

Population Increase and Vulnerability to Disasters In the Informal Settlements of Mwanza City, Tanzania

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Abstract

Urban population growth has demonstrated synergetic relationship with the growth of informal settlements and disasters. The increase in the number of people and their properties in informal settlements have accelerated the vulnerability of communities to disaster risks. This study employs Participatory Disaster Risk Assessment (PDRA) methodology to analyse vulnerability to disasters at household and community levels. Analysis and interpretation based on socio-economic and political ecology status of local community revealed that people living, and working in Mwanza city and their properties have been exposed to natural, human-made and human-induced hazards and disasters. The study revealed that these disasters have threatened and destroyed the economies of poor households, both in terms of their frequency and severity of the damages. The study findings show that the future stability of Mwanza city ecosystem is on threat should the increased number of people and human activities on hazardous land persist. To improve quality of life and safety in the community prone to natural, human-made and human-induced disasters, there should be mitigation measures and strategies to reduce severity of disasters and to improve safety and security of people and their property. The study recommends that measures and strategies aimed at reducing disaster should address the whole set of issues leading to poverty and disparities within the community under the umbrella of neo-liberalism.

Keywords: population increase, vulnerability to disasters, informal settlements, Mwanza city, Tanzania.

1. Introduction

In 2002, Tanzania had a total population of 34 million people (URT, 2002), 23% of whom lived in urban areas. It is estimated that 70% of this urban population lives in informal settlements. Poverty is one of the common features of a communities living in informal settlements (Satterthwaite, 2001). Poverty refers to the reality in which people whose per capita income is not sufficient to finance the cost of elemental normal expenditure (Pino, 1997). The World Bank (1989:12) estimated that around 330 million city dwellers, or 28% of the developing world's population, lived below the poverty line of US\$1 per capita per day.

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Due to the existing social, political and economic conditions in Tanzania, unskilled and poor people suffer from living in poor environments created by rapid expansion of unplanned and uncontrolled urban development (Ayers & Hug, 2009). As noted by Barbier et al (2010), such urban dwellers become a cause of ecological deterioration by over-exploiting surrounding resources. Also they neglect environmental quality under the pressure of survival (Justus, 2010).

The number of unskilled and poor people in urban areas in Tanzania has been on the increase (Rugumamu et al, 2009). However, the nature and characteristics of people living in informal settlements and the degree of vulnerability to disasters are not clearly understood. As a result few interventions and common misconceptions in disaster management have been a regular phenomenon, with most of the interventions being directed towards disaster response (Rugumamu et al., 2009; URT, 2005). This approach is also supported by Act number 9 of 1990 on disaster relief and its coordination in Tanzania (URT, 2004).

The theoretical underpinning of this study is that there is a complex relationship between and among individuals, local communities and Mother Nature. Under normal conditions, the intricate linkage between community and the nature in a given ecosystem is supposed to create a balance between human beings and nature. However, Pelling (2003:20) observes that rapid population increase in the cities of developing countries is a major factor in the increased vulnerability to disaster, particularly to the low-income families living in squatter settlements. Urbanisation leads to pressure on land resource as migrants move into already overcrowded cities (Lupton & Woltson, 1994). New urban arrivals have few alternatives other than to occupy unsafe land, construct unsafe habitations, or work in unsafe environments prone to disasters (URT, 2000).

For the purposes of this study, a disaster refers to a single serious disruption or a series of such disruptions, which significantly affect the functioning of a society, causing widespread human, material or environmental losses, which exceed the ability of the affected communities to cope, using their own resources (Wisner et al, 2005:50). Expressed schematically, a disaster refers to a cross-cutting combination of settlements on hazardous areas and a community's capacity (Figure 1). Community capacities are found in resources and skills people possess, develop, mobilize and access, which allow them to have more control over shaping their own future and to cope with disasters (Imelda & Zubair, 2004:5). The lack of community resilience or ability to cope and recover from hazards may result into increased vulnerability to disasters. Imelda and Zubair (2004:18) defines vulnerability to disaster as the extent to which the community, structures, services and geographical setting might be damaged or disrupted by the impacts of hazards emanating from the lack of resources, skills and social services. The exposure to hazards is a threat to a community's capacity to cope and recover from disasters, thence increased vulnerability to disasters.

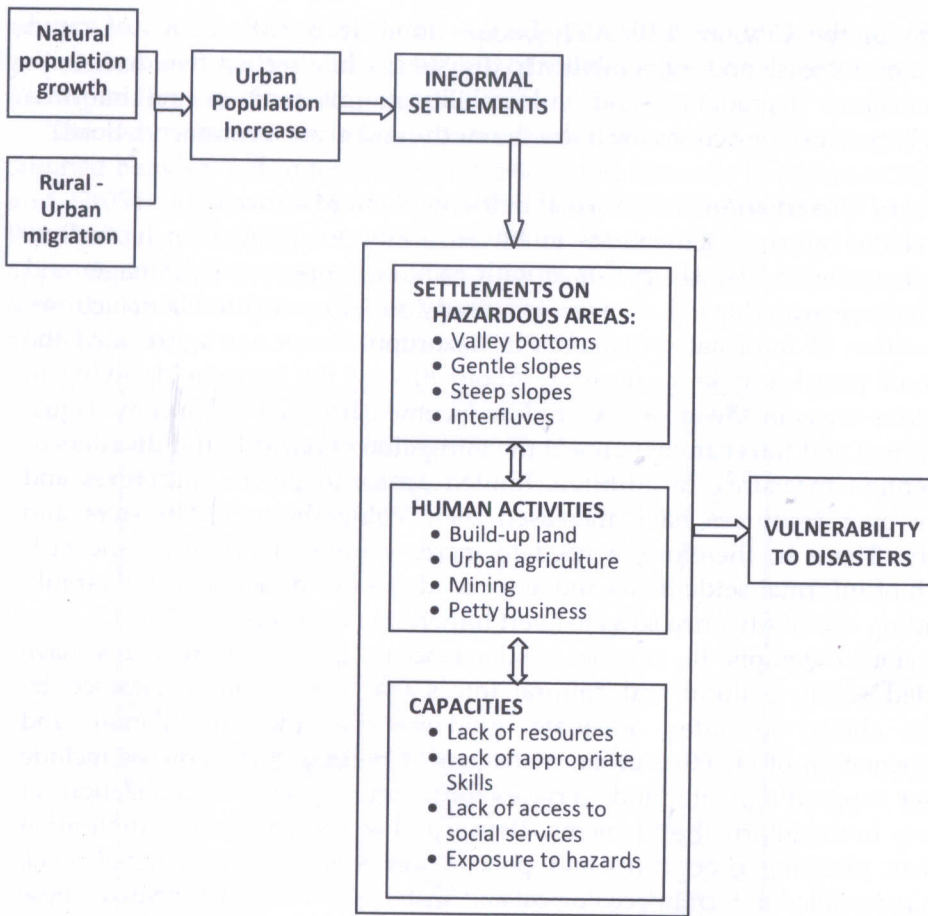


Figure 1: Population Increase in the Informal Settlements and Vulnerability to Disasters

