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The Effect of Rapid Urbanization on the Environment: A Case Study of Moshi Municipality, Tanzania

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Abstract

Rapid urbanization is a recent phenomenon in the developing countries, starting in the 1950s as compared to developed countries where it occurred much earlier. Rural-urban migration, stimulated by the "urban lights" pull factor, and natural population increase are the major causes of rapid urban population growth. The outcome is a general urban crisis since municipals' resources are overwhelmed by excessive demand for social services that they cannot meet, eventually culminating into urban pollution.

This study is a retrospective sample survey carried out in September 1993 on the effect of rapid urbanization on the environment of Moshi municipality. The purpose of the survey was to establish the presence of rapid urbanization in the study area, and to employ both quantitative and qualitative methods in examining this unprecedented population growth and the urban pollution caused by unmanageable domestic waste.

1. Introduction

Rapid urbanization is a recent phenomenon in developing countries starting in the early 1950s. Only five out of the fifteen world largest cities in 1950 were in the developing countries: Shanghai, Buenos Aires, Calcutta, Bombay and Mexico; each with a population ranging from 3.0 to 5.8 million. By 2000 it was projected that these would be joined by ten other cities in the developing world that would be among the world's largest cities, each with population ranging from 12 to 31 million (UN, 1982).

In Tanzania, studies show that in the 1957-67 and 1967-88 intercensal years, 14 regional headquarters recorded rapid growth rates averaging 6.2% and 8.2% respectively (Censal Reports, 1957-67 and 1967-88). Tanzania has the fastest rates of urbanization in the world, ranging from 4.38 to 6.44% per annum between 1950-2000 (UN, 1990:106-107). These growth rates exceed the international rate of rapid urbanization of 4.0% according to the United Nations sources.

Unlike the developed world, developing countries are encountering pervasive urbanization characterized by large demographic increase in absolute numbers of people migrating from rural to urban centres lured by "urban lights" (Kalwani, 1994:iii). The "urban lights" include the search for employment and social amenities found in urban centres. The rural-urban migration factor in rapid

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urbanization is rooted in the colonial economic legacy under the labour reserve and the settler plantation economic interlock (Mbonile, 1993). However, over the past 40 years urbanization has risen rapidly in the developing world due to adverse "push factors" in the rural areas, and attractive "pull factors" in urban areas (Kironde, 1996:22). The major adverse push factors in the rural areas include outmoded peasant agriculture wholly dependent on the population pressure on rural arable land, low food production due to unscientific farming methods worsened by frequent severe droughts (Krokfors, 1995:55-63). In contrast, attractive pull factors include relatively modern facilities in urban centres attracting investment and offering a base for the informal sector, which in turn attracts rural-urban migrants. Employment in urban areas means regular cash, comparatively high wages, social amenities, etc., and thus better prospects and living conditions compared to the underdeveloped agriculture based rural life. Unfortunately, however, these "urban lights" are overwhelmed by the great tide of intercity migrants of desperate, energetic young people pouring into urban centres. As an outcome, urban authorities are saddled with unprecedented population increase far beyond their financial capacity. Consequently, there is a marked deterioration in the quantity and quality of public utilities and the urban environment, and a host of other negative effects.

Some of the negative effects of pervasive rapid urbanization in the developing world include shortage of surveyed land, squatter settlements, lack of basic public utilities, poor housing, poor sewage and solid waste disposal (Tabibzadeh, Espagnet & Well, 1989:29-30). In Tanzania, financial constraints have "made it difficult for both the government and the city council to provide or expand and maintain infrastructure and services to the required standard. Sanitation and solid waste management has been left neglected for periods "(*Sunday News*, 1993).

1.1 Objectives of the Study

Using a case study of Moshi municipality, this study applies both of quantitative and qualitative methods to analyse sewage and solid disposal problems associated with rapid urbanization in developing countries.

2. Theoretical Framework

For the last two decades, both social and natural scientists have attempted to advance frameworks and models for examining the relationship between population and the environment. This is a continuation of earlier efforts began around 1950 to study all the basic perspectives developed in human ecology (Hawley, 1950; Duncan, 1964). Basically, two perspectives that constantly interact have been identified: population, and environment. The interaction between the two is a constantly ongoing process, and is guided by two mediators: organization and technology (hence the acronym POET).

