ECA/POP/TP/93/5[2(b)(vi)]

UNITED NATIONS
Economic Commission
for Africa

# RELATIONSHIP BETWEEN POPULATION AND ENVIRONMENT WITH PARTICULAR REFERENCE TO MORTALITY IN SELECTED ECA MEMBER STATES



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### Annexe 1

## 1. INTRODUCTION[1]

The 1974 World Population Conference held in Bucharest, Romania, produced the World Population Plan of Action (WPPA)[2] document in which it defined the reduction of morbidity and mortality as goals for planning for better quality of life and for accelerated social and economic development. Among the strategies adopted for reducing morbidity and mortality was the improvement of the environment through eradication or control of infectious and parasitic diseases, and provision of portable water and sanitation.

In addition, the June 1992 Rio Earth Summit focussed on a number of environmental problems of developing countries, including Africa. The programmes of action that emerged from the Summit-Agenda 21-encompassing sectoral issues such as managing demographic change and population pressures, ensuring efficient and equitable use of water resources, and optimize environmentally clean industrial production, require an appreciation of the complex relationship between population growth and environment[3].

After the international conference on Primary Health Care held at Alma-Ata in the Soviet Union in 1978 infant, child and maternal

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[1] This study was prepared by Dr. V. Muba as a consultant for ECA.

[2] UN, World Population Prospects 1990, Population studies No. 120, ST/ESA/SER.A/120, New York 1991.

[3] ECA, African Strategies for Implementing UNCED Agenda 21: A Proposal. Paper presented to the Twenty-eight session of the Commission, Addis Ababa, Ethiopia, 3-6 May 1993

mortality rates were amongst the indicators selected by the World Health Organization that were to be used in monitoring the "Health for All" by the year 2000 (HFA) programme[4]. The conference recommended among others that there was need for emphasis on preventive measures to be fully integrated with curative, rehabilitative and environmental measures.

World regional estimates of life expectancy at birth for 1990-95 gives 54.1 years for both sexes for Africa compared to 63.3, 74.9 and 65.5 years respectively for less developed group of countries, those of the more developed and for the world as a whole. Estimates of Infant Mortality Rates (IMR) for same period were 94 for Africa, and 70, 12 and 63 respectively for less developed, advanced countries and for the whole world[5]. These estimates suggest that conditions of health remained poorer in Africa than elsewhere.

Results of comparative studies of selected countries in Eastern, Southern, Western, Central and Northern African subregions completed by the ECA secretariat have identified and emphasized the existence of large differentials of mortality within and between

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[4]WHO, Development of indicators for monitoring progress towards health for all by the year 2000, pg. 9-38, Geneva 1981.

[5]UN, World Population Prospects 1990, Population studies No. 120, ST/ESA/SER.A/120, New York 1991.

African countries[6]. However, mortality levels have been declining, but at various pace and magnitude.

The 1974 World Population Conference, the June 1992 Earth Summit and the International Conference on Primary Health Care point to the existence of links between mortality, environment and conditions of health of a population on one hand and mortality, environment and quality of life of a population on the other. The subject of this study is to assess the relationship between environment and population factors with particular reference to mortality in some ECA member states. Specific attention for this study has been focussed on countries in the Southern African Development Community (SADC).

## 1.1 Scope and Coverage

Linkages of population factors, environmental conditions and aspects of socioeconomic development exist in various complex forms over time, among countries. In developing countries, including those in Africa, one regards environment issues as being inter-linked with poverty, underdevelopment, inequality in the distribution of wealth and over-exploitation of natural resources. Population size, its distribution, composition, components of growth, etc have a bearing on environment. These population factors and environmental conditions vary geographically within and

[6]ECA, "Mortality levels, patterns, trends and differentials in Africa", in African Population Studies Series No.8 pp.36,79, 17. Addis Ababa 1985.

among countries and that both affect mortality differently.

In carrying out this study, to assess inter-relationships between population, environment, and mortality, cross-sectional data covering 38 African countries were used. Data from other regions of the world have been used to provide comparison with the situation for the specific SADC countries.