Vulnerability to disasters is the function of past and present social, economic and political factors that may have influenced people’s capacity to anticipate, cope with, resist and recover from the impact of hazards (Fekade, 2000:130). A hazard refers to any phenomenon, substance or situation that has a potential to cause disruption or damage to infrastructure and services, people, their property and environment (IDNDR, 1996:2). Hazards in informal settlements are categorized into geological (earthquakes, volcanic eruptions and landslides); hydro-meteorological (flood, flash flood, storm and drought); biological (severe epidemic in humans, plants and animals); and technological (accidents).

This paper is divided into six major sections. The next section describes some observations in informal settlements in Mwanza city. Section three shows the evidence of vulnerability to disasters in the City as indicated by findings of a

research in the City in 2010/2011. Section four deals with issues of rapid population increase and vulnerability to disasters; while section five deals with environmental degradation and vulnerability to disasters in the informal settlements. The last section concludes the study, and gives recommendations.

2. Some of Observations in Informal Settlements in Mwanza City

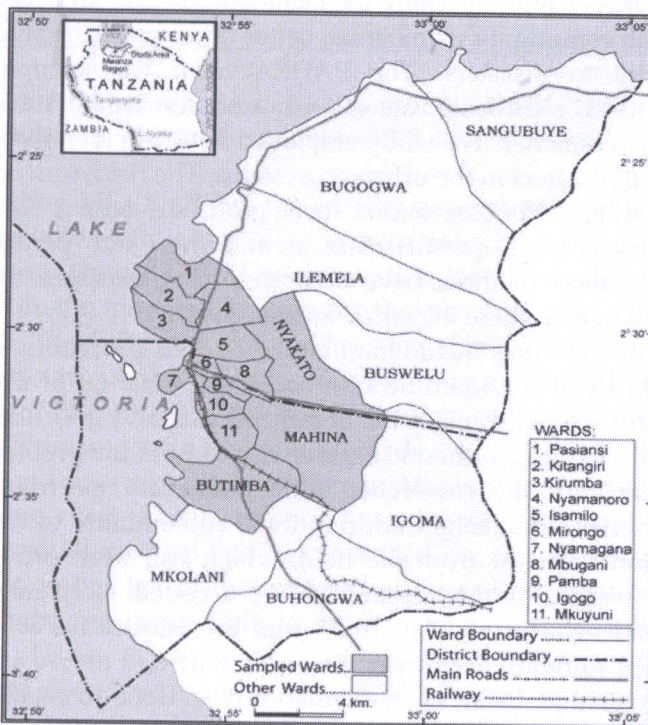
Most of the informal settlements in Mwanza city are located on hazardous areas characterized by steep slopes with rock outcrops, poor drainage, and soils that are waterlogged or even too sandy to support durable structures. Proliferation of informal settlements in hazardous areas has aggravated the degree of people's risks to disaster. About 81% of the households living in hazardous areas in Mwanza city are low income earners. Their income is just for survival and thus cannot support the mitigation of hazards and disasters or intervention measures. In addition, limited access to power, structures and control over resources have increased their vulnerability to disasters and poverty. There is, therefore, a need to increase understanding on the fast-growth of informal settlements and associated risks of disasters in the rapidly expanding city of Mwanza so as to avert impending disasters.

Previous attempts to enhance understanding of such settlements have provided social, political and cultural forces that have been constrained by limited ability to offer adequate guidance for the formulation and implementation of effective urban management policies. Such policies include squatter upgrading, site and services programmes, and formalization of property in the informal settlements. The result has been piecemeal application of urban planning procedures and policies developed at the national level, which have failed in forming ecological and sustainable cities in Tanzania. These have prompted the need to assess the extent of informal settlements growth in relation to urban population increase, and people's vulnerability to disasters in the informal settlements in Mwanza city. One way is through the identification of the location of informal settlements; examining the capacity of people living in those settlements, and the prevailing risk of disasters from hazards in the area.

Mwanza is the second largest city in Tanzania, after Dar es Salaam. The study selected the city because, first, it is relatively not well researched. Most of the studies on informal settlements in Tanzania have been conducted in Dar es Salaam (see, e.g., Kironde, 2000; Rugumamu, 2001; and Kiunsi et al., 2009). Second, Mwanza has a high population growth rate of 3% and rural-urban migration of 11% per annum, which puts severe pressure to the urban poor to access housing, infrastructure, services and environmental resources. Third, a large portion of the city's landscape is ecologically vulnerable. The landscape is characterised by highly dissected steep slopes, rocky hills, narrow interfluves and river valleys which have been settled by poor people without appropriate hazards and disasters mitigation measures. Thus, the city has vulnerable

ecosystems and renders itself an appropriate case study in view of the population increase and vulnerability to disasters in informal settlements that are expanding into hazardous areas.

The city is located on the southern shores of Lake Victoria (Map1). It is situated between Latitudes 2°15'S and 2°45'S and between Longitudes 32°45'E and 33°05'E. It covers an area of 1325 Km² of which 425 Km² is dry land and 900 Km² is covered by water (MCCR, 2007). Of the 425 Km² dry land areas, approximately 86.8 Km² is urbanised while the remaining areas consists of forested land, valleys, cultivated plains, grassy and undulating rocky hilly areas (Mwanza City Council Report-MCCR, 2009).



Map 1: Mwanza City Administrative Boundaries and the Sampled Study Wards

Source: Cartographic unit, UDSM (Drawing by Matias A. Ngowi).

In the research design, a stratified sampling of city landscape was carried out based on the soil-water-slope interaction in order to get the city land units, i.e., interfluvies, steep slope, gentle slope and valley bottoms (Conacher & Dalrymple, 1977). In each of these land units, a random sample of households was selected for interview. With the help of the street leadership, the numbers of sub-street leaders were identified, from which a purposive sampling was taken to include different land users. Nachmias and Nachmias (2000) argues that, for a sample to

be representative enough for statistical analysis, it is recommended that at least a total of 10% of the entire population be taken for study. This study drew a sample of 10% of 4000 households living in the hazard-prone informal settlements.