The thrust of the argument is that all forms of life have a population-environment interaction; except in non-human forms of life where organization

and technology are genetically programmed (Ness, 1994:10), i.e., they change spontaneously at a slower but steady pace compared to population and environment. In essence POET is a generic model with the basic framework from which different models concerned with various population-environment interactions can be developed and mediated by some form of organisation and technology. This analogy rules out the assertion that there is direct relationship between population and the environment and vice versa are products of social organisation and technology prevailing in a given human society at a given place and time.

Several models have been developed from POET that deal with various issues of population-environmental interactions at varying degrees and levels. All these reflect the basic human ecology proposition bound by technological and organisational aspects that guide the nature of population-environment relationships.

Since it is not possible to discuss all POET models in this article, we will consider only one model developed by Commoner (1972) and Harrison (1992), which is related to this study and is postulated as follows:

Population = Population x (Goods/Population) x (Pollutant/Goods)

Where, Goods/Population ratio represents consumption, and the Pollutant/Goods ratio represents technology. Harrison (*op.cit.*) used this model to estimate the impact of changes in population, consumption, or technology on the environment. This has been applied to estimate four types of environmental impact in the developed and developing countries linked with the application of technology. These included the environmental impact resulting from destocking animals on grazing land and the outcome of increased yield per area; reduction rate of air pollution in various Organization for Economic Cooperation and Development (OECD) countries after the introduction of air cleaning technology. Others, the environmental impact as a result of recycling domestic wastes into useable by-products to increase consumption, income and protection of the environment against pollution; and the impact of adopting family planning technology in large population societies as developing countries on the environment.

The Rio de Janeiro Earth Summit of June 1992 agreed that large populations are detrimental to the environment due to pressure on limited resources. The World Bank, (1984:79) has observed that "...population growth at rates above 2% ... act as a break to development." Although Boserup argues that overpopulation stimulates technological innovation, she overlooks the problem of overshoot characterised by stress-and-relief in the trade off between overpopulation and environmental interaction before technological discovery is achieved (Ness, 1994:15).

Experience shows that, overuse of resources by whatever cause, without due replenishment, gives way to depletion of the environment. One of the concepts of the population and development question as related to environmental problems is the "Environmental Concern of Rapid Population Increase Effect" (ECRPIE) (Mtatifikolo, 1992: 4-9), which is a brain child of the POET generic model.

ECRIPIE asserts that where policy permits, a rapid and unchecked population increase beyond the carrying capacity of land—a state known as population pressure—may cause ecological, biological, and food problems. Such cases include intensification of land use for agriculture and wood harvesting for various purposes, and this may lead to severe drought, and ultimately desertification. This concept can be applied to study the urban context. For instance, similar stress in an urban environment can lead to shortage of housing, inadequate social services, etc. Therefore, the concept was employed in this study to investigate problems of urban pollution and domestic waste management in Moshi Municipality.

3. Literature Review

Adequate removal and safe disposal of solid wastes need proper information on the quantity and type of wastes generated in a given area. This is important in the determination of methods and equipment required for proper handling of different types of wastes—domestic, commercial, industrial hazardous or non-hazardous (Ngiloi, 1992:52). These precautions are necessary for human life and environmental protection (WHO, 1972).

Literature shows that cities in the developing countries face rapid urbanization beyond their ability to cope with the collection and safe disposal of solid waste, resulting in serious urban environment pollution. The generation of solid waste, both in developing and developed countries, increase with the economic level of countries and cities. Studies show that the range of generation of solid waste per capita per day in cities/municipalities in industrialised countries is 1.9-0.7kg, while in low income countries it is 0.6-0.5kg (Cointreau, 1982:10). Another study showed that industrialised countries generate 0.75-2kg and developing countries 0.2-0.5kg of solid waste per capita per day (Haskoning, 1989:10-15).

Tanzania, like other Sub-Saharan countries, has urban sanitation problems due to acute financial and organisational constraints facing municipal councils that are trying to cope with waste management in the context of rapid urban population increase. For example, it has been noted that in 1986 all regional headquarters required 164 cesspit emptier trucks to adequately remove sewage in their respective areas. Of these, the government could only afford 29%, of which only 50% were in good working condition by the year 1998 (MLGC, 1990).