There is growing awareness in Africa of the seriousness of the situation. The secretariat of the Economic Commission for Africa with its member states has issued the Africa Environment and Development Agenda as well as a common position as a framework in implementing Agenda 21[7]. The African Common Position on Environment and development Agenda takes into account all declarations and resolutions adopted by member states on environment programmes particularly the Lagos Plan of Action, the Kilimanjaro Programme of Action and the Kampala Agenda of Action for Sustainable Development in Africa. Managing demographic processes and population pressures was identified as one of the environmental priorities at all these meetings and it is an integral part of the African Common Position.

## 1.2 Objectives of the Study

The prevailing situation in Africa is such that population is more and more linked to economic and environmental crises. Some of

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[7]ECA, African Strategies for Implementing UNCED Agenda 21: A Proposal. Paper presented to the Twenty-eight session of the Commission ,Addis Ababa, Ethiopia, 3-6 May 1993.

the causes are determined by economic and policy structures which influence production, consumption, population distribution and environment. Environmental degradation like deforestation, decertification and soil erosion lead to reduced agricultural production of food, poor sanitation, lack of safe drinking water, accelerated population growth, etc, which have impact on population and development.

This study is undertaken in order to identify population-environment interrelationships and linkages. The linking variables would provide knowledge to be utilized for integration in development plans by policy makers, planners and other officials in population, environment and development. It is expected that integration of these variables in development plans would lead to achieving declining mortality rates, better quality of life, raising standards of living and better use of natural resource base to achieve sustainable development among ECA member states. The knowledge base is also important in the implementation of Agenda 21.

## 1.3 Methodology of analysis

Due to time and financial constraints the study had to limit itself to review of literature and previous research work on the subject. In view of lack of longitudinal data on individual

countries, other researchers like Cleaver and Schreiber[8] used cross sectional (i.e. inter-country) data for Sub-Saharan African countries to study inter-relationships between population and environment. Using Kenyan data, Ewbank et al[9] studied inter-district mortality variations and demonstrate that some environmental factors affect mortality. Assuming that the inter-country relationships in Sub-Saharan African countries apply within Sub-Saharan African countries, and relationships in Kenya apply to SADC countries this paper looks at the situation in SADC countries and compares it to situations in other parts of the world. Since the study was carried out in Tanzania a number of observations come from that country.

## 1.4 Organization of study report

This study is divided into five parts. Part one is an introduction which gives the background. Part two describes the general environmental conditions in SADC countries and their comparison to other regions of the world. The interaction between population and environment is described in parts three and four. Though it is difficult to establish strict causal relationships, part three describes the impact of population on environment while

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[8]Cleaver K.M. and Schreiber G.A. The Population, Agriculture and Environment Nexus in Sub-Saharan Africa. World Bank. May 1992.

[9]Ewbank D., Henin R., and Kekovole J. An Integration of Demographic and Epidemiologic Research on Mortality in Kenya in Determinants of Mortality Change and Differentials in Developing Countries. In United Nations, Determinants of Mortality Change and Differentials in Developing Countries: The Five-Country Case Study. St/ESA/SER.A/94. New York:1986.

part four discusses the feedback effects of environment on population. Finally part five gives the summary, conclusions of the study and its recommendations.

## 2. ENVIRONMENT

Over the centuries, man has been able to support his growing numbers by inventing new technologies that extend the productivity of his natural surroundings. The natural surroundings consist of land, water and air. Man needs fertile soil, clean air and clean water to survive.

### 2.1 Land, water and pollution

There is growing concern that much of Sub-Saharan Africa's natural resource base and ecological environment are deteriorating. The most pressing problem is the high rate of loss of vegetative cover, mainly due to deforestation and conversion of savanna to cropland. The result is loss of soil fertility and soil erosion. Forests provide many products and serve many functions, including essential environmental ones.

Forests and woodlands are cleared for farming and logged for fuel-wood, logs and pulp-wood. The rate of forest loss in SADC countries is shown in table 1.