Data collection involved three main operations: pre-fieldwork, fieldwork, and post fieldwork. Pre-fieldwork involved the collection of secondary information. The data collected here included spatial, temporal, social economic, institutional and technical variables.

Secondary data were gathered from published and unpublished reports, topographical maps and the aerial photos that were used to identify land units, house units and land use/cover. These data enabled the Participatory Disaster Risk Assessment (PDRA) team, especially the facilitator, to gain an overview of the state of art and the community members to better understand the study area and the vulnerability to disasters. The PADRA team was composed of community local leaders, representatives of each land use in the study area, CBOs, NGOs and the researcher. The study employed PDRA in identifying poor people, and analyzing disasters in the urban ecosystems. The fieldwork activities included public meeting, field observations, focus group discussion, structured and unstructured interviews, questionnaire monitoring, and participatory resource mapping. All these methods have strengths and weaknesses, therefore the study used a combination these to complement each other.

The post-fieldwork activities included compilation and processing of data from the field. It involved the identification and categorization of problems and opportunities so as to put in place the organized data and information for the participants to discuss and authenticate; and also to rank the problems and opportunities that enables the researcher and community to discuss and agreed upon the priorities that might address their vulnerability to disasters. Data and information acquired from the field, which had been proved and verified by PDRA team and the researcher, were coded electronically to facilitate analysis and evaluation. The study used the Statistical Package for Social Sciences (SPSS) software to process the coded data and derive a table of frequencies and percentage. Later, cross-tabulation was done to establish the relationships between the household's income and the spatial variation in the locations of informal settlements in the study area.

3. Vulnerability to Disasters in Informal Settlements

3.1 Population Increase and Spatial Distribution of Informal Settlements (ISs)

The rapid population growth of Mwanza city started around the time of independence. According to the population figures indicated in the Mwanza Town Master Plan (1994), the population growth of Mwanza city (by that time, Mwanza district) were as follows: about 19,900 in 1957; 34,861 in 1967; 143,332 in 1978; 223,013 in 1988; and 476,646 in 2002 according to the population and housing census, Mwanza city (see Fig. 2).

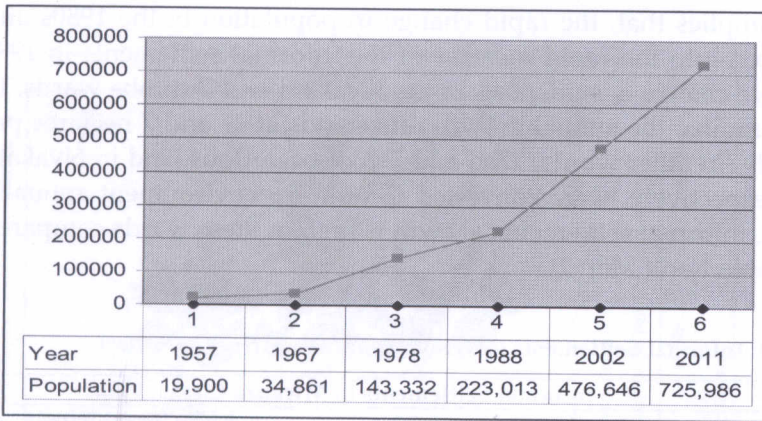


Figure 2: Population Growth for Mwanza City 1957 - 2011

Source: National Population Census Reports 1957, 1967, 1978, 1988, 2002; MCCR, 2009.

According to MCCR (2009), the current population (2011) is estimated to be 725,986 people with an annual growth rate of 3.2% and rural-urban in-migration of almost 11%. The population density is 134 persons per km². Along with the population growth, the physical size of the city has also increased. The hilly topography has, together with the Lake, directed the physical growth of city, which according to the existing Master Plan has taken place along the three major roads leading out from the city centre: the Musoma, Shinyanga and Makongoro roads (MCCR, 2004).

The rapid growth of population in Mwanza city resulting from natural increase and rural-urban migration has instigated the need for more housing and other social services that has exceeded the capacity of the city authority. This situation has led to the invasion of hazardous areas by the poor urban dwellers who are susceptible to natural, human-made and human induced disasters. Using Geographical Information Systems (GIS), the study determined the growth and coverage of informal settlements on hazardous areas in Mwanza City (interval of 17 years) in 1975, 1992 and 2009 (see Table 1 and Map 2). The GIS analysis has shown that there is variation on density of the built environment on hazardous areas. More residential pressure has been put on the gentle slopes than on the valley bottoms and the interfluves of the city. According to interviews with the city council members, the poor people residing on marginal areas in Mwanza city are also marginalized from the city social services because they have settled in those areas illegally. This situation has reduced their capacity to cope with and recover from natural, human-made and human-induced hazards.

Generally, the spatial distribution of informal settlements has revealed that there is an increase in the informal settlements area coverage since 1975-2009