4. Hypotheses

1. Domestic sewage and solid waste collection and disposal facilities, specifically trucks in the Municipality, are overwhelmed by the large quantities of wastes generated by its rapidly increasing urban population.
2. Low level of formal education, poverty, acute shortage of potable water are dominant in the high density/squatters areas of Moshi Municipality, and to a great extent are responsible for the poor sanitary conditions (of pit latrines) in these areas as compared to the low/medium density residential areas.

3. There is an inverse relationship between the municipal's financial resource allocated to the collection and safe disposal of domestic waste service, and the great demand by its rapidly expanding urban population.
4. Poor collection and disposal of domestic sewage and solid waste in the municipality has a negative impact on the protection of its urban environment.

List of Variables

The study considered 9 variables, some of which were computed in the multiple regression analysis to come up with the various decisions as explained under methodology. These variable were:

(a) Sewage generated per capita in cubic litres/metres per year multiplied by the population size.

(b) Solid waste generated per capita in kilograms per year multiplied by size of the population under consideration.

(c) Total quantities of sewage collected and disposed of by the municipality in a year is obtained by computing: number of cesspit emptier trucks x @ capacity (in cubic litres) x number of trips/week/year less total sewage generated in the whole year.

(d) Total quantities of solid waste collected and disposed by the municipality is: number of trucks x @ capacity (in metric tons) x number of trips/week/year minus the total solid waste generated in the entire year.

(e) Funds allocated to the municipality for collection of domestic wastes in respective annual budget.

(f) Ability of the one sewage Trickling Filter Plant (TFP) to treat sewage in the municipality. This was determined by comparing its designed capacity and any overflow caused by the sewage overload.

(g) Education of residents in the different residential areas of the municipality assessed in terms of the number of years completed in formal schooling.

(h) Latrine condition assessed with reference to whether or not roofed; walled and roofed; type of thatch material, e.g., corrugated iron sheets or scrap, rags, etc.; state and condition of the floor, i.e., concrete or earth.

(i) Condition of the urban environment. This was reached by considering the backlog of uncollected waste computed under (c) and (d) above. Where the percentage of backlog greatly exceeds the amount collected it was assumed that the urban environment was polluted in one way or another.

5. Conceptual Framework

The conceptual framework is shown in Figure 1, and labelled 1–9. Rapid population increase (1) is the source of increased generation of solid and sewage wastes (2). Efforts to remove and safely dispose wastes assumes two things: first, the financial position of the municipal government budget for such social services; and second, urbanites' educational level and attitudes towards handling their domestic wastes in order to assist the municipal government. If one or both of this mechanisms work well—e.g., the municipality has better and adequate waste clearing and treatment facilities, i.e., adequate funds and good waste management—and a literate, self-mobilized urban community to assist it in this task (9), then a protected and health environment can be expected (4,5).

