

# The Emerging Population Increase and Its Environmental Challenges and Remedies in Iringa Municipal, Tanzania

Msafiri Y. Mkonda<sup>1,2\*</sup> and Xinhua He<sup>1,3</sup>

<sup>1</sup>Centre of Excellence for Soil Biology, College of Resources and Environment, Southwest University, Chongqing 400715, China.

<sup>2</sup>Department of Physical Sciences, Faculty of Science, Sokoine University of Agriculture, Morogoro 3038, Tanzania.

<sup>3</sup>School of Plant Biology, University of Western Australia, Crawley 6009, Australia.

## Authors' contributions

This work was carried out in collaboration between both authors. Author MYM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MYM managed the analyses of the study. Author XH managed the literature searches. Both authors read and approved the final manuscript.

## Article Information

DOI: 10.9734/JGEESI/2017/31072

### Editor(s):

(1) Pere Serra Ruiz, Department of Geography, Universitat Autònoma de Barcelona, Spain.

### Reviewers:

(1) Eriogun Henry, Federal University of Technology, Nigeria.

(2) Antipas T. S. Massawe, University of Dar es Salaam, Tanzania.

Complete Peer review History: <http://www.sciencedomain.org/review-history/17868>

Short Research Article

Received 19<sup>th</sup> December 2016

Accepted 16<sup>th</sup> January 2017

Published 16<sup>th</sup> February 2017

## ABSTRACT

The study has shown that the environmental challenges encountered in Iringa and most other urban areas in Africa are due to the anthropogenic activities arising from the influxes of migrants from rural areas. The urban areas are continuing to receive mostly rural migrants beyond their demographic carrying capacities, hence suffering from the environmental degradations arising from the living activities of their increasing populations/overpopulations on struggle to make livelihoods attainable. The aim of this study is to show the link between the influxes of migrants and environmental degradation in the Iringa municipality of the Southern highlands of Tanzania. Household surveys, informative interviews, physical observations, group discussions and literature

\*Corresponding author: E-mail: [msamkonda81@yahoo.co.uk](mailto:msamkonda81@yahoo.co.uk);

reviews were employed in the data collection and crosschecking. The SPSS v. 20, Microsoft excel and themes content methods of data analysis were also used. The results show that poverty and population increase are the root causes contributing about 90% of environmental degradation. In addition, food and energy requirements, and inadequate awareness on the issues of environmental management were found to be obstacles in the addressing of the problem. Deforestation, monoculture, poor waste management, and pollution of heavy metals (especially lead, copper and arsenic) are some of the anthropogenic activities creating environmental degradations in the Iringa municipality. These anthropogenic activities increase the emission of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O), which are some of the greenhouse gases that cause some of the very harmful climate change going on in the world. The study also revealed that, the existing relationship between man and environment is parasitic and asymmetric, and that, there is more environmental degradation than conservation. Therefore, recommends that proper agronomic practices and alternative energy sources should be employed to enhance crops yield and environmental goods and services as well.

*Keywords: Population; poverty; deforestation; energy; environment.*

## 1. INTRODUCTION

According to the report by UNEP [1], it is projected that, the world population will be between 7.9 billion and 10.9 billion by 2050. Rapid population growth has occurred over the last few decades, between 1959 and 2000; the world's population increased from 2.5 billion to 6.1 billion people [1]. This increase is more pronounced in developing countries where environmental conservation is less concerned [2]. Developing countries like Tanzania are probably prioritizing development projects at the expense of environment conservation. Despite the presence of National Environmental Management Council of Tanzania (NEMC), the implementation of the directives set by this environmental organ is hampered by financial, political, legal and other factors which have roots throughout levels from the local to the national. In most cases, NEMC's capacity to tackle the above factors is inadequate [3]. In 2010, the GDP for Tanzania was US \$23.3 billion and the GDP per capita was US \$1,515, thus, this available financial capacity is directed to solving the economic challenges [3]. The country needs to increase economic development in order to attain a certain living standard of its people including through efficient utilization of available natural resources especially land. Rural-urban migration has been a normal routine in most developing countries. As the migrants continue to arrive, the urban populations continue to increase till they exceed the carrying capacities of the urban areas. Mabogunge [4] and Lawi, [5] urged that rural-urban migration is going on as a response to pulling forces (in the urban areas) and pushing forces (in the rural areas). Pulling forces are mainly the good social amenities

provided in urban areas because these services are not provided at all or less provided in the rural areas.