Table 1: Forest Loss in SADC countries, 1981-85

| Country | Annual Forest Loss (%) |
|---|---|
| Angola | 0.2 |
| Botswana | 0.1 |
| Lesotho | n.a |
| Malawi | 3.5 |
| Mozambique | 0.8 |
| Namibia | 0.2 |
| Swaziland | n.a |
| Tanzania | 0.3 |
| Zambia | 0.2 |
| Zimbabwe | 0.4 |

Note: n.a.= not available

Source: Environment and Population. Supplement to **Population Reports**. The Environment and Population Growth: Decade for Action by Cynthia P. Green, Series M, Number 10 (Vol. XX, No.2), May 1992.

Degradation and destruction of forests have a severe impact on wildlife habitat and bio-diversity, with potentially irreversible losses of animal and plant life. Degradation of tropical moist forests has a particularly negative impact on bio-diversity by destroying plant and animal life which may exist nowhere else in the world. As forests and woodlands are destroyed, people must walk further and/or pay more for fuel-wood, construction materials and other essential forest products. Wood fuels are a staple source of household energy in Africa.

Sub-Saharan Africa is highly vulnerable to soil degradation and erosion because of factors such as soil characteristics, intense soil drying in dry seasons, heavily erosive seasonal

rainfall in many areas, wind erosion in drier areas, and low-resource farming with inadequate soil conservation measures[10]. Hanks[11] notes that although precise statistics on the extent of soil erosion in Southern Africa are difficult to obtain, but it had been reported that in Zimbabwe 15% of the country's agricultural land is very severely eroded, 13% is seriously eroded, 19% moderately eroded, and only 53% is in relatively good condition.

Rivers, streams, lakes, swamps and coastal waters provide critical economic goods and services and perform vital ecological functions. These water resources are seriously affected by sedimentation, siltation, agro-chemical run-off, industrial pollution etc. These problems are reported as becoming increasingly serious in many parts of SADC countries although quantitative information is particularly poor. The causes include soil erosion, deforestation, destruction of protective vegetative strips alongside water bodies, indiscriminate drainage, encroachment for farming, poorly conceived irrigation development, lack of environmental regulations and enforcement on industrial activities, etc. Groundwater resources have also come under pressure, especially in the semi-arid regions. Deforestation, soil degradation and erosion, and poor on-farm soil and water management

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[10]Cleaver K.M. and Schreiber G.A. The Population, Agriculture and Environment Nexus in Sub-Saharan Africa. May 1992. World Bank. pg.11.

[11]Hanks J. Southern Africa's abused environment. Earthwatch No.31 1988.

practices all increase surface run-off (causing soil erosion) and reduce the amount of rainfall that infiltrates the soil and eventually percolates into groundwater aquifers.

The consequences of environmental degradation are profound. Most alarming is the possible negative impact on rainfall, although direct causality is difficult to establish. UNICEF[12] notes that for millions of the poorest families on earth, a principal environmental concern is the ever present threat of disease in their immediate surroundings. The greatest threat to their lives and health is not pollution of water by chemicals, but pollution by faecal organisms, not industrial waste, but human waste, and the greatest of their environmental problems is the lack of clean water and safe sanitation which alone can protect them against diarrhoeal disease, schistomiasis, hookworm, guinea worm, cholera, and typhoid. UNICEF calls it the silent environmental crisis which takes its daily toll on the life and health of millions of those whose voice deserves to be heard in the environmental debate. Tables 2 presents accessibility to safe water in SADC countries.

[12]The State of the World's Children 1993. UNICEF. Oxford University Press. pg.31.

Table 2: Percentage of Population with Access to Safe Water in SADC Countries (Rural/Urban) 1988-90

| Country | % of Population | | |
|---|---|---|---|
| | Urban | Rural | Total |
| Angola | 75 | 19 | 35 |
| Botswana[a] | 84 | 46 | 54 |
| Lesotho | 59 | 45 | |
| Malawi[a] | 97 | 50 | 48 |
| Mozambique | 44 | 17 | 56 |
| Namibia | n.a | n.a | n.a |
| Swaziland | n.a | n.a | n.a |
| Tanzania | 75 | 46 | 56 |
| Zambia | 76 | 43 | 60 |
| Zimbabwe | 31 | 80 | 60 |

Note: (a) Data refer to periods different from that indicated.
n.a.= not available
Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

## 2.2 Environmental hygiene and sanitation

One of the most deadly and widespread pollutants of water is untreated human waste. In developing countries, two in every five people lack proper sanitation and sewage is routinely released into waterways untreated[13]. Human faecal wastes contain nitrogen and phosphorus. In high concentration, these substances are major causes of oxygen depletion in bodies of water, which kills off fish, other animals and plants[14]. Population access to adequate sanitation in SADC countries is given in table 3.