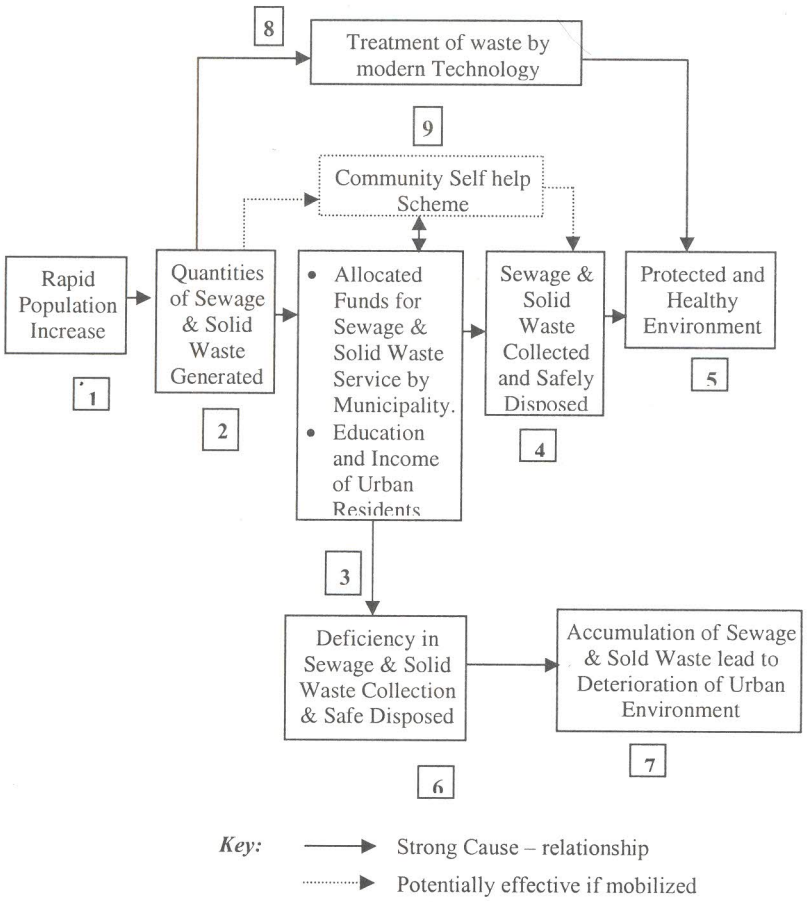


Fig 1: *Conceptual Framework for Prevention of Domestic Waste from Polluting Moshi Urban Environment*

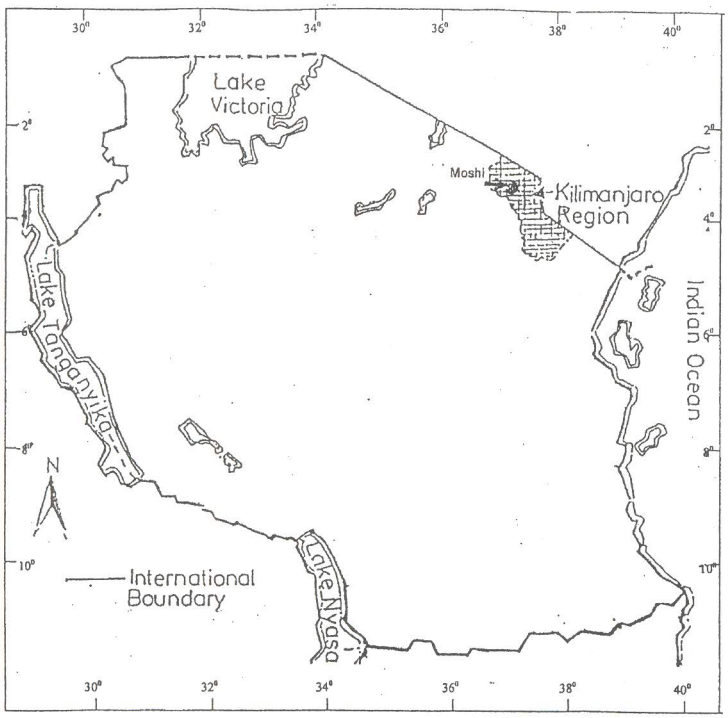
Contrary to this, collection and disposal of domestic wastes lag far behind, and hence get out of control (6); resulting into deterioration (pollution) of the urban environment (7). The model suggests that the environment could be saved from contamination by preventive measures or precaution given under (2) and (3).

This framework can be implemented if (a) there is adequate investment in modern technology for waste treatment and recycling; and (b) modern technology in waste treatment is supported by community-based action for a cleaner and healthier environment.

6. The Study Area and Research Methodology

6.1 The Study Area

Kilimanjaro region is located in North Eastern Tanzania, and lies between 2°50′ 4°30′ latitudes south, and 37° and 38°20′ longitudes east (see Fig. 2). Moshi Municipality, with an area of 77km², is part of the foothills of Mount Kilimanjaro, the highest mountain in Africa towering at 5,600 metres above sea level.



Source: Kilimanjaro Region Planning Office

Map 1: *Location of the Kilimanjaro Region in Tanzania*

The relief rainfall (mean annual of 860 millimetres), and the fertile volcanic soils—both originating from the mountain—form a naturally rich agricultural land surrounding the municipality. These qualities account much for the abundance of food; mainly bananas, maize, and beans which feed the largely expanding population. This has led to a culture of high fertility as revealed by the 1978 and 1988 National Population Census (NPS) when the Total Fertility Rate (TFR) for the Kilimanjaro was the highest at 7.0 and 6.6 respectively. The long sustained high fertility in the area has resulted into population pressure over the limited arable land (Maro, 1975). Consequently, population pressure, *inter alia,* is the major push factor in the rural-urban migration in Kilimanjaro region.