Despite of being useful as labour sources, these migrants are also creators of environmental chaos in their destination areas. Chen [6] was enthusiastic on this and raised a question on the sustainable disposal of urban waste and its management under the continuing influxes of migrants.

Moreover, the impacts of increased anthropogenic activities on the urban environments are mainly due to the increasing pressure arising from growing urban populations. Adegboyego [7], argued that human activities and sheer pressure of human numbers is the major source of environmental stress. Therefore, sustainable utilization of land, forest and water sources and other environmental resources, is main of what would make the human-environment relationship symmetrical and mutual [8].

Although the science of assessing environmental impacts caused by population influx in most urban areas of sub-Sahara Africa is progressing rapidly, a variety of knowledge gaps still exist. Therefore, this study dwells on anthropogenic activities and their environmental impacts in urban areas.

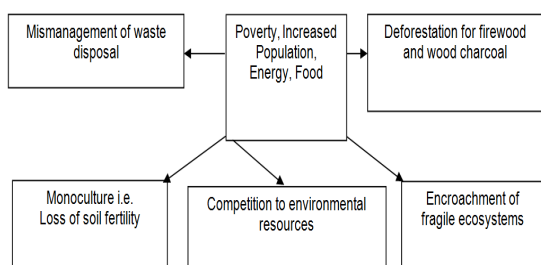
Aim of the study is to investigate existing anthropogenic activities and their environmental implications in urban areas, with the Iringa Municipal in Southern Tanzania the case study urban area. These anthropogenic activities evolve from the continuing and increasing

migration of people from the rural areas to the studied Iringa municipal area.

Trends of population growth, root causes of the environmental degradation, driving needs (food, water and energy), nature and types of activities impacting the environment and finally have been highlighted, and some mitigations of the problem recommended in this study.

## 2. THE CONCEPTUAL FRAMEWORK

Since the ancient population models on migration by Ravenstein (1875), Stoufer (1940), Zipf (1949), Gravity modal (1960), Lee model (1966), Mabogunje, [4] and Shark model (1989); population movement has a ground of socio-economic aspects based on the pull and push factors. People moves from their area of origin to the destination anticipating some socio-economic gains. In the study area, despite of the natural increase, rural-urban migration is another cause of this urban population influx. Fig. 1 shows some driving forces for environmental degradation such as extreme poverty and energy requirement. On top of that, population increase subjects the environmental resources into stress. Being; deforestation, encroachment of wetland, poor agronomic practices, waste disposal and competition to environmental resources these leads overutilization of available environmental resources.



**Fig. 1. The conceptual framework showing human-environment interactions**

Source: Created by the author, 2016

## 3. MATERIALS AND METHODS

### 3.1 Profile of the Study Site

The study was conducted in Iringa Municipal in Tanzania. It is in the Southern Highlands of the country. It has a population of 151,345 (as of 2012 census). It is situated at latitude of 7°S and

longitude of 35°E. Iringa region is bordered with different regions; Dodoma and Singida in the north, Mbeya to the west, Morogoro to the East and Njombe Region to the south. It has the total area of km 258,936. The name is derived from the Hehe tribe word *lilinga*, meaning fort. Iringa municipal is the administrative capital of Iringa Region and has 15 wards. Within the municipal there are numbers of human activities taking place. Agriculture, deforestation and settlements establishment to mention few. Within the municipal there are many established industries especially for manufacturing and food processing. The Mtera Hydro Electric power is adjacent the municipal. About 74% of this area was suitable for agricultural activities whilst the remaining area covered by water, parks, hills and forests [9].