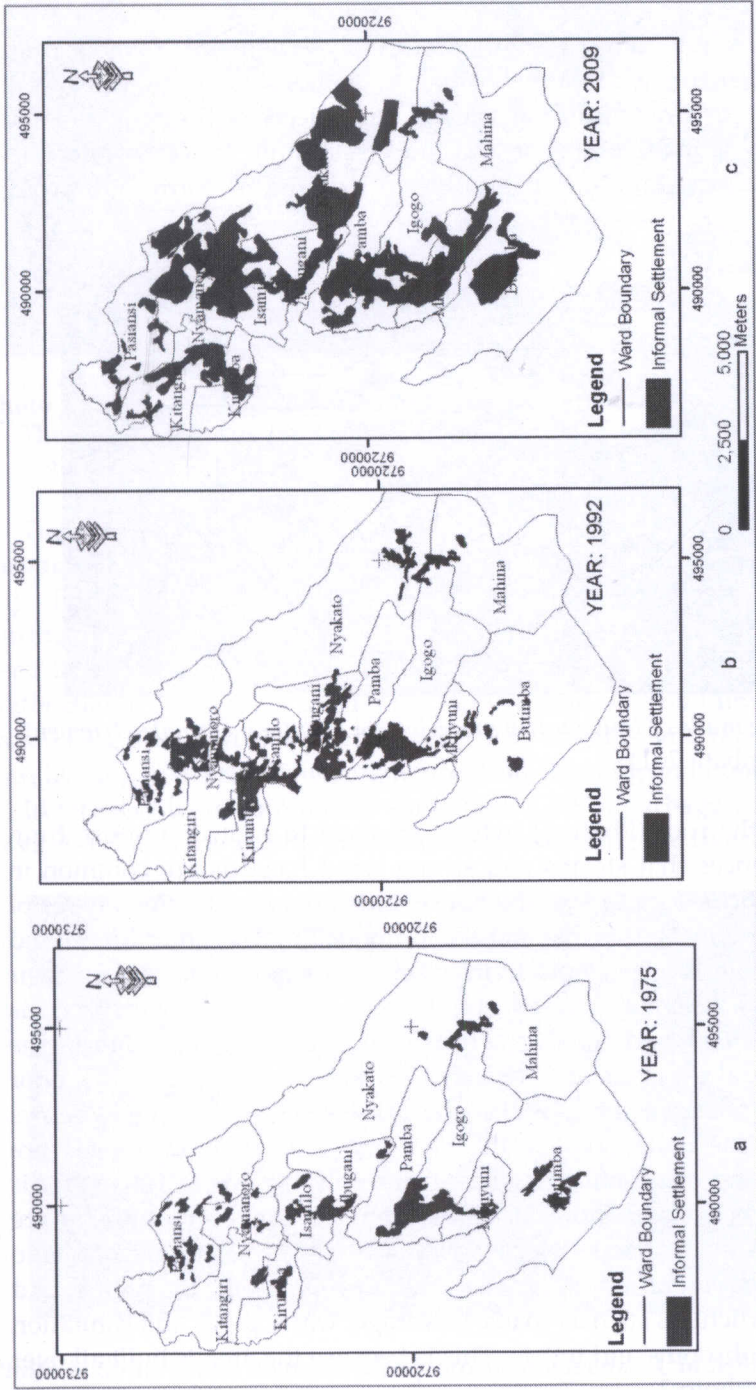
(Table 1). This implies that, the rapid change in population in the 1980s and 2000s has resulted into the rapid increase in the informal settlements in 1992 and 2009. Greater change is evidenced in the Nyakato and Butimba wards. In Nyakato and Butimba, the annual growth rate stands at 27 and 7 hectares per year, respectively. In other words, 27ha and 7ha of hazardous land in Nyakato and Butimba, respectively, were converted to built-up environment annually since 1975–2009. Informal settlements growth is high in these wards compared to others (see Table 1 and Map 2).

Table 1: Informal Settlements Coverage and Change from 1975-2009

Ward	Informal Settlements in Mwanza City								
	Coverage in hectares			Increase in area coverage				Growth rate in past 34 Years	
	1975	1992	2009	1975-1992		1992-2009		1975-2009	Annual Growth
	Ha	Ha	Ha	Ha	%	Ha	%	Ha	Ha
Butimba	31	61	271	30	97	210	344	240	7
Igogo	114	153	213	39	34	60	39	99	3
Isamilo	57	87	113	30	53	26	30	56	2
Kirumba	22	55	127	33	150	72	131	105	3
Kitangiri	12	27	146	15	125	119	441	134	4
Nyakato	16	52	924	36	225	872	1677	908	27
Nyamanoro	25	103	117	78	312	14	14	92	3
Mahina	22	22	22	0	0	0	0	0	0
Mbugani	25	87	131	62	248	44	51	106	3
Mkuyuni	23	35	140	12	52	105	300	117	3
Pamba	88	89	151	1	1	62	70	63	2
Pasiansi	69	366	367	297	430	1	0	298	9
Total	504	1137	2722	633	126	1585	139	2218	65

Source: Calculated from the Aerial Photos of 1975, 1992 and 2009 Interpretation.

During the field survey the study noted that most of the informal settlements (if not all) in the city are located on the gentle and steep hillsides, valley bottoms and narrow interfluves. These settlements are prone to hazards and disasters. It was evidenced from the interviewed households that 68% of the household's incomes are devoted towards addressing vulnerability to disasters issues, while 32% is used for household consumption. This observation strongly coincides with the fact that the more the settlements of poor people are on hazardous areas, the more the risk for them to become poorer as most of their resources will be used for rehabilitation and reconstruction of propertied damaged by recurring hazards and disasters over time and space.



Map 2 (a), (b) and (c): *Spatial-temporal Growth of Informal Settlements (ISs) in Mwanza City (1975, 1992 and 2009).*

Source: Interpretation of Aerial Photos of Mwanza City 1975, 1992 and 2009.

3.2 The Inextricable Link between Human Activities and Disasters in the ISs

3.2.1 Built-up Land

A variety of residential houses in the informal settlements ranged from temporary to permanent, and relatively small to big houses. Most houses were more temporary in nature, with roof patched with pieces of tin or corrugated iron sheets and walls made of stones and mud (see Photo 1). These materials used in houses construction are susceptible to damage if storm and strong wind hazards occur.



Photo 1: *House made of low quality materials in Pamba informal settlement* (Photo: Hambati, 2011).

The stones on the roof (Photo 1), which are used to protect a house from hazards, are evidences that storms and strong wind hazards are common in the area. This is affirmed by 64% of the households interviewed. Such types of houses are vulnerable to storms and flash-floods on the interfluves and hillsides respectively; while people living there are susceptible to lose their properties and lives. They are also susceptible to the related biological hazards such cholera, dysentery and typhoid. This finding revealed that, due to the prevalence of natural disasters such as storm, landslide and flash-flood, poor people are at risk to lose their properties and income. The GIS analysis shows that half of the house units (50%) in the informal settlements in the city are located on gentle and steep hillsides. The geomorphology of Mwanza city is mainly hilly and rocky (see Photo 2). Houses built in such environment are mostly owned by low income people, are small in size, and comprise of one to three rooms. There were no space for the development of public and households infrastructures such as roads, sewerage, water pipes and sanitation facilities such as bathrooms and toilets. This is because the area is built all over as it can be seen in Photo 2.

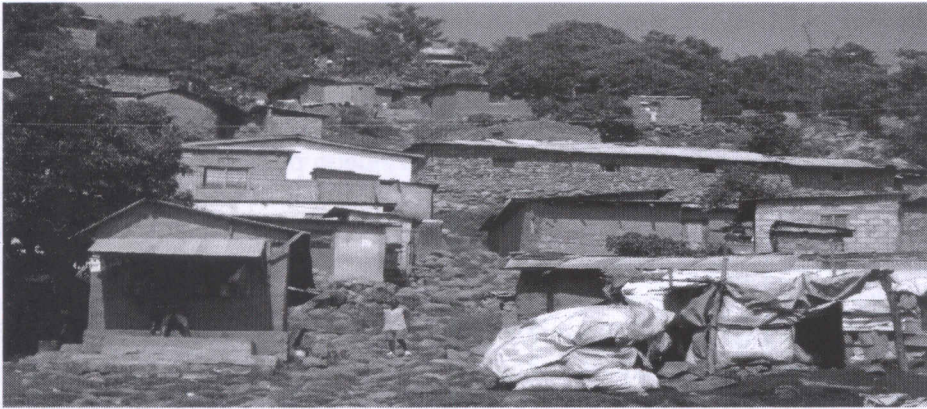


Photo 2: Houses on steep hillsides in Mbugani ward. Note the stony environment. The houses are susceptible to flash-flood and landslide hazards during the rainy season. (Hambati, 2011)

The houses located on the hilly slopes and interfluves are mostly accessible through footpaths (see Photo 2). This implies that in case of emergency disaster (e.g., fire), households in the area cannot be reached easily. The study noted during the fieldwork that some of the houses were built on reclaimed land that used to be the river valleys. Building on such areas has the effect of blocking water channel, especially during the rainy season. The buildings prevent water from being absorbed slowly and evenly into streams, and later into the rivers, thus leading to overflowing and, hence flash-flooding and flood disasters.