6.2 Research Methodology

The sample size comprised 8 out of 15 wards, covering 410 (2.05%) households with a total population of 2027 people living in differentiated residential settlements, i.e., low, medium, high densities, and in squatter areas. The latter were further re-grouped into two main categories related to similarities of socio-economic status for simplicity of the study, namely, low/medium density; and high density/squatter. The generation, collection, and disposal of sewage and solid waste were estimated using the "Environmental Empirical Models" (Gauff, Brown & Partners, 1980:13; Haskoning, 1989:15; CODESTRIA, 1986: 22). While comparative analysis was employed to compare population change and the municipality's budgets, multiple regression analysis was applied to determine relationships among different variables.

7. Data Presentation

7.1 The Demographic Factors of Moshi Municipality

Moshi Municipality had a total population of 96632 people in 1988, with the following composition: 38.1% children, 59.7% working people, and 2.2% elderly (Bureau of Statistics, 1990:2, 36). The sex ratio was almost 1:1 with slightly more females. The 1993 Moshi Municipality Survey (TDHS, 1991/1992:8) obtained roughly the same population proportions.

Three major components of the urban population change were studied: natural increase, migration, and boundary re-classification. Findings showed that Moshi municipality experienced rapid urbanization. The main sources of population increase were natural increase by 45%, and rural-urban migration by 43.1%. The fact that natural increase was slightly higher than rural-urban migration emphasizes the high fertility rate in the area. The role of Moshi boundary reclassification was traced by comparing the total populations of the 1978 (52223) and 1988 (96645) national censuses, which showed dramatic change. The population change occurred when some former rural villages were incorporated into Moshi Municipality, raising the number of wards from 13 to 15.

It is clear from the above that Moshi Municipality is facing rapid urbanization caused by three factors ranging from natural increase, rural-urban migration, and boundary reclassification. This fast increase in urban population has a detrimental effect in the provision of basic social services, including solid waste management.

7.2 Quantity of Solid Waste Generated

The total waste generated per annum in 1993 by the sample population of 2027 people was 388 metric tons. Of this, 1649 people in high density/squatter areas generated 81.4%, while 378 people living in low/medium density area produced 18.6%. The high percentage of domestic waste generation in the high density/squatter area is mainly a function of population increase. Municipal officials revealed that at the time of the survey, only 1 truck out of 5 bought in the 1980s was in working order serving the entire region, while funds allocated for domestic waste service were only Tshs. 1,200,000/=. There was thus an acute shortage of facilities and financial resources needed for the collection and disposal of increased solid wastes generated by the expanding urban population.

7.3 Relationship Between Population and Collection of Solid Wastes

There was a negative relationship between population increase and the collection of solid waste, funds, and vehicles allocated for the service. This relationship was found out by computing the total quantity of solid waste generated for year 1978 and 1988 less the total quantity of solid waste collected and disposed by an average of 4 trucks. It was found out that despite the increase of trucks from 3 (1978) to 5 (1988) for the collection and disposal of waste, over 82% of solid waste remained uncollected. This was partly due to meagre funds allocated for waste management: from Tsh 650,000/= (1978) to Tsh 1,200,000/= (1988), which was a negligible financial increase when compared to the population increase and inflation rates. Regarding the number of vehicles (5), these were inadequate to cope with the increased waste output.

