd., respectively. The third is located at Kalerwe belonging to Kisita Young Farmers Co-operative Society. In 1991 the three abattoirs had a combined total slaughter of 52 024 cattle, 16 007 goats and sheep. This generated a total of 2296 tonnes of waste as shown in Table II (Matagi, 1993, 1996, 1998). There are no proper facilities at any of the abattoirs to remove solid waste, which is left to rot in the vicinity of the abattoirs, resulting in an awful stench that can be detected from a distance. The remains of blood, dung, hide, horns and hooves all mixed up make the abattoirs unsightly. The abattoirs hire KCC to remove the waste. Unfortunately KCC has no proper disposal system; they dump it near the sewage works. National Water and Sewerage Corporation operates a Training Centre with ultra modern conference facilities within the vicinity of the dump. It has failed to attract conferences in this place because of the noxious smell. Surface runoff drains the decomposing waste into Nakivubo Channel, which flows into Lake Victoria at Inner Murchison Bay.

TABLE III
Types of sanitary facilities in Kampala City, 1993

No.	Type of sanitation	Percentage
1	Water borne sewerage	9
2	Septic tanks	5
3	Unshared pit latrines	12
4	Shared pit latrines	72
5	No toilet facilities	2

Source: MLHUD (1993).

4. Sewage and Sanitation

4.1. Existing sanitation system

There are five different types of sanitary facilities in Kampala and their coverage is given in Table III (MLHUD, 1993). Pit latrines are the predominant mode of excreta disposal, accounting for 84% of the city population (MLHUD, 1993).

4.2. Water borne sewage system

National Water and Sewerage Corporation (NWSC) is a para-statal organisation, which handles sewage in the city. This system serves households and other premises that have piped water supply and flush toilets (MLHUD, 1993). The sewer system is designed to accept only sewage, household wastewater from the kitchen, bathroom and industrial effluents. There is a separate storm water drainage system.

Only the busy commercial centre, the central industrial area and high-class residential areas are sewered. The sewer network of 100 km, conveys wastewater to a conventional sewage treatment works that uses mechanical and biological treatment (trickling filters). The sewage works was designed to treat 32 000 m^3 day of sewage but it now receives less than half of the designed capacity. The rest oozes out of the manholes and old dilapidated sewer pipes. Many manhole covers have been either stolen or broken. Rubbish, stones, filth and silt, as well as storm water find their way into the sewers via these manholes after rainfall. This often results in sewer blockages causing sewage to spill over into the roads, which makes the city messy, muddy and smelly. The scenic beauty of the city is lost due to spillage of sewage on the streets (Matagi, 1993). Water borne diseases like typhoid and dysentery are prevalent and persistent among the city's population (Matagi, 1993). Diarrhoeal diseases are the third most frequent reported diseases after malaria and respiratory tract infections (Jenkins *et al.*, 1996). This is largely linked to the spillage of sewage, which ends up contaminating drinking water and food. Every year countless man-hours are lost due to the work force seeking medical treatment for water borne diseases.

4.3. SEPTIC TANKS

Septic tanks are generally used in premises with piped water supply and flush toilets, but which are not connected to the sewerage system. The solids discharged digest in a watertight tank while the liquid flows from the tank into a soak away. Kampala City Council and NWSC initially provided a septic tank emptying service. However, today the army, private firms and NGO's have entered this lucrative business. Vacuum tankers are used to empty septic tanks at a fee (US$ 70). In waterlogged areas in the valleys that were formerly swamp, septic tanks are a problem due to the high water table. Septic tank effluent cannot flow away and may flood compounds making them messy and muddy (MLHUD, 1993).

4.4. PIT LATRINES

Pit latrines are dry, on site sanitation systems. They are used by the majority of people in low income, high-density areas, and in the sparsely populated rural and peri-urban area (MLHUD, 1993). They are efficient excreta disposal systems when properly used. But in densely populated areas with high water table, pit latrines have to be built above ground with steps leading up to the toilet. Unfortunately when they fill up some of the unscrupulous owners have an outlet pipe which they open releasing the human excreta into the environment. This is usually done during the rainy season where rainwater carries the excreta into nearby drainage channels. These pit latrines are usually communal; thus their proper use, maintenance and upkeep are neglected. As a result they become filthy and fall into despair, forcing people to defecate wherever they can. This attracts flies, which in turn transmit diarrhoeal diseases, hence, the high prevalence of these diseases in the city. It is not surprising Kampala had an outbreak of cholera epidemic in 1997 (Nuwagaba, 2000).