In terms of large community sanitation, a lot of garbage was seen piled up in various locations among the settlements and along the riverbanks (Photo 3).



Photo 3: Solid waste disposal along Mirongo Riverbank in Mbugani ward. Note the plastic materials scattered around the area (Photo: Hambati, 2011).

Burning of garbage seemed to be a common practice of managing waste in these areas as there is no garbage collection service provided by the city authority. Furthermore, pit latrines are common in the area. Due to the fact that the water table is high in the valley bottoms and shallow soil depth on the slopes (hilly rocks), it is not possible to dig very deep pits for the purpose, and therefore, a means of channelling the waste out of the pits and into local drainage systems (streams and rivers) has been created.

3.2.2 *Urban Agriculture*

Urban agriculture (AU) is the second major land use in the in the study area. Of the total respondents, 43% confirmed to engage in agricultural activities. The AU is mainly small scale farming, and very few households (5%) engaged in livestock keeping. Vegetables are one of the major crops frequently grown in the valley bottoms, as indicated by 23% of the respondents. Common vegetables grown include spinach, cabbage and eggplants, to mention a few. Other important crops are cereals, cited by 21% of the respondents, which include rice and paddy, and to a greater extent, maize and beans (Photo 4). Bananas (3%), tubers (2%), and fruits (1%) are also cultivated in the valley bottoms. The crops and vegetables in the valley bottoms are susceptible to flood and flash-flood disaster during rainy season.



Photo 4: *Intercropping of crops along the valley bottoms.* (Photo: Hambati, 2011).

About 5% of households residing on the hillsides in the area were engaged in livestock keeping. Animals kept include cows, goats, sheep and pigs. According to the in-depth interviews with the households, 3% mentioned to engage in livestock keeping to get food supplement for their families, while 2% engaged in the activity so as to have organic fertilizers for their farms on the valley bottoms. This means that some of the informal settlement dwellers in Mwanza city are agro-pastoralist. This strongly coincides with the former

activities done by the majority of migrants (87%) in their rural areas: farming and livestock keeping. As such, upon arriving into the city, they utilized their experiences on environmental societal dynamics, relating human action to physical environment in order to survive.

During the field survey it was noted that about 3% of the respondents who were livestock keepers do zero-grazing (see Photo 5), while 2% engaged in free land gazing. According to an interview with one official in the area, the increasing numbers of livestock has been the source of soil erosion and landslide on the hillsides. Because of that, the ward government has been assigned by the city council to institute by-laws, with penalties, prohibiting livestock keeping in the area. However, prohibiting poor farmers from keeping livestock, which is the source of the household income, has resulted into more poverty in the area.



Photo 5: Cattle keeping in Igogo Ward. This is one of the informal settlements on steep hillsides. This activity can cause landslide hazard, as can be seen from the stones in the background (Photo: Hambati, 2009).

3.2.3 Mining

Among other activities, the marginal areas such as valley bottoms and hillsides with outcropped rocks are popular sites for sand extraction and stone quarrying, respectively. Though only 9% of the total respondents mentioned mining as being among their major economic activity practiced, observations showed that it was one of the major economic activity taking place in the areas. Stone quarrying was mostly conducted on the hillsides (see Photo 6). One of the respondents engaging in stone quarrying and crushing activities pointed out that:

Before a stone is crushed, it is severely heated for over 24 hours through the use of metal basin holding fire. After the rock is heated it gets cracks and faults, leading it to fragment.



Photo 6: Stone Mining and Crushing. The stone heating process (at the right), charcoal to be used in heating (in the plastic basin at the fore left) and tools (spade and hammer) normally used in rock mining and crushing. Note the hanging rocks at the background. The area is susceptible to landslide (rock-fall) and soil erosion hazards (Photo: Hambati, 2011).

This activity in the area has aggravated the whole process of rock-fall and soil erosion on the hillsides and ravines. Thence the areas were susceptible to landslides and soil erosion over time and space. The rock fragments and pebbles are further crushed into gravel using hammers ready for supply to construction industries. The land where rocks are mined is normally not filled. The rocks above the slope are left hanging making the whole area at risk of landslide (rock-fall). In case of a landslide disaster, households have to spend some resources for medication and recovery. This situation has increased the vulnerability to disasters, especially to the low income poor families living in informal settlements in the city.

Sand extraction mainly takes place along valley bottoms, especially in the Mirongo river valley. Even though the city council has prohibited this activity, it is still done on the wayside. Field observation during the study revealed that sand extraction activities in the area have substantially increased the rate of riverbed and riverbank erosion, which ultimately threatens the community livelihoods and ecosystems in the area.

3.2.4 *Petty Business*

Due to activities such as agriculture, sand extraction, mining and buildings in the area, secondary activities are automatically attracted to the area. Such activities include those of food vendors who sell food to the miners, of those cultivating, as well as building constructors. This has created employment for others, such as cigarette vendors, juice and other small-bites vendors. In fact even cloth vendors were spotted in the area. In the residential area, there were

small shops that sell consumers items. There were also several small businesses such as vendors selling donuts, fried fish, fried and baked cassava, vegetables, tomatoes, and other groceries items. These household goods are susceptible to dust pollution as can be seen in Photo 7. This shows that although formal employment is limited in the area, the unemployed have in fact found ways to cope with the hardships of urban life through whatever little skills or knowledge they have and can use. However, informal businesses in the city are illegal and temporary as the traders are often subjected to eviction. The eviction of traders who engaged in small scale businesses have led to loss of properties and increased vulnerability to more disasters.