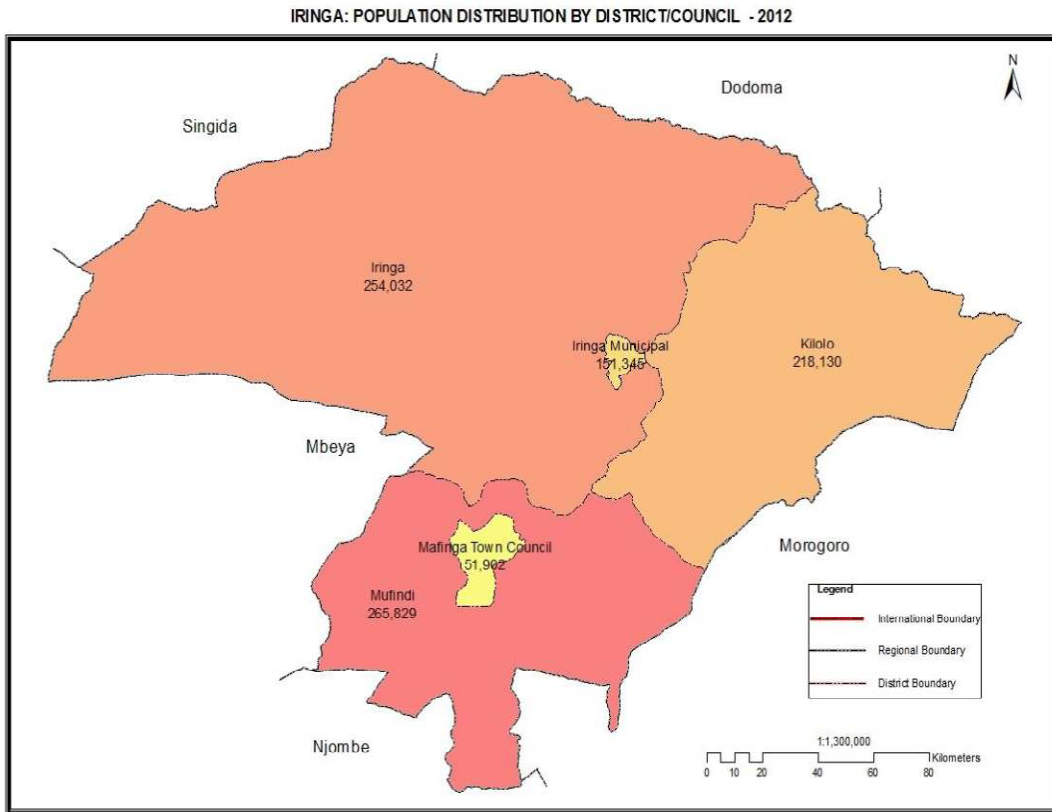
### 3.2 Anthropogenic Activities and Pollution

#### 3.2.1 Agricultural activities

Maize is the major crop produced in the study area. It contributes more than 80% of the cereal crop produced in the region [10]. Furthermore, the crop is a source of key food to the majority respondents. However, long-term production of the crop has exhausted soil fertility. Monoculture is the major contributor of this predicament [10]. In some areas where inorganic fertilizers have been applied, soil microbes have been killed. And in some cases over application of excessive nitrate fertilizer has contributed to emission of nitrous gas into the atmosphere through denitrification process.

#### 3.2.2 Waste disposal

The area experiences the problem of both hazardous and liquid wastes disposal. Some studies show that its only 30% of the produced wastes that are collected [11]. Despite of little awareness on environmental pollution, the rampant increase of people especially through migration has contributed much. It is revealed that; over 20,000 people enters in Iringa municipal every year from different locations for socio-economic reasons [11]. These are many people compared to the town's carrying capacity. Their being in urban produce tones of wastes per year. Interview from the District Environmental Officers supported this verdict.



**Fig. 2. A map showing the study area**  
 Source: NBS and OCGS, [11]

**3.2.3 Pollution from heavy metals**

Heavy metals such as lead, copper, and arsenic are the major atmospheric pollutants in the study area. Their major sources are vehicles, industries and paddy production. Arsenic metal mainly comes as a result of rice/paddy production [10]. There are number of processing industries mainly based on fruits and food processing. These industries cause a lot of atmospheric pollution. The impacts of this type of pollution (heavy metals) are many. To mention few are Sickness or illness (e.g. asthma by pesticides) Mental or behaviour problem (hyperactive, losing memory by heavy metals) Organ damage or failure (Pb, Hg), Miscarriage or birth defect (PCB), Low fertility (pesticides), Irritation (Cl<sub>2</sub>), Death of organisms [12]. Then, it is in these industries were some people moves from rural to urban searching to be employed [12].