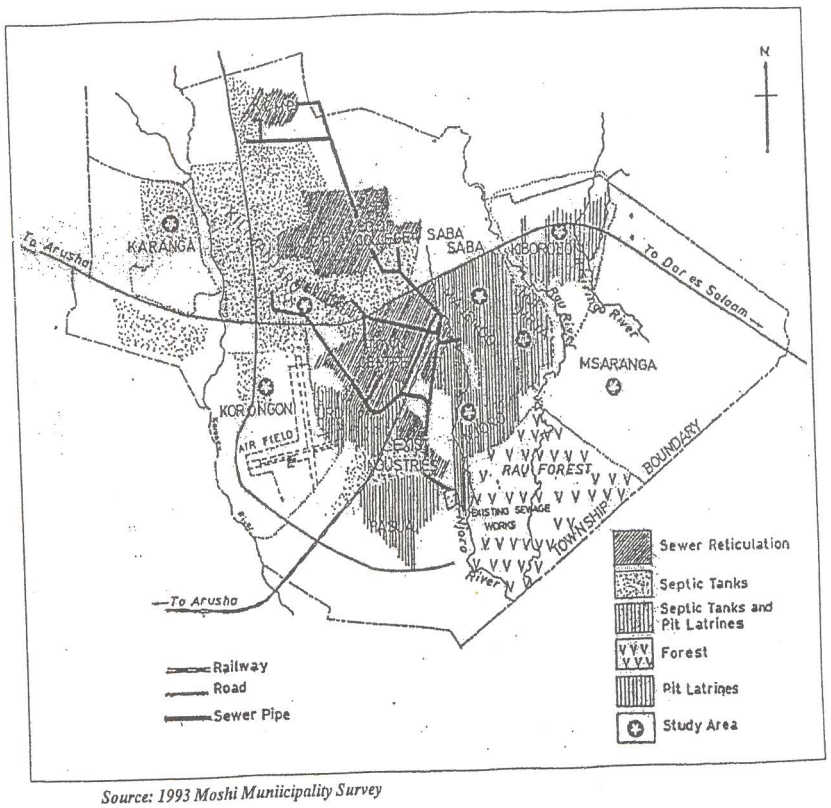
Furthermore, the results were confirmed by a multiple regression analysis suggesting that rapid population increase had negative relationship with cash and number of vehicles that the municipality provided for solid waste management. Consequently, the urban environment was polluted in one way or the other by a huge backlog of solid wastes.

7.4 Relationship Between Population and Collection of Sewage

Negative relationship existed between population increase, collection of sewage, funds and the number of cesspit emptier trucks allocation for sewage service in the Municipality. The findings further showed that the collection and disposal of sewage generated by the rapidly increasing urban population overwhelmed the municipal collection facilities, averaging 3 cesspit emptier trucks, and the meagre financial resource.

7.5 Ability of the Municipal Sewage Trickling Filter Plant (TFP)

The TFP plant is connected to the one public sewer occupying the centre of Moshi town as appears on Map 2, before it was recently extended to the Cooperative College and Kilimanjaro Christian Medical Centre (KCMC). Initially, in the early post-independence era, the TFP served a relatively small urban population in the low/medium density area. With the passage of time, the population increased due to spontaneous rural-urban migration and natural population increase while the TFP capacity remained constant, i.e., 13.5 cubic metres. Frequent breakdowns of the plant were reported due to sewage overload from public sewers. Some sewage started overflowing into Njoro River, where the plant is situated, thus polluting the river.



Source: 1993 Moshi Municipality Survey

Map 2: ***Administration and Sanitation Diagram of Moshi Municipality***

7.6 The Municipal Solid Waste Dumpsite

The refuse dump is located in the southern fringes of the Municipality near the TFP, and has an area of 4 acres. The survey noted that there was uncontrolled dumping of waste: domestic, commercial, and industrial refuse were often

dumped together and rarely covered with earth to reduce risks of scattering and contaminating the surrounding areas. Foul smell and smoke from spontaneous fires of burning refuse were common pollutants. The uncovered dump became one of the main sources of environmentally associated diseases affecting mostly children from poor families who were seen scavenging around the dumpsite. In addition, run-off and wind further spread the waste into surrounding areas, rivers, and wells; hence contaminating the very sources of domestic water for neighbouring residents, notably in Njoro, Mji Mpya, etc.

7.7 Attitudes and Practices of Urbanites Towards Management

Pit latrines are the usual toilet facilities for squatters in high-density area, where 69% of the residents had only primary education, of which only 25.8% had health care education. Some 45% of the low-income earners could not afford to install flush toilet facilities. Around 74.4% of the pit latrines were found to be in bad sanitary conditions, i.e., they were dirty, shabby, roofless, or made up of scrap and old materials. In contrast, 46% of the urbanites living in the low/medium residences had at least secondary education, primary health education, and relatively higher income. Most of them possessed decent flush toilets connected to the public sewer or septic tanks. The study revealed that the latter's good education, income, and managerial positions influenced the installation of high quality toilet facilities, and the frequent availability of the Municipal sewage and solid waste collection services in their residential areas. It was noted that these privileges were also part of the legal rights given to residents living in planned areas.