4.5. NO SANITATION SYSTEM

In the densely populated slums, some households do not have access to sanitation facilities at all. People living in these areas have inevitably improvised by using what are euphemistically referred to as 'mobile toilets' – plastic bags used inside their houses and disposed off indiscriminately, either by throwing them in the open at night or in the water drainage channels.

4.6. DRAINAGE

Kampala is built on a series of hills which have steep slopes separated by valleys of varying gradients. These valleys form an essential natural drain for the city. However, of recent years the city has experienced flooding especially in the low-lying areas. Here the storm channels and surrounding area are submerged and houses destroyed by pools of water (MLHUD, 1993; Matagi, 1998). In the valleys, water floods the roads making travel impossible. The drainage problem in Kampala has been compounded by the change in rainfall pattern. Rainfall in Kampala is mostly thundery characterised by heavy high intensity rainfall over short periods. Within 30 min after a shower or thunderstorm there is a sudden large amount of surface run off which the drainage channels cannot evacuate, leading to flooding. This is due to rapid urbanisation where the green zones have been destroyed by development. The concrete and bituminised roads increase the co-efficient of runoff, leading to more surface run off (Byandala, 1994). The cutting down of trees and hedges in the city allows raindrops to hit the ground with high velocities leading to soil erosion. The silt from the soil erosion clogs the drainage channels leading to floods.

Poor facilities for refuse collection in crowded slum areas have led residents to utilise the drainage channels for disposal of garbage. The absence of toilets in such areas compels some residents to dispose of the contents of their 'mobile toilets' into drainage channels (MLHUD, 1993). Combined with the accumulation of silt this leads to channel blockage and flooding.

5. Industrial Pollution

Metropolitan Kampala has a number of formal as well as informal industrial areas as shown in Figure 1 and Table IV (Droruga, 1990; Matagi, 1993). In 1972 the Kampala Development Plan designated the formal industrial areas and located them with a fixed acreage as shown in Table IV (MLHUD, 1993). However, due to the political turmoil of the 1970's and 1980's and the resulting economic stagnation, Nabisasiro and Kinawataka have never been developed. The City Council current policy of 'mixed urban planning' allows industries, residential and commercial premises to occur side by side. This has it own associated hazards that will be discussed elsewhere. The informal industrial areas are in Katwe, Bwaise, Kalerwe, Nakivubo, Wandegenya and some parts of Nakawa and Port Bell. In addition, practically all Kampala's Markets and more so its linear commercial 'strips' attract a range of informal artisanal industries, which are located either within, or around them. These industrial areas accommodate 93% of Uganda's chemical industries and employe 66% of Uganda's industrial labour force in the sub-sector (UMA, 1989). By 1990 there were 5000 registered factories, all producing below capacity, and they contributed only 45% of the Gross Domestic Product (MNR, 1994). However the annual industrial growth rate of that same year was 14%, one of the fastest in the world at that time.

Industries contribute to pollution by air emissions, noise and wastewater discharge. According to the Uganda Revenue Authority, in 1994, 1995 and 1996 Uganda imported 8704, 11 160 and 190 668 tonnes of chemicals respectively, valued at US$ 450 million Table V (UMA, 1998). The average growth rate of chemical imported over the period was 21% per annum. Unfortunately most of these chemicals are used in the chemical industries located in Kampala. Inventories

TABLE IV
Industrial areas of Kampala City

No.	Zone	Area/hectare
1	Central	165
2	Port Bell	32
3	Nakawa-Ntida	147
4	Kawempe	196
5	Nalukorongo	251
6	West Bugolobi	165
7	Nabisasiro	70
8	Kinawataka	187
9	Total	1213

Source: MLHUD (1993).

carried out from 1990 up to the present show that most industries in Kampala do not have proper methods for disposing of expired chemicals nor chemical wastes (Droruga, 1990; Matagi, 1993; Wasswa 1997). Wasswa (1997) categorised the different disposal methods used by the industries Table VI. Unfortunately, the two methods that are environmental friendly i.e. shipping back to the supplier and recycling account for only 9% of the waste disposal system (Wasswa, 1997).