Photo 7: *Petty businesses along the roadside in one of the streets in Kirumba Ward.* Businesses of this nature are illegal and temporary and often the traders are subjected to eviction. Note, the onions and fried fish (at forefront) are exposed to dust and other related pollution that may threaten health of the consumers (Photo: Hambati, 2011).

3.3 Household Income in the Informal Settlements

According to the households interviewed, income was categorized into three main levels: high, medium and low incomes. High income is that which is above the national minimum wage. Medium income is the one which is equal to the national minimum wage, while low income is that which is below the national minimum wage. The majority of the households interviewed (81%) earned between Tsh 39,000 to about Tsh 79,000 per month (Table 2). This was below the national minimum wage, which was at Tsh 100,000 in the public sector and Tsh 80,000 in the private sector. Large proportions of respondents who mentioned income between Tsh 0-79,000 were from Mbagani (13%), Igogo

(12%), Isamilo (10%) and Pamba (8%) wards. Other wards have proportion of respondents less than 8% (Table 2). This implies that, according to the mentioned household income level, people living in Mbugani, Igogo, Isamilo and Pamba wards are more vulnerable to disasters compared to those living in Nyakato, Kirumba, Kitangiri, Mbuyuni, Nyamanoro, Butimba, Pasiansi and Mahina wards. During the household interviews, low income was attributed to the low level of education and informal sector employment. Houses owned or rented by this category of low income earners were made up of poor quality materials, and were located in the valley bottoms, steep hillsides and narrow interfluves. These are areas prone to natural and human-made disasters.

Table 2 Households' Income per Month in the Study Wards

Income category (In TZS) per month	Name of Ward and their proportions of respondents (in percent) Mentioning the category of household income per month												
	<i>But</i>	<i>Ig.</i>	<i>Isa</i>	<i>Kir</i>	<i>Kit</i>	<i>Mah</i>	<i>Mbug</i>	<i>Mkuy</i>	<i>Nyak</i>	<i>Nya'n</i>	<i>Pam</i>	<i>Pasi</i>	<i>Total</i>
	N=	N=	N=	N=	N=	N=	N=	N=	N=	N=	N=	N=	N=
	38	56	45	26	23	10	50	19	24	54	42	13	400
	%	%	%	%	%	%	%	%	%	%	%	%	%
0-39,000	2	10	8	3	3	2	12	3	3	2	7	1	56
39001-79000	3	2	2	2	1	1	1	1	2	8	1	1	25
79001-100000	2	1	0.5	1	1	-	-	1	0.5	-	1	1	9
100001-150000	1	1	-	-	-	-	-	-	-	2	-	-	4
150001-200000	1	-	-	-	-	-	-	-	-	2	-	-	3
200001-250000	1	-	-	-	-	-	-	-	-	-	1	-	2
250001+	-	-	0.5	-	-	-	-	-	0.5	-	-	-	1
Total	10	14	11	7	5	3	13	4	6	14	10	3	100

Key: But = Butimba; Ig.= Igogo; Isa = Isamilo; Kir = Kirumba; Kit = Kitangiri; Mah = Mahina; Mbug = Mbugani; Mkuy = Mkuyuni; Nyak = Nyakato; Nya'n = Nya'noro; Pam = Pamba; Pas = Pasiansi

Source: Disaster Risk Field Survey, 2010

3.4 Recurrences of Disasters in the Informal Settlements

As the disaster profile shows in Table 3, about 281 disasters were reported in the period between 2000 and 2010. These events led to 3227 deaths and 718 injuries, and a destruction of a total of 3,377 houses. The profile also shows the humanitarian/relief agencies that intervened during the events. In the profile, epidemic disasters such as HIV/AIDS and malaria are leading diseases in claiming lives of people in the area. HIV/AIDS has claimed the lives of 2897 people, and was directly affecting 6349 people. This pandemic disease disrupts households' resilience to environmental hazards and health status, thus becoming more vulnerable to disasters and loss of properties. These results imply that most of the household income is used for medication rather than hazards mitigation and prevention measures, thus more vulnerability to disasters over time and space.

Table 3: Disaster Profile in the Informal Settlements in Mwanza City from 2000-2010

Disaster Event	Cases Reported	Time/Year	Disaster Magnitude			Humanitarian assistance/relief	Ward/Place	
			Killed people	Injured people	Destroyed houses			Affected people
<i>Natural</i>								
Flash-flood	6	30/11/2000; 1/12/2000 7/1/2003; 3/12/2006 7/12/2006; 8/3/2010	5	81	989	1,075	Government (PMO), Roman Catholic Relief Services (RCRS), Red Cross Tanzania (RCR)	NM, MB, PB
Flood	3	1/12/2000 7/12/2006; 8/3/2010	42	50	1,413	2,908	Government (PMO), Roman Catholic Relief services, Red Cross Tanzania	MB, NK
Storms	3		2	17	617	636	PMO, RCRS	IS, MB
Rock fall	13	-	4	9	39	52	-	ALL
<i>Epidemics</i>								
Malaria	Varies	-	248	-	-	876	USA Aid Dept, MOH	ALL
Cholera/diarrhea	3	1/12/2000; 7/12/2006; 8/3/2010		-	-	254	PMO, RCR and Plan International	MB, NM, PA
Typhoid	2	7/12/2006; 8/3/2010		-	-	21	-	KR, KT
HIV/AIDS	Varies	-	2,897	-	-	6,349	MOH, World Vision	ALL
<i>Human made</i>								
Fire	63	-	4	32	319	355	-	ALL
Robbery/Stealing	122	-	6	268	-	274	-	ALL
Drug addiction	54	-	7	83	-	90	-	ALL
Boat/ferry accident	12	-	9	178	-	187	-	KR, KT
Total	281		3,227	718	3,377	13,077		

Key: Name of wards: NM=Nyamanoro; MB=Mbugani; IG=Igogo; PS=Pasiansi; NK=Nyakato; IS=Isamilo; KR=Kirumba; MK=Mkuyuni; KT=Kitangiri; MH=Mahina; BT=Butimba; PB=Pamba; **MOH**= Ministry of Health

Source: MCCR, (2009:1-2)

During focus groups discussion in December, 2010, it was mentioned that the city has experienced three severe floods during the rainy seasons of: 1st December, 2000; 7th December 2006; and 8th March, 2010. These reported flood cases led to a loss of 42 lives, injuring 50 people, and destroying 1413 houses, while generally affecting about 2908 people who lost their properties. The mostly affected people were from Mbugani and Nyakato, who were living along the Mirongo River valley. When asked about the lost and destroyed properties, most of the respondents (87%) mentioned domestic furniture, food stock, petty business and crops (vegetables, maize and beans). Public infrastructures such as power lines, roads, and water supply systems were also affected.