**3.3 Data Collection**

A sample of 200 respondents was randomly sampled at household level to undertake this

study. Then, purposive sampling was used to select 2 wards among the 15 wards in the study area [13]. Factors considered for this sampling were the magnitude of environmental pollution and degradation, means of transport and accessibility to the area. Household was taken as a group of people eating on the same pot and forming a family [13]. Household head was the key respondent in that juncture. Household surveys, informative interviews, physical observations, group discussions and literature reviews were employed for data collection and crosschecking [13]. Statisticians, environmental and agricultural officers were among the key informants. Two groups discussion were formed in the two selected wards. In this solicitation study, we arrived in the study area early in March 2015 after following all research protocols. We spent one month for data collection. While coming at a nearby distance we saw bare mountains due to excessive deforestation. The situation indicated that deforestation was at maximum. Another immediate overview was the status of maize crops in the field. Once again the situation revealed that soil had experienced

excessive infertility due to poor agronomic practices and more likely due to monoculture. At the central core (urban) we saw adverse waste disposal emanating from both solid and liquid wastes.

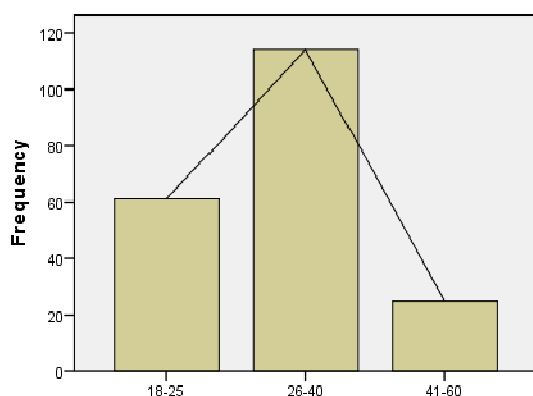
### 3.4 Data Analyses

Quantitative data from questionnaire survey were analysed using Statistical Package of Social Sciences (SPSS) version 20 [14]. This analysis came after the systematic coding of all relevant data [14]. Qualitative data from Participatory Rural Appraisal (PRA's) such as key informative interview, physical observations and group discussions were analysed through content analysis, then were summarized and written in the text.

## 4. RESULTS

### 4.1 Age of the Respondents

Findings showed that, the age composition involved were, 18-25 were 61 respondents (30%), 26-40 were 114 respondents (57%) and 41-60 were 25 respondents (13%). This information implies that, all the interviewed respondents were above 18 years old.



**Fig. 3. Age of respondents**  
Source: Field Survey Data, 2015

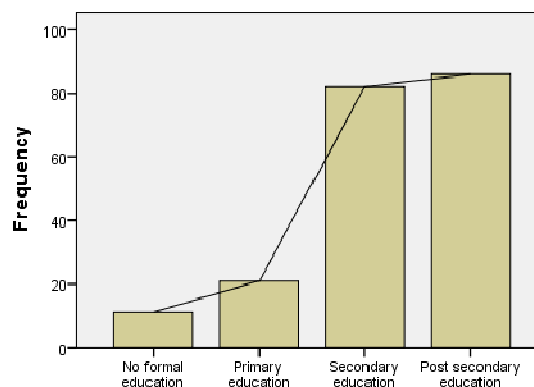
### 4.2 Marital Status

The sampled respondents were categorized into married, single, widow and divorced. These respondents' aspects were useful for determining the responsibility of each group. Final results obtained indicated that, 40 respondents (20%) married while 80 respondents (40%) were single,

50 respondents (25%) were widow and 30 respondents (15%) were divorced. Majority respondents were widows and other married, this means that they were adult. Hence, their life experiences had immense contribution to the research due to involvement in socio-economic activities.