Coffee processing factories have the highest dust emissions which are between 1–25 mg m^{-3}, much higher than the World Health Organisation permissible level of 0.2 mg m^{-3} (MNR, 1994). This exposes over 5000 employees in this industry to occupational asthma, trinities and allergic alveolitis. Other factories whose emissions have caused nasal and eye irritation to residents who live nearby are two soap factories that use furnace oil. Little work has been done on industrial emission in Kampala. However, Nyangababo and Salmeen (1987) using mosses as bio-indicators found that Sembule Steel Mills located in Nalukolongo industrial area was responsible for air contamination. By comparing samples taken around the mill with background levels an increase in pollutants was found as shown in Table VII. This is probably attributed to air pollution generated by the steel mill. Wasswa (1997) found that sediments in Nakivubo Channel that drains Kishenyi and Katwe area had heavy levels of copper, 17 ppm, chromium, 53 ppm and lead, 91 ppm because of the small artisanal metal fabrication workshops in this area. Wasswa (1997) further observed that car battery repair, reconditioning and manufacturing were the major sources of lead pollution in both Nakivubo Channel and Lake Victoria sediments. Other sources of lead in the city environment are traffic and electric wielding using lead coated arc. High levels of copper and chromium were found at Lugogo and along Jinja Road. This is attributed to the electric pole treatment of Uganda Electricity Board and Ahmad and Sons tannery. These two

TABLE V
Chemicals imported in Uganda 1994–1996

No.	Chemical name	Weight kg^{-1}		
		1994	1995	1996
1	Organic chemicals or inorganic compounds of metals	10 692	13 708	40 585 527
2	Organic chemicals	27 688	30 764	8 430 600
3	Pharmaceutical production	10 267	15 795	68 934 575
4	Fertilizers		142 802	37 894 726
5	Tanning and dyeing extracts	974	1 650	5 855 293
6	Paints and varnishes essential oils, perfumery	1 128	1 151	4 372 804
7	Cosmetics, toilets, soap, polishes	4 391	5 290	5 753 907
8	Explosives, matches, and combustible preparations	1 192	1 779	253 347
9	Miscellaneous chemical products	8 648 486	10 947 450	18 587 975
10	Total	8 704 818	11 160 389	190 668 754

Source: UMA (1998).

TABLE VI
Industrial waste disposal methods in Kampala City, 1994

No.	Types of disposal	Percentage
1	Municipal sewers	26
2	Streams	35
3	City Council Skips	18
4	Pits	8
5	Incineration	4
6	Recycling	3
7	Ship back to supplier	6

Source: Wasswa (1997).

industrial establishments use copper and chromium as constituents of the raw materials in their processes. High concentrations of zinc were observed in sediments leading from paint factories (Wasswa, 1997). Wasswa (1997) assessing the impact of anthropogenic activities within the city used guidelines values for classification of Great Lakes sediments GLISP (1986) and concluded that Lake Victoria sediments were heavily polluted with phosphorous and total nitrogen. Lead, zinc,

TABLE VII

The percentage increase in local atmospheric heavy metal pollution by Sembule Steel Mills

No.	Heavy metal	Percentage
1	Cadmium	76.7
2	Lead	99.5
3	Nickel	85.4
4	Iron	69.4

Source: Nyangababo and Salmeen (1987).

manganese, chromium and copper were found to be at moderate pollution level (Wasswa, 1997).

Of particular importance to water pollution are those so-called ‘wet’ industries that discharge their wastewater into public sewers or storm water drainage channels, which eventually enter surface water (Droruga, 1990; Matagi, 1993). Nakivubo Channel, a storm water drainage channel that passes through the Central Industrial area, has the highest concentration of the ‘Wet’ industries. These industries include 4 soft drink factories, 2 textile industries, 2 abattoirs, 2 soap factories, over 24 engineering workshops and garages and 1 leather-tanning factory. Most of these industries have obsolete technologies, which in most cases are environmentally polluting. For instance no factory has pre-treatment facilities for their wastewater before it is discharged into either the environment or public sewer. Industries in this zone have a combined daily discharge of 5000 m^3 of wastewater (Droruga, 1990). Unfortunately most of the industrial effluents end up in Murchison Bay of Lake Victoria, which at the same time is the source of water supply for the city. In essence the city is drawing water from its own waste dump (Kizito, 1986; MNR, 1992; Matagi, 1993). Therefore, the future security and integrity of water quality for the city’s water supply source is questionable, if industrial wastewater treatment is not properly addressed.