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[13]World Health Organization (WHO). The international drinking water supply and sanitation decade: Review of decade progress (as at Dec. 1988). Geneva, WHO, Dec. 19909. p. 305.

[14]World Resources Institute. and United Nations Environmental Program. and United Nations Development Programme. World resources 1990-91. New York, Oxford University Press, 1990. p.383.

Table 3: Percentage of Population with Access to Adequate Sanitation in SADC Countries (Rural/Urban) 1988-90

| Country | % of Population | | |
|---|---|---|---|
| | Urban | Rural | Total |
| Angola | 25 | 20 | 21 |
| Botswana | 98 | 20 | 42 |
| Lesotho | 22 | 14 | 15 |
| Malawi | 100 | 81 | 84 |
| Mozambique | 53 | 12 | 21 |
| Namibia | n.a | n.a | n.a |
| Swaziland | n.a | n.a | n.a |
| Tanzania | 75 | 46 | 56 |
| Zambia | 76 | 43 | 60 |
| Zimbabwe | 31 | 80 | 60 |

Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

Water polluted with sewage is a major source of illness and death in developing countries. Each year diarrhoea, the third most common cause of death in developing countries (after respiratory disease and circulatory disorders), kills more than four million people - mostly children[15]. Despite cleanup efforts in some places, water pollution is worsening in developing countries[16]. More than 95% of urban sewage in developing countries is discharged untreated into nearest waterway or field[17]. Factories and mines release large quantities of heavy metals, toxic chemicals, and

[15]Wyatt, A. and Brantly, G. A.I.D. Environmental Health Workshop: Final workshop report. Research Triangle Park, North Carolina. Research Triangle Institute, Apr. 5, p. 275

[16]La Riviere, J.W.M. Threats to the world's water. Scientific American 26(13): Sept.1989. p80-107.

[17]Bartone, C. Towards a healthier urban environment. Source 2(2): Jun. 1990. 2, p. 30-31.

solid wastes into the water. Among measures to address water pollution are adequate sanitation and waste treatment facilities including alternatives to water-carriage sewerage, prevention of pollution at its source, and waste reduction.

## 2.3 Landlessness and housing

Despite human efforts to reclaim land from sea and deserts, the area of land is fixed. Over time as the population grows, the area of land available per individual has been decreasing. Let alone density per area of land which has been decreasing, the rate of decrease is even more serious if we consider density per area of arable land.

Table 4: Cropland per Capita in SADC Countries 1990 (hectares)

| Country | Cropland per Capita |
|---|---|
| Angola | 0.36 |
| Botswana | 1.06 |
| Lesotho | 0.18 |
| Malawi | 0.28 |
| Mozambique | 0.20 |
| Namibia | 0.40 |
| Swaziland | n.a. |
| Tanzania | 0.19 |
| Zambia | 0.62 |
| Zimbabwe | 0.29 |

Source: Environment and Population. Supplement to **Population Reports.** The Environment and Population Growth: Decade for Action, by Cynthia P. Green, Series M, Number 10(Vol. XX, No.2),May 1992.

Given that most of the population in SADC countries is agricultural, 1990 cropland per capita given in table 4 reflects availability of arable land to the population. It ranges from 0.18

in Lesotho to 1.06 in Botswana. With 0.2 hectare or less Tanzania, Mozambique and Lesotho are considered to be in critical condition of low area of cropland per person. Malawi and Zimbabwe are considered to be in serious condition for having 0.21 to 0.35 hectare. Only Botswana and Zambia have satisfactory cropland area per person of more than 0.4 hectare. As the population increases farmers are forced to cultivate in areas that are less favourable such as dry, hilly, rocky, or have thin weak soils.