### 4.3 Education Level

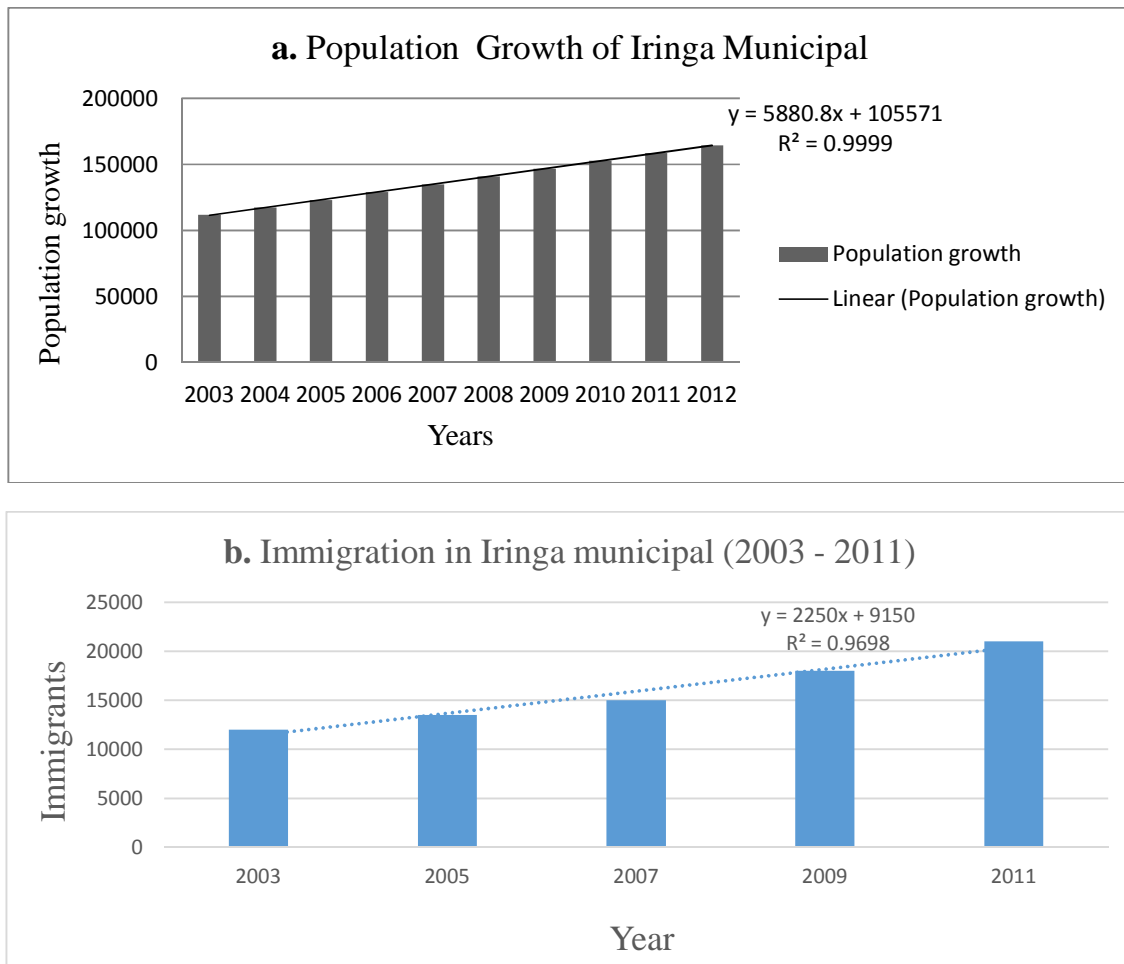
The educational levels of the respondents were as follows, 11 respondents (5.5%) had no formal education, 21 respondents (10.5%) had primary education, 82 respondents (41%) had secondary education, and 86 respondents (43%) had post-secondary education. This educational distribution gave significant validity of the responses as most of the respondents were learned.



**Fig. 4. Education level of respondents**  
Source: Field Survey Data, 2015

### 4.4 Population Growth

The growth of population in the study area was increasing throughout the period assessed in this study. Temporal and spatial population variations reflect the spatial endowments and allocation of the existing resource base. Some areas are high potential zones while others are low potential areas. Result showed that population growth in the study area from 2003 to 2012 has a rapid increase (see Fig. 5). The population data from the field shows that there was slightly increase in number of people. The results show that there is positive correlation between the rate of population growth and that of environmental degradation (Fig. 6). The increase in population exacerbates the magnitude of environmental degradation.



**Fig. 5. Population growth (a) and rate of immigration (b) in the study area (2003-2011)**  
 Source: Field Survey Data, 2015