6. Traffic and Atmospheric Pollution

The rapid growth in Kampala’s population and a resurgence of economic activities has resulted in significant volumes of vehicular traffic and increased traffic congestion at key locations throughout the urban road net work (MLHUD, 1993; Byandala, 1996; Kiggundu, 1996; Magezi, 1996; Mwesigwa, 1996; MNR, 1996; Turyagumanawe, 1996; Were-Higenyi, 1996). Average Annual Daily Traffic (AADT) Volumes as high as 25 000 have been recorded (MLHUD, 1993; Magezi, 1996). Moreover, most vehicles imported are used and the average age of the vehicle fleet in Uganda is estimated at over 10 years (Magezi, personal communication). It is assumed that 10% of all vehicle kilometres are undertaken in conditions of moderate congestion with average speeds of 30 km hr^{-1}. Therefore the total economic cost of incremental consumption of fuel arising from congestion was estimated to be 12 270 000 L equivalent to UG Sh 4564 million in the baseline year 1991 (Magezi, 1996). This has since increased, considering the growth rate in number of vehicles imported to be between 6–34% per year (Magezi, 1996). In 1994, 3000 vehicles were being registered every month, in the country. In 1995 it was estimated that there were 96 211 motor vehicles in the country (MFEP, 1996). By 1996 the number had increased to 120 000 according to Police estimates (Turyagumanawe, 1996). Unfortunately these vehicles are not evenly distributed in the country, most of them are in Kampala, where they cause traffic congestion, resulting in increased fuel consumption. About 6.87 million giga joules of petrol and diesel were used in 1995 (Magezi, 1996). Because of prolonged traffic congestion, coupled with inefficient carburetion, a lot of exhaust fumes are released into the environment. An estimated 918.2 tonnes of green house gases were released in Kampala from vehicles in 1995 (Magezi, 1996). As well as causing an increase in green house gases, traffic congestion has also increased heavy metal pollution. Uganda uses leaded fuel. The lead content on average is 0.6% by weight for petrol (Commissioner for Petroleum Department, pers. comm.). In 1992 Uganda imported 78 024 metric tonnes of petrol (MNR, 1996). Using the above average percentage of lead in petrol, we can calculate that in 1992 alone 468 metric tonnes of lead were released into the environment from vehicular exhaust fumes.

The presence of heavy metal pollution in Kampala city has been further demonstrated by using lichens (Nyangababo, 1987) and mosses (Nyangababo and Salmeen, 1987). Nyangababo (1987) using lichens as bio-indicators found heavy metal pollution levels for cadmium 4.94 $\mu g\ g^{-1}$, lead 246 $\mu g\ g^{-1}$, iron 13 400 $\mu g\ g^{-1}$ and nickel 79.6 $\mu g\ g^{-1}$ (per dry weight). The most heavily polluted areas followed a pattern that corresponded with the city road net work and distribution of industries. Among the most heavily polluted areas were the City Centre (Nakasero), the central industrial area, Kisenyi and Katwe. Chemical industries and motor traffic influenced the presence of high concentration of heavy metals in the central industrial area. Kisenyi and Katwe are affected by emissions from the small but numerous artisanal foundry, metal works and heavy trafficked roads. While the city centre is within reach of the emissions from the numerous industries from the central industrial area and heavy traffic with slow speed due to traffic congestion. The clean areas were identified as Kyebando and Nsambya which had a rural setting far away from industries and heavily trafficked roads (Nyangababo, 1987). During strong winds dust from the untarmaced roads, exposed bare ground, side walks along roads and dug out dutches for underground cables or pipes makes Kampala unsitely. The dust causes respiratory problems to the residents.