As shown in Table 3, there were 13 cases of rock-fall reported to the city authority. This led to the loss of 4 lives, injuring 9 people, and leaving 52 people homeless. However, most of the household interviewed (78%) observed that there rock-fall and rockslide cases reported to the Mwanza city authority were few compared to the real situation. This was because most of these cases and their impacts happened to individual households rather than community as a whole, and were thus overlooked and unreported. According to focus groups discussions, for a disaster to be reported to the authority (Ward chairman/Ward executive officer) it should have at least caused loss of life or affected more than three families who are in need of government assistance and support. In other words, rock-fall impacts at individual households were not reported to the authority. The effects and impacts of other disasters are as shown in Table 3.

The evidence on the prevalence of disaster in the informal settlements in Mwanza city, as shown in Table 3, indicates that there is variation in the level of disaster impacts within and among the categories of low, medium and high income people.

4. Rapid Population Increase and Vulnerability to Disasters in the Informal Settlements

A primary factor linking rapid population increase to vulnerability is the migration of poor population into hazardous areas. As noted during the survey, most of the respondents (87%) in the study area are migrants. According to the 2002 household and population census, the rapid population increase in Mwanza city is a result of natural increase of 3% (births exceeding deaths), and rural-urban migration of 11% (in-migrants exceeding out-migrants) in the period between the 1990s and 2000s (URT, 2002). According to the Mwanza city council annual report (2004), the rapid population growth in the city has exceeded the ability of the municipal government and resources to provide safe structures and housing for the increased urban migrants. The failure of the city council to provide housing services to in-migrants has triggered newcomers to erect illegal shelters in valley bottoms, steep slopes and narrow interfluves. Kironde (2000) noted that informal settlements in Dar es

Salaam city, have repeatedly sprung up wherever people find space, for instance in valley bottoms, which were declared as fragile ecosystems. A similar finding is also noted by El-Masri and Tipple (2002) on urbanisation and poverty in developing countries, where they found that poverty has pushed poor people to live as cheaply as possible on dangerous, marginal sites, and in poorly built houses. Thus, uncontrolled rapid population increases in cities with little care from respective city authorities put many poor urban informal dwellers at the risk of natural, human-made and human-induced hazards and disasters, which in turn increase their vulnerability to poverty as they spend their little income for rehabilitation and recovery from hazards and disasters.

Mbonile (2002) noted that, in most Tanzanian cities, migration has largely been seen as a response to economic and social crises at the places of origin and of destination. From the economic and social perspective, Todaro (1997) notes that the decision to move, and the choices of destinations, are determined by perceived availability of better socio-economic opportunities. Apart from economic, cultural, educational and possibly medical reasons, Skeldon (1990) observes that there are also underlying structural forces that affect the migrant decision-making processes in relation to the destination. These are government policies and a range of ecological factors. As observed during the field survey, because of the 1974 threat of hunger, the government issued directives that every area fit for agriculture should be utilised for that purpose. In most cases this order had direct effects on spatial mobility. Consequently, some people got plots on marginal lands (valley bottoms and on slopes), but it was only for agricultural activities. Later, however, the plots were turned into building land, thus exposing people and their properties to flood and flash-flood hazards in valley bottoms and ravines, respectively, which in turn have resulted into the loss of properties and vulnerability to disasters.

The Mwanza city population growth rate from the early 2000s has stabilised at 5% per annum (URT, 2002). According to UN-Habitat (2003), this annual growth rate is the highest rate recorded in developing countries cities so far. With this trend of growth, Mwanza city population is expected to double in 13 years time. This will require improvement and additional structures in social services and housing. However, this high annual growth rate has resulted in more proliferation of informal settlements into hazardous areas that are overcrowded, and which lack social services. As Tolba (1992) comments, this situation of overcrowding and poor social services in cities has exposed the informal settlement dwellers and their properties to natural, human-made and human-induced hazards.

As Satterthwaite (2001) has explained, the concentration of people and infrastructure in hazardous areas not only creates an impressive symbol of the apparent human domination of nature, but also provides a daunting future prospect in terms of hazard exposure. According to Birkmann (2006), human development on hazardous areas has a dual positive and negative impact. On the

positive side, well-planned hazardous areas with strong buildings, efficient public facilities and good emergency services provide a physical shield against natural, human-made and human-induced hazards. Their growth is often a reflection of economic success and rising of *per capita* income of the residents, while the resulting economies of scale offer opportunities for a better and safer quality of life for many people. On the negative side, urban expansion into hazardous areas has been accompanied by deforestation, slope modification and interference with natural drainage channels on a scale sufficient to increase, rather than reduce, the threat from natural, human-made and human-induced processes which result in hazards and disasters that hamper income prosperity achieved so far.

According to the Mwanza city Council report, 75% of the total population is housed in informal settlements (MCCR, 2009). This proportion is higher compared to that reported by IDNDR (1996), which reveals the proportion of the total population housed in informal settlements in several large cities throughout the LDCs to range from 30 to 60%. The IDNDR report also indicates that most of the people housed in informal settlements (57%) are low income earners. This finding is also supported by the 1999 World Bank report, which reports that around 330 million city dwellers, or 28% of the developing world's population, fell below the poverty line of US\$1 per capita per day (according to the Purchasing Power Parity (PPP)). A similar situation was also observed in Mwanza City during the household survey, where 56% of informal dwellers fell below the poverty line of US\$1 per capita per day. However, when these poor people are asked what poverty means to them, income is only one of the aspects they enumerate, as they also express problems of expressing their opinions to the government, poor levels of health, literacy, education, and a limited range and quality of services. In other words, poverty in the informal settlements is not only defined by low income below the poverty line, but also by the lack of basic ability to satisfy physical needs, or to reach one's objectives of participation in community life, and the lack of influence in decision-making.

The study reveals that most of the informal settlement dwellers (87%) in Mwanza City live in fragile homes, often built of flammable materials, usually without pipe water or reliable facilities for the disposal of sewage and other wastes. These findings coincide with those of Palela (2000) in Dar es Salaam city. The wetlands on which houses are built in the informal settlements have little security of tenure, and the congested streets are difficult to access by emergency services. This implies that informal settlements in Tanzania have got similar features because city authorities have been reluctant to provide social services to settlements on hazardous areas. This is purposefully done to discourage the occupation of fragile ecosystems, even though this increases the degree of vulnerability to disasters in the informal areas.