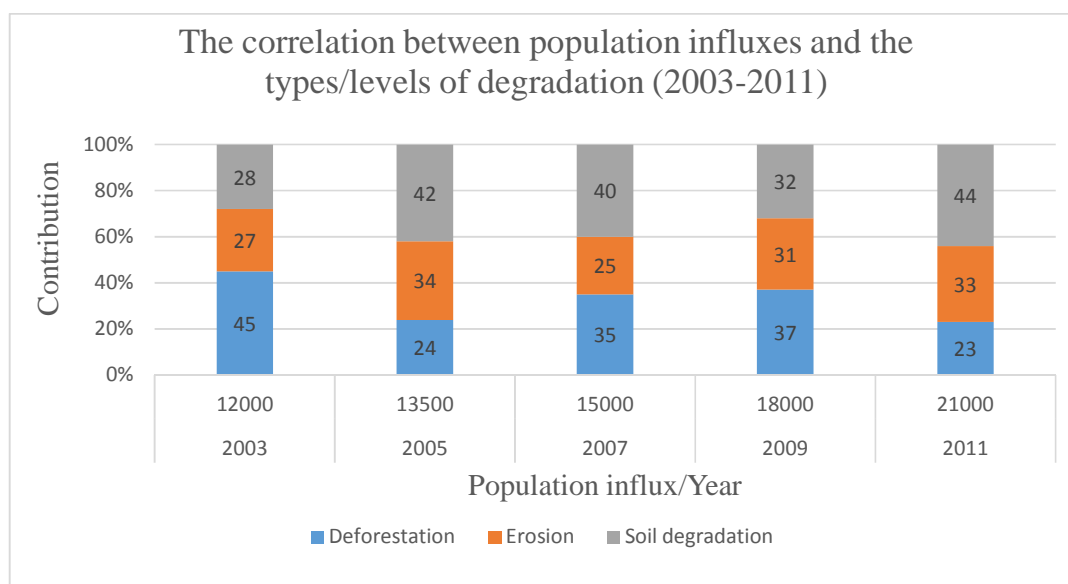
#### 4.5 Deforestation

Over 90% of the respondents agreed that rapid population growth is the main cause of deforestation. It has significantly contributed to forest deforestation searching for goods, energy and other services (Fig. 6). The results are in agreement with those by Adegboyego [7] and Adger [10]. This implies that; the increasing population (Fig. 5) set stress in the environmental resources when in need services and goods (fire wood, wood charcoal to mention few), area for agriculture and for settlement establishment. It has been noted that, Ipogolo, Kibwabwa and Mtwivila Mountains have suffered consequently from excessive deforestation in the area. Firewood and wood charcoal is also a business as some vendor sells them to other

people as a source of earnings. The removal of plant cover on the land also increase the rate of carbon emission into the atmosphere as 50% of the plant biomass is made of carbon, thus cutting tree means we emit that amount of carbon [15]. Therefore, this has immensely contributed to greenhouse gases and carbon being the major emitted gas [15].

#### 4.6 Soil Erosion

Results from field survey showed that a majority of respondents agrees that population growth causes the soil erosion which reduces the carrying capacity of the eroded lands (Fig. 6). Poor agronomic practices which do not follow the landscape tillage requirement are done and have increased erosion [16].



**Fig. 6. Influence population influx in deforestation, erosion and soil degradation I the study area from 2003 to 2011**

Source: Field Survey Data, 2015

#### 4.7 Loss of Soil Quality

Loss of soil quality (soil infertility) is among the core environmental problem in the study area. The results from both questionnaire survey and secondary data showed that poor agronomic practices especially monoculture have been a major source of this predicament (Fig. 6). About 90% of the respondents reported that population increase and abject poverty have forced the peasants to practice monoculture without adding soil organic matter, and thus, degrading soil quality. This verdict is in agreement with most government report which shows that; important soil nutrients like Potassium (K), Magnesium (Mg), Calcium (Ca, Nitrogen (N), Carbon (C) and Phosphorus (P) have been exhausted to the extent that they need immediate replenishments. It is this extent in which soil has failed to support crop production and crop yields thus leading to food insecurity. Therefore, immediate remedies need to be done for the sake of both crop production and soil conservation.

#### 4.8 Mismanagement of Hazardous and Liquid Wastes

The study findings show that industries contribute much to pollution of hazardous and liquid wastes. Hazardous wastes in the study area are in the form of solid and toxic material

such as plastics, metals and metal compounds (NaOH used for removing S in gasoline product), iron, rubber and wires. Whilst liquid wastes are materials ejected from the industries. These can be oils, inorganic solvents, lubricants, acids, diesel, battery solvent, detergent solvents and petrol. All these need proper management in order to avoid environmental pollution. Peasants, food vendors and homesteads have their own contribution towards waste disposal. Their daily activities use plastic bags which are later not well disposed. They end up into polluting the environment due to poor waste disposal to the environment.

#### 4.9 General Impacts of Environmental Problems

UNEP [1], indicates that global and local environmental problems cut across in the wide threshold. In the study area as happens to other areas of the country experiences the following problems and their threats; Ozone depletion(threat to life on earth), Global warming (threat to ecosystems), Acid rain (threat to ecosystems), Air pollution (threat to human health), Surface water contamination (threat to human & aquatic life), Ground water contamination (threat to human & aquatic life), Soil contamination (threat to human & ecosystems), Plant toxicity (threat to human & ecosystems), Food safety (threat to human &

ecosystems), Deforestation (threat to ecosystems), and Wetland disappearance (threat to ecosystems).