Human settlements start where conditions for habitation are favourable. Towns have usually developed where land is arable, along the rivers where fishing can be undertaken, on transport routes where trading can be undertaken, in mining areas etc. As the activities in the settlements increase and population in the towns grows, more land area is needed for housing. The expansion of housing estates eat into the arable land. With concentration of people in an area, some essential services such as survey of plots for housing, sanitation, transport, etc are needed. Rapid expansion of cities has overtaken the ability of the local governments to provide these services. The result has been shortage of houses in urban areas and mushrooming of squatter settlements and slums. These have been accompanied by deterioration in sanitary conditions such as lack of sewage and garbage collection services.

## 2.4 Diseases and ill-health

In many developing countries majority of deaths and ill-health among people are connected to environmental conditions. Child morbidity and mortality, in particular is much higher where environmental degradation has led to poor environmental sanitation, malnutrition and consequent death. Desertification, poverty and consequent poor practices of agriculture in many countries have resulted in many deaths and suffering due to scarcity of food among the people. Lack of fresh water for cooking, drinking and sanitation as well as for personal hygiene, prevalence of waterborne and other infectious diseases cause much suffering and mortality among children at large because of poor health resulting from poor diet, frequent illness, rapid rate of population growth and lack of health facilities and services. These diseases of environmental nature are very common among countries in the SADC. For example, in Botswana conditions of under-nutrition, diseases associated with poor socio-economic status, rank very high among major causes of ill-health. In Lesotho, major causes of mortality, particularly among children, remain to be those associated with malnutrition, gastroenteritis, etc. The diseases patterns for Swaziland and Tanzania are also dominated by d'arrhoea, those of digestive conditions, malaria and nutritional deficiencies[18].

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[18]ECA, Assessment of Mortality levels, trends and differentials in relation to the Goal of "Health For All" by year 2000 in Some ECA Member states, ECA/POP/TP/92/3(b(iv)), Addis Ababa, November,1992

## 3. POPULATION AND ENVIRONMENT INTERACTION

It has been observed that three basic factors combine to determine the impact of human society on the environment: the number of people, the average individual's level of consumption or affluence, and the technology used to produce agricultural and industrial outputs. This relationship is understood most easily in a simplified equation 1 below:

Environmental Impact = Population size x Affluence x Technology

or its acronym (IPAT)[19]:

$$I = P \times A \times T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

That is, the impact (I) on environment is a product of:

**P** = The number of people, or population size;

**A** = The affluence of each individual or per capita consumption of goods and services; and

**T** = Technology, or, more precisely, the quantity of resources consumed and pollution generated during production and consumption per unit of goods and services

Affluence and technology broadly represent the "development" term; energy consumption per capita is a good indicator of their joint effect. The relation is considered to be multiplicative,

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[19]UNFPA. **Population, Resources and the Environment.** pg. 16-17.

with each of the casual factors magnifying the effect of the others. Thus, "For any type of technology, for any given level of consumption or waste, for any given level of poverty or inequality, the more people there are, the greater is their overall impact on the environment". This basic equation demonstrates why developing nations, with large populations but limited economic advancement, can generate a vast impact on the environment (hence on prospects for sustainable development), if only because the P multiplier on the A and T factors is so large. Likewise, the equation makes clear that developed nations also generate population impacts in so far as the A and T multipliers for each person are exceptionally large[20].

Rapid population growth demands more and more from nature in terms of food, water, and energy. At the same time, both increasing consumption and pollution by growing human numbers reduce nature's productivity. Despite nature's resilience especially for renewable natural resources when overused or degraded, many can only restore themselves eventually if they are given enough time. Grasslands take a year to grow back after overgrazing; fish stocks may take five years to return to previous levels after moderate over-fishing; forest ecosystems may take 20 to 100 years to grow back; topsoil take hundreds of years to be

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[20]United Nations Secretariat. Population, Environment and Development in Tanzania: Overview in Population, Environment and Development in Tanzania. Demographic Unit, University of Dar es Salaam. June 1992 (Draft).

replenished; and aquifers can take between one and thousands of years to refill[21]. Unfortunately if human beings exploit natural resources faster than they can regenerate, nature may not have time to renew itself. The ever-increasing human demand will exceed the rate of renewal of land, forests, and fresh water. Some resources, such as soils and fish, may already be overexploited. Population growth increase consumption of non-renewable mineral resources, raising their price, requiring a search for substitutes, and hastening the day when such key resources as oil may not be available at all. Green observes that the impact of population growth touches virtually all the specific ways that human beings interact with the environment including agriculture, forests, fresh water, oceans, minerals, energy and urban growth[22].