Smith (2003) notes that the rapid growth of human settlements on unsafe locations and the influx of disadvantaged groups into cities have triggered a challenge for many urban authorities to plan for sustainable development over time and space. This implies that people living in unsafe locations and their

properties are not only exposed to hazards, but are also at the risk from internally generated 'hybrid' disasters such as air and water pollution, fire, diseases and traffic accidents. In addition, the difficulty to fulfil the aspirations of rural-urban migrants creates additional social pressure likely to lead to urban crime, and even terrorism. It is these concerns that create doubts about the long term sustainability of large cities in developing countries.

5. Environmental Degradation and Vulnerability to Disasters in Informal Settlements

Rapid environmental degradation, particularly deforestation and soil erosion due to rapid population growth, triggers disasters. As noted during the field survey, floods and landslides kill people and destroy public infrastructure, housing and harvests. The latter losses, although less spectacular than deaths, represent a critical threat to the economy of a country and its citizens, especially those whose principal source of revenue or livelihood is dependent on agricultural products. Goudie (2006) pointed out that unplanned settlements in valley bottoms and steep slopes in most of the cities in developing countries were blocking water channels, hence causing water to overflow and flood the areas, especially during the rainy seasons. According to Kupaza (2009), the Sustainable Dar es Salaam Programme report (1997) supports this argument by attributing the severity of the Msimbazi floods to a combination of natural causes as well as environment-development interactions, pointing out housing densification and sand extraction as being among the causes of flash-floods and floods. As Masud (2010) has noted, these land uses on hazardous areas in city's steep slopes and valley bottoms have an adverse impact on the people and the environment. However, the majority of the sampled population (90%) denied that their presence had an effect on the hazardous areas. Justus (2010) notes similar observation in Mombasa city, where settlements on hazardous areas have degraded environmental sanitation, but people in the area have denied triggering the situation. Due to the fact that the area is sensitive in terms of settlement legality, there is a chance that the response was made out of fear or self-defence rather than out of sincerity or understanding.

There have been various others studies in the study area on the impact of human activities on hazardous areas by Mbonile (2002), Magigi and Majani (2006), and Katega (2007). These studies, however, did not look into the hazardous areas (valley bottoms, steep slopes and narrow interfluves) as fragile ecosystems embedded with natural and human-made disaster risks, but had other particular concerns, such as pollution and sand extraction. These studies examined the causes of pollution in the Mirongo River valley, and pointed out major sources of pollution. Most—if not all of the studies—cited untreated domestic waste, pit latrines and industrial effluents as the main sources of pollution in the valleys. Findings from previous studies clearly

indicate that valley bottoms, where most of the rivers and streams are found, are polluted with industrial effluents, farming activities and other wastes originating from domestic and untreated sewage. Since most households interviewed (87%) in the study area in Mwanza city reported that there has not been any substantial improvement in small scale industrial technology or in the city's drainage system, it is logical to assume that the situation is either the same or may have even worsened with time and other developments. As Sarah (2011) notes, poor drainage system and sanitation in cities have exposed the communities living there to pollutions and other related biological hazards and disasters such as dysentery and cholera.

As noted earlier, sand extraction activities are carried out in the valley bottoms, while rock quarrying is done on the hillsides in the study area. Jambiya et al (1997) noted that sand extraction is detrimental to the environment, pointing out soil erosion as being one of the most negative consequences of the activity. Kondoro et al (1998) on the other hand, points out other negative effects, apart from soil erosion, to include pitting, changing water courses, reduced biodiversity, as well as building and infrastructure destruction. Main and Williams (1994) observed that rock quarrying and sand mining on the hills and rivers, respectively, disturb nature's equilibrium.

According to Norman (2010), human activities on hazardous areas increase the vulnerability of community and resource to hazards such as floods, flash-floods, landslides and epidemics in urban areas. As noted during the field survey, most of the respondents claimed that their squatting in the valley bottoms and steep slopes have been the sources of seasonal floods and poor environmental sanitation. This situation of poor environmental sanitation has been aggravated by the lack of sanitary services such as sewage systems and drainage facilities in the informal settlements. During the field survey, 78% of respondents in the small scale industries and petty business residing in valley bottoms mentioned flooding as their major problem during the rainy seasons.

Phong (2010) notes a similar problem of flooding in Hong River basin in central Viet- Nam, especially during rainy seasons due to overcrowding of human settlements in the area, which cause a restricted natural seepage of water and accelerates amount of run-off in the area that results in floods, flash-floods and water pollution. Ojo (1996) notes that flowing water in valley bottoms rises up to the surface with a greenish colour during the rainy season. Contrary to Ojo's observation, the flowing water in Mirongo River valley rises up with a blackish colour, and contains domestic and pit-latrines wastes during the rainy season. All studies have in common the understanding that human settlements and their socio-economic activities have been the source of pollution in the area. As noted by Pelling and Wisner (2009), this could be the evidence of the community and resource vulnerability to disasters over time and space.

6. Conclusions and Recommendations

Rapid population growth in Mwanza city and the growth of informal settlements on areas prone to natural, human-made and human-induced hazards and disasters have threatened and destroyed poor household economies, both in terms of their frequency and the severity of damage associated with them. These shocks, in addition to causing death and injury, also give rise to long-lasting damage such as the destruction of buildings, homes and infrastructures; and diverting scarce resources to coping with rehabilitation and reconstruction. This in one way or another increases the household vulnerability to disasters.

Effective disaster management is, therefore, a pressing concern for some of the development agencies and governments in developing countries. Indeed, the extent to which resources are effectively applied to mitigating and coping with disasters has immediate consequences for growth and development. The capacity of a community faced with the risk of natural and human-made disaster can be defined as the vulnerability of a society before disaster strikes, and its resilience after the event. Therefore, one can conclude that the adaptive capacity of a community is not in fact externally determined, but related to its level of local development over time and space.

Should the trend of settlements on hazardous land persist, the future stability of Mwanza city ecosystem is threatened, hence more vulnerability to disasters. Therefore, the study recommends the following:

- Improved quality of life and safety in the city through reducing the severity of hazards by introducing community-based interventions aimed at improving safety and security of the people and their properties.
- The local government, together with the city authority, should identify the existing house units on hazardous areas and limit further development of the areas by allocating land to those who are in need of land and urban new-comers.
- To reduce vulnerability to disasters in urban ecosystems, community capacity in terms of how to utilize resources on fragile ecosystems should be improved and coordinated by the government through seminars, workshops and public meetings so as to create community awareness on the ill-effects of the utilization of resources on hazardous areas.
- To conduct a study on factors underpinning the emergence and growth of informal settlements (IS), and how these factors can be addressed to curb growth of ISs and their vulnerability to disasters in a city ecosystem (modelling of informal settlements).

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