Attitudes and practices of urbanites concerning collection or treatment of domestic wastes where municipal facilities were not provided differed between the high density/squatter and low/medium density residents. The former simply dumped the uncollected wastes haphazardly on the ground, hence increasing the chances of polluting the environment. Moreover, pit latrines were substandard, and were usually abandoned once filled due to the inability by majority of the poor squatters to hire private cesspit emptier trucks. Furthermore, over 50% of 410 households in the high density/squatter areas were not surveyed, and thus not accessible to the municipal's waste collection trucks.

The urbanites had the mentality/attitude of placing the whole domestic waste collection responsibility on the Municipal's shoulders simply because they paid multiple taxes to it. Implicitly, community mobilization or cost sharing is yet to be appreciated. This is further complicated partly by ignorance and poverty, whereby cost sharing is seen as another form of tax to the already overtaxed community. In contrast, there was great awareness and demand by the low/medium density residents for a healthy environment, facilitated by access to public waste collection facilities. Partly due to this public health awareness, those who could afford—mainly those living in the medium/low density areas—were willing to hire private waste collection vehicles.

8. Discussion

8.1 Components of Rapid Urbanization

Rural-urban migration has for long been cited as the main source of rapid urbanization in developing countries (Maro & Mlay, 1979), and in developing countries generally (Todaro, 1982:213). However, other scholars have also argued that natural increase is the leading component in rapid urbanization in Tanzania and LDCs in general (Hayuma, 1979:119; Lugold *et. al.*, 1977:76). Boundary reclassification also contributes in the expansion of the urban population as has been in the case of Moshi Municipality, and this concurs with other studies in developing countries, e.g., Thailand (Goldestein, 1978:239-258). The foregoing arguments show that rapid urbanization is a result of several population components interacting at varying magnitudes in different places, depending on the social, economic, and political conditions prevailing in a specific area.

8.2 Impact of Rapid Urbanization on Urban Environment

The TFP in Moshi Municipality failed to treat sewage efficiently because of being overwhelmed by a rapidly increasing urban population. This phenomenon is observed in most of the developing countries, which were former colonial dominions whereby such plants were purposely designed for a small urban elite, i.e., Whites and Asians under restrictive colonial population policies (Wekwete, 1992: 130-135). The lifting of such policies at independence opened the floodgates for rapid urban population growth that was not matched by increased capacity of sewage treatment plants. As an outcome, water contamination by sewage and solid waste has become a common problem in many LDCs, made even worse by grinding poverty and rampant illiteracy. This situation had taken a heavy toll on human life due to endemic water-borne diseases such as cholera. Uncontrolled throwing of refuse into Rau, Njoro, and Kisiringo rivers in Moshi urban by nearby squatters has polluted these rivers, posing a constant threat to the health of the urbanites. When combined with sewage escaping from the TFP, the nearby dumpsite together with the construction of pit latrines near the and Njoro river has further contaminated the river which is the main source of drinking water for the ignorant and poor squatters. An earlier research by the National Environmental Management Council (NEMC) had a similar conclusion:

> Sanitation conditions in Moshi i.e. sewage, seepage from pit latrines, run-off drainage and solid waste, do not differ from other towns in the country. Generally the conditions are poor hampering the life quality of the town dwellers through filth, pollution and spreading of diseases. There have been cases of cholera. Njoro is the main recipient of the town effluent (NEMC, 1989:3).

Human sufferings from the polluted urban environment were also confirmed by the 1993 Moshi Municipal Survey, which cited the presence of 4 out of the 15 leading environmental killer diseases: cholera, skin diseases, diarrhoea, and intestinal worms (Moshi Municipality Records, 1991 & 1992:7 & 5). This is indicative of the serious and harmful effects of a polluted environment on public health.

The above observation tallies with global experience as documented in other studies, for example that of UNCHS in 1994 which concluded that: "Environmental hazards endanger lives, health and livelihoods of urban populations. Consequently...affect the urban poor, who often live and work in ...the vicinity of dump sites for refuse and major industrial polluters" (UNCHS, 1994:14). According to this study, the possible causes of urban environmental pollution were mainly two. First, rapid urbanization, coupled with municipals' limited budgets to cope with large quantities of domestic wastes. The government of Tanzania supports this in its observation that, "The social sector has lagged behind because... Government's ability to finance these services is very limited...due to rapid increase in population" (URT, 1990:49-50).