Vehicular noise pollution from exhaust pipe systems, tyres, engines and horns in the business district has also increased. Dust emissions have increased leading to nasal and bronchial discomfort. Traffic accidents have been on the increase too. Uganda had the second highest fatal accidents in Africa after Ethiopia. In 1995, for instance, there were 1256 fatal accidents in which 1546 people were killed (MFEP, 1996; Turyagumanawe, 1996).

7. Urban Agriculture

Kampala has an urban product of US$ 120 per capita, with over 70% of its population earning below the poverty level given by the World Bank as US$ 171 per capita in 1991. Therefore, it is a city of poverty (Mwesigye, 1996). This has forced some city residents to resort to urban agriculture to supplement their meagre income. Farming is done on marginal areas such as slopes and swamps (MNR, 1992). Unfortunately, these are also very fragile ecosystems prone to degradation. Extensive maize cultivation on hill slopes has led to serious gulley erosion, which at times can result in landslides. Indiscriminate drainage of swamps in the city environs for cultivation has affected the water table. Today, most springs dry up during the dry season. This affects families in the suburbs whose only source of clean water is from springs.

Drainage of swamps has led them to lose their function of wastewater purification. Pollutants enter surface waters unchecked and the risk of ground water contamination has increased. Agriculture has led to rapid destruction of green belts within the city and leading to deforestation. Trees are cut to prepare land for agriculture. Vegetation cover removal leads to carbon dioxide sink loss, increased solar radiation in the city, reduced soil water retention capacity and accelerated erosion. Such findings concur with the findings of the NEAP (1990), which concluded that land degradation is the major environmental issue in Uganda. This is also true for Kampala city, where farming is taking place on road reserves. The danger caused to traffic is obvious. Accidents have occurred in many parts of the city due to reduced visibility caused by tall crops like maize and cassava being grown, especially near road bends. But more importantly runoff soils from the gardens block drainage systems leading to floods and road damage.

8. Water Hyacinth

Water hyacinth was first noticed on Ugandan waters in 1988 in Lake Kyoga. A year later it was observed in the Entebbe area of Lake Victoria. The origin has now been traced to Rwanda via River Kagera (Twongo and Balirwa, 1995; Twongo, 1996). By 1995 the pernicious weed covered about 80% of the shoreline of Lake Victoria on the Ugandan side; 55% of that of Lake Kyoga; a considerable proportion of the northern shores of Lake Albert; as well as the banks of about 500 km of river Nile in Uganda. In 1995 water hyacinth covered an estimated area of 2,300 ha of the inshore of Lake Victoria-Uganda, 600 ha of Lake Kyoga and about 550 ha along the Nile (CVC-NTCMCWH, 1996). By 1995 Kagera River was delivering 350 ton/month of water hyacinth into L. Victoria (Twongo, 1996). The problem of water hyacinth in Uganda has been compounded by its vigorous reproduction, which is estimated to double every 14 days.

Water hyacinth has had a tremendously devastating socio-economic and ecological effect on the country. Hydro electricity power generation at Jinja has been affected by water hyacinth blocking screens to the turbines. Disruption of power supply has affected industry and research activities, and has forced domestic users to look for other alternative energy sources. Blockage of the pier at Port Bell, south of Kampala by water hyacinth has made it difficult for the railway-ferry to dock. This has forced the country to use the more expensive road transport to import goods.

Water abstraction has been hindered at Entebbe town. The water hyacinth clogs the screens and chokes the pumps. Because of the deterioration in water quality due to the decomposition of water hyacinth in the water, National Water and Sewerage Corporation has had to redesign it's treatment works in Entebbe by adding an alum dosing treatment step in order to improve the colour and turbidity so that the water can be aesthetically acceptable to consumers (Matagi, 1995). The water treatment works in Kampala and Jinja have also stepped up the usage of chemicals because of the deteriorating water quality in Lake Victoria (Wana-Etyem and Okurut, 1995).

Water hyacinth blocks fishing landing sites, occupies fish breeding grounds, destroys fishnets, causes fish kills due to the anoxic conditions from decomposing water hyacinth and hinders navigation on the lake. As a result the fishing industry has suffered and the price of fish has gone up.

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