These environmental impacts are supported by the findings from the study area in which some of these impacts have started to show up. Government report shows that heavy metals especially lead from vehicles, machines and industries are affecting the wide range of peoples' health such Organ damage or failure (Pb, Hg), Miscarriage or birth defect (PCB) and Low fertility (pesticides) [17]. PRA's results supported through the Iringa Regional Medical Doctor *who said currently there is an increased trend of young age people (25 to 35 years) who experiences fertility problem. Most of these are from town areas (polluted environment by heavy metals). He added that miscarriage has been also increasing among the females living in urban areas.*

#### **4.10 Remediation**

Controlling population increase (natural increase) and migration in Tanzania is very difficult. This is because the Tanzanian Constitution of 1977 gives free movement of people within the country provided that the movement is for good will. In connection to that the incumbent Population Policy of Tanzania (Population Policy 2006) has no restriction on the number of children a family need to reproduce. Basing on that reality; it is better to play with other variables which can be manipulated easily. Subsections below discusses in detail on the needed types of remediation [17].

##### **4.10.1 Sustainable economic development**

The improvement in socio-economic development across the country will speed up the development in other sectors some of which are not entire environmental based [17]. In this stance, people can remain in rural areas where environments are less vulnerable to pollution than that of urban areas. Sustainable agriculture is more preferably and encouraged as it addresses the win-win situation between agricultural development and environmental conservation. Conservation agriculture also involves the mould and ridges farming depending on the land scape. In 1990; Iringa Region (including the study area) had environmental project called; Iringa Environmental Conservation in Iringa (locally; *Hifadhi Mazingira Iringa-HIMA*). However, the project did not excel for a long time due to number of reasons. Some being phase

out of the project and shortage of funds. It is in this note therefore, we need sustainable agricultural development which considers the two variables at par and not being asymmetric and parasitic as it is now.

##### **4.10.2 Application of soil organic manure**

Research findings revealed that; loss of soil fertility has been a key problem in the study area. Important soil nutrients like Potassium (K), Magnesium (Mg), Calcium (Ca), Nitrogen (N), Carbon (C) and Phosphorus (P) have been exhausted to the extent that they need immediate replenishments. Optimal loss of SOM contents can be replenished by organic fertilizations such as cow manure, pig manure and straw. In the traditional homesteads of the indigenous Hehe (study area) population in Southern Tanzania, large amounts of animal manure are usually accumulating and some taken as wastes. In the study area the application of these different types of manure applications can lead to increased soil C and N contents [17]. In areas where there is no access to organic manure, people should increase soil nutrient level by adding inorganic fertilizers i.e. inorganic soil carbon (SIC) in order to improve crop production.

##### **4.10.3 Adoption of alternative energy sources**

In most rural, peri-urban and urban areas of Tanzania; wood charcoal is a major source of energy for cooking in the peoples' homesteads [18]. Since wood charcoal and fire woods are harvested from forest and are source of forest degradation; we need to reduce on this type of energy which is forest dependency [18].

##### **4.10.4 Proper management of wastes**

Better and recommended waste disposal should be applied in order to arrest poor waste disposal. Wastes should be well collected, transported and put somewhere in order to destroy them [18]. Sorting of the wastes can help to reduce the risk of further contamination. Therefore, an integrated approach of waste management, including the use of 3Rs; Reduction (minimization), Recycling, and Recovery. For example; redistilled dichloromethane can be used for attaching rubber gaskets to sewer pipes, metal hydroxide sludge produced from treatment of metal plating rinse can be replaced by an electrolytic and ion exchange metal recovery system and waste solvent from paint-thinning can be reused and for



cleaning equipment and recycling of metals, glass, paper, plastic and rubber [19].

#### **4.10.5 The use of biotechnology in remediation of wastes**

This can involve the applications of chemical, biological or biochemical approach to clean up contaminants or minimize some environmental risks. According to Yang et al. [12]; environmental remediation approaches encompasses (i) *Phytoremediation*; this involves the use species-specific plants to extract, stabilize, or degrade contaminants. It is a cost-effective natural processes that is applicable to metal and organic contaminants, (ii) *Bioremediation*; this involve the use of bacteria or microorganisms to metabolize, detoxify, or degrade contaminants. It is applicable to organic contaminants, and (iii) *Ecological remediation*; this uses earthworms to clean the contaminants.