Secondly, urban residents—especially the majority who are both economically and educationally disadvantaged—have not been sensitised and motivated enough to know, appreciate, and assume their roles as primary beneficiaries of an aesthetic environment. Most of them still wait for the municipality to remove and dispose domestic wastes since, in their perception, they pay enough taxes for the Municipality/government to carry out such tasks. The policy of economic liberalization of 1984, which advocates cost sharing following the shrink in public expenditure on social services, has not spelt out clearly how to prepare and empower people to undertake greater responsibilities in solving their own social problems. There is need, therefore, to establish better community participation strategies for solving socio-economic problems to ensure sustainable development (Ngware, 1996: 17-78). This view supports conclusions of the WHO Review Team's Report of 1987 after a tour of Tanzania, specifically as a follow-up on community participation in primary health care matters:

> The National Primary Health Care (PHC), underscores the importance of community involvement in planning, implementing and evaluating health activities. Mechanisms exist in Tanzania for Mass mobilization and effective community involvement, they... include the basic Ten Cell Unit and the development Committee at regional and district levels. During the PHC review it was observed that the health sector does not fully exploit these mechanisms for health action except during crisis situations (WHO, 1987: 225).

Likewise, we cannot win the battle against urban pollution single-handedly by leaving the task to the government in a traditional or conventional approach where the local authority alone is expected to have both operational and institutional responsibility for waste management service (Halla & Majani, 1999:351). Other key partners —including the central government, the private sector, the community at large, and other interested stakeholders—have also to come in. In addition, we have to adopt modern technology in the management of large quantities of waste resulting from rapid urbanization. Modern technology is needed to transform the otherwise garbage and sewage to fertilizer for agriculture; or to reusable metal, plastics; paper, or methane. This is possible with LDC's through a number of ways; one being the establishment of technological cooperation with developed countries in the spirit of sharing knowledge for mutual benefits of social and economic development.

An example of such cooperation is the Thies Abattoir in Senegal. This abattoir once polluted the environment through decomposing animals' stomach contents, blood, and visceral matter. Senegal managed to adopt modern technology by installing a waste treatment plant through technical cooperation between a home-based company, SERAS, and a foreign international firm, CIRAD (Farinet & Forest, 1993:6). The effect of the plant was felt only six weeks from its installation – 90% of the pollution dropped. In addition there was compost, biogas, and energy for a 20KW generator used to supply electricity to the slaughterhouse.

9. Conclusion and Recommendations

This study has established that Moshi Municipality, like most urban centres in developing countries, is experiencing rapid urbanization caused mainly by rural-urban migration and natural increase. As a result, there is rapid growth of sprawling squatter settlements. The low levels of education and income among the residents in the squatters contribute greatly to urban environmental pollution. The municipal's limited financial resources and waste management capacity are overwhelmed by the large quantities of wastes generated by its rapidly increasing urban population, leading to environmental pollution.

The Municipality, however, cannot escape the blame on contributing to urban pollution by not utilizing appropriate methods of safe disposal of wastes. For example, refuse is often left uncovered by earth at the dump site, sometimes commercial and domestic wastes mix together, there are spontaneous fires left to pollute surrounding areas, and so on. This renders the Municipality prone to environmental diseases, and thus urgent measures are needed to contain the environmental pollution particularly in surrounding residential areas where the poor live. Permanent strategies to alleviate the problem and create a healthy sustainable environment are not available, apart from sporadic crisis campaigns at the outbreak of epidemic environmental diseases, e.g., cholera, skin diseases, etc.

From the above, we recommend the following to policy makers, and stakeholders in general, on containing domestic wastes problem in LDCs' urban centres:

1. Mobilization of community participation by sensitising the people to be conscious of their environment, and to take the initiative of improving and developing it for the people's common good.
2. Utilisation of modern technology to arrest the situation, because reliance on collection and disposal of wastes in open dumpsites is a menace to nearby residents.
3. Good governance to tackle a number of socio-economic and environmental problems, e.g., the alleviation of the rural/urban economic imbalance that creates the rural-urban pull factors. This can be done through modernization of the rural agricultural economy to reduce or reverse the trend.

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