As development planning taking into account environmental considerations and their integration into planning has the aim of achieving population goals, it is important to identify acute population pressures on resources and resulting environmental degradation in the whole country, and its rural and urban areas that are affected. The role of urbanization, development of smaller towns and cities and location of industry should therefore be monitored and integrated into population-environment programmes.

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[21]Green,C.P. The Environment and Population Growth: Decade for Action. Population Reports, Series M, No. 10. Baltimore, Johns Hopkins University, Population Information Program, May 1992. p.11.

[22]ibid.

Worldwide, an estimated 0.2 billion hectares of land have lost much of their agricultural productivity since 1945[23]. Sources of soil degradation include water or wind erosion, loss of chemical nutrients, concentration of salts or acidic chemicals, compaction, and waterlogging. Major causes are overgrazing, responsible for 35% of all degraded land; faulty agricultural practices, 28%; cutting forests for farming and logging, 30% and stripping land for fuel-wood, 7%[24]. All these are a contribution of population growth through increased demand for food and firewood.

Many problems attributed to drought, such as dry lands and reduced crops, are symptoms of overuse of land. Over-cultivation and overgrazing leave marginal lands less able to retain water and more prone to erosion and the formation of salt deposits and loss of topsoil. In some areas animal dung is used for fuel rather than for manure due to shortage of firewood. The resulting loss of dung for manure reduces soil fertility. Population growth contributes to these developments by making intensive farming practices necessary to grow more food.

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[23]World Resources Institute. World Resources 1992-93: A guide to the global environment. New York. Oxford University Press, 1992. p. 385.

[24]ibid.

Quantitative analysis on the factors affecting environment was done by Cleaver and Schreiber[25]. Deforestation and loss of wilderness were taken as indicators of negative impact on the environment. They hypothesized that deforestation is related positively to population pressure on cultivated land, to the rate of population growth, and with policies favourable to agriculture. It is negatively related with the use of modern farming inputs such as fertilizer. Though open access to land tenure situation were also hypothesized to stimulate deforestation, it could not be measured.

To test the above hypotheses, regression analysis was undertaken with the rate of deforestation as the dependent variable, for the period 1980-1988. Independent variables include the number of hectares cultivated per person (average 1965-1987), fertilizer use per hectare (1987/88), the population growth rate (1965-1990), and the agricultural policy dummy variable. The resulting computation produced the statistic as follows:

None of the variables is statistically significant at the 90% confidence level or above (having a 2-tail significance test of 10% or less) in its association with deforestation. The 2-tail significance test indicates the probability that the coefficient is actually zero. Hence, a 2-tail test of 17% for the population

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[25]Cleaver K.M. and Schreiber G.A. **The Population, Agriculture and Environment Nexus in Sub-Saharan Africa**. World Bank. May 1992.

| Independent variable | Coefficient | T-statistic | Significance test (2-tail) |
|---|---|---|---|
| Constant | -0.54 | 0.41 | 69% |
| Cultivated ha per person[a] | -0.60[b] | 1.50 | 15% |
| Fertilizer use per ha[a] | -0.19[b] | 1.17 | 25% |
| Population growth rate | 0.56 | 1.40 | 17% |
| Agricultural policy dummy | 0.76 | 1.65 | 11% |

Adjusted R squared = 0.09
F statistic = 1.92

Notes: ([a]) Converted to natural logarithm.
([b]) Represents elasticity.

growth rate indicates a 17% probability that the coefficient is zero and 83% that it is not zero. Agricultural policy, cultivated land per person and population growth are close enough to the 90% confidence level to suggest the plausibility of the hypotheses. The coefficients are consistent with the hypotheses. However, the overall equation is not good at explaining variation among countries in the rate of deforestation. The authors suggest that numerous other unquantifiable factors are at play, such as the land tenure situation, rainfall, and logging policies. The poverty of the data is also suggested as a reason for the poor fit.