#### **4.10.6 Forest restoration**

It is wealthier to restore forest for both ecological and human significance. Forest restoration can be done either by conserving the available natural forest or by planting new trees. In the study area, forest degradation has been at maximum. However, if forest degradation can be stopped for at least four years; the study area can experience regeneration of plants [19]. Agroforestry system can also be adopted for environmental goods and services in homesteads. The major significance of forest is carbon sequestration [19].

#### **4.10.7 Improved agricultural practices**

Agronomic practices like better crop rotation contour farming, agroforestry and irrigation agriculture can help to restore the soil quality (fertility). It is these practices which will serve duo purpose of increasing crop yields and conserving the environment [19].

### **5. DISCUSSION**

This paper has shown the impacts of populating influx in most urban areas. There is significant population increase in the study area where it increases at  $R^2=0.99$  as shown in (Fig. 5). In addition, there is significant correlation between population influxes and environmental degradation (Fig. 6). Using the theories like Ravenstein (1875), Stoufer (1940), Zipf (1949), Gravity modal (1960), Lee model (1966),

Mabogunje, [4] and Shark model (1989) and the conceptual framework (Fig. 1); this study has determined the link between population influx and increased environmental degradations in urban areas (Fig. 5). The people from far rural areas migrate to town aiming to attain their livelihoods. However, due to competition over labour work (at destination) i.e. which mostly pay little, a big number of these migrants ends up settling nearby the town (outskirt) involving in small scale farming especially gardening. Here they compete for resources and end up polluting those resources. In some areas, most of the farmers are polluting the soils and water systems through the excessive application of chemical fertilizations they are on unnecessarily.

In the study it was also found that overpopulation complicated the waste production and management. Population influxes appeared to produce more wastes, whereas it is less than 30% of these wastes are collected by the vendors, and thus leaving 70% of them uncollected. In this aspect, water pollution was the biggest challenge due to the presence of the Great Ruaha River nearby which is the source of water for over 80% of the population of the Iringa municipality and other populations downstream. This river is getting polluted mostly from the liquid wastes dumped haphazardly by homes, local industries, public institutions and other urban sources.

Environmental challenges caused by deforestation, erosion and loss of soil quality were also observed in the area. These were arising from the shortage of food and energy (many homes are not connected to the municipal power supply) that drives the majority poorest into haphazard trees cutting in the nearby surroundings for own use and selling as fire wood in the municipal.

Mismanagement of hazardous industrial waste was another big environmental problem. Disposable materials like plastic bags, nylons and other rejected hard materials from the nearby industries were found to pollute the urban. Nearby the study area, there were numerous industries that process fruits and produce their products, as well as wastes in the mostly plastic packaging which is used. Again, as a result of increasing population, the utilization of these fruits products is also increasing and generating a lot of the plastic packaging waste consumers are throwing everywhere haphazardly.

These study has recommends ways of mitigation, which include the maintaining of sustainable economic development in the rural areas of origin to overcome the forces of migration through the creation of jobs in agriculture and processing factories and agriculture, as well as, the adoption of alternative energy sources with less pollution to the environment. This will reduce the entire dependence on fire and/or charcoal woods (Fig. 7).



**Fig. 7. Woos charcoal vendor in the study area**

Source: Field Data Survey, 2015

Proper management of the waste materials especially the industrials ones, should be accorded. A polluter Pays Principle (PPP) can be adopted the enable the waste produces to be more responsible by paying for waste collection. Recycling, reuse and recovery (as explained in section 4.10.4) can be another good option to reduce wastes. In general, section 4.10 of the main text had given the explanations on the same.

## 6. CONCLUSIONS

The study has shown that the environmental challenges encountered in Iringa and most other urban areas in Africa are due to the anthropogenic activities arising from the influxes of migrants from rural areas. The urban areas are continuing to receive mostly rural migrants beyond their demographic carrying capacities, hence suffering from the environmental degradations arising from living activities of their increasing overpopulations on struggle to make livelihoods attainable. Under such a trend, it is discernible that extra rural-urban migration will cause more serious degradation and pollution in

the (destination) urban areas. Thus, to reduce the mess, it is advisable to improve the living situation in rural areas to keep the pushing forces at minimal.

## ACKNOWLEDGEMENT

The authors are indebted to two anonymous reviewers for their helpful comments and insights.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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