Despite the poor overall fit of the equation, it suggests the possibility that countries with more cultivated area per person have lower rates of deforestation, all other things being equal. Countries with higher intensity of fertilizer use have lower rates

of deforestation. Countries with more rapid population growth have higher rates of deforestation. Countries with better agricultural policy have higher rates of deforestation - implying a trade-off between agricultural growth and deforestation.

These results, if confirmed by future studies, suggest that solving population growth and intensifying agriculture would slow the rate of deforestation. Although poor agricultural policy would reduce deforestation, it is not a useful instrument, because the objective of accelerating agricultural growth will override that of reducing deforestation in every country. Hence the importance of environmental action plans and land use planning, which develop mitigating actions to reduce the negative environmental impact of improved agricultural policy, and which should serve to focus agricultural growth into environmentally less destructive channels.

In studying the loss of wilderness the hypotheses were that the degree of wilderness loss is associated with declining levels of cultivable land per person, but is reduced by intensification of agriculture. An improved agricultural policy environment is likely to stimulate the destruction of wilderness area by farmers. In addition, better educated people are hypothesized to show more concern about the environment and, hence, that countries with higher rates of primary school enrolment will have lower rates of wilderness loss.

Statistical regression analysis to explore the above hypotheses with the percentage of wilderness loss the dependent variable produced the results shown below.

| Independent variable | Coefficient | T-statistic | Significance test (2-tail) |
|---|---|---|---|
| Constant | 76.9 | 8.8 | 1% |
| Cultivated ha per person[a] | -7.2[b] | 1.4 | 17% |
| Fertilizer use per ha[a] | -2.6[b] | 1.1 | 28% |
| Primary school enrolment rate | -0.2 | 1.9 | 7% |
| Agricultural policy dummy | 11.0 | 1.8 | 8% |

Adjusted R squared = 0.15
F statistic = 2.5

Notes: ([a]) Converted to natural logarithm.
([b]) Represents elasticity.

The signs of the coefficients are consistent with the hypotheses. Cultivated area per person and intensity of fertilizer use are not statistically significant at 90% confidence level. The results are interesting enough, however, to suggest the plausibility of the hypotheses. The hypotheses suggest the possibility that the greater the available area under cultivation per person, the lower the rate of wilderness loss. The higher the intensity of fertilizer use, the less the wilderness loss. The greater the percentage of school-age children in primary school, the less the wilderness loss. The better the agricultural policy, the more the wilderness loss. The authors stated that the equation explains only a small part of the variation among countries because

of omitted factors such as land tenure, expanse of parks and reserves, government efficiency in managing parks and reserves, and that development of infrastructure in wilderness areas are likely to affect the maintenance of wilderness area.

Confirmation of these findings by future studies will lead to the conclusion that reduction in population growth, intensification of agriculture, and expansion of primary school enrolment would reduce the speed of wilderness loss. The need for harmonization of environmental conservation and agricultural development is further indicated.

Although the Sub-Saharan region is less densely populated than other regions, its ability to support more people is severely restricted by limited water supplies and poor soils. As population grows in Africa's marginal areas, farmers are pushed into semi-arid rangelands that previously supported only nomadic tribes, providing supplementary fodder and water for their livestock during droughts. Since these lands are now under cultivation, the livestock that once depended on them often suffer large losses during dry periods.

Population growth creates water shortages not only by adding to the numbers of consumers but also by increasing population density beyond the level that nearby water supplies can serve. Many communities are draining water aquifers faster than aquifers

can replenish themselves.

Rugumamu et al.[26] cites the Tanzania case to show that population pressure causes much of the land degradation especially from the way people use the land resource. The Tanzanian population engaged in agricultural activities have traditionally settled in areas suitable for crop cultivation and mixed farming. Indigenous knowledge of land suitability, such as identification of indicator trees and grasses, was undoubtedly responsible for the original selection of promising areas for human settlement. Hence the agricultural systems of the people were well adapted to environmental conditions.

Rainfall and soil fertility govern population distribution. With about 10% of the country getting adequate rain (over 1000 mm per annum), it carries 63% of the population; 8% with fairly well-watered land areas carries 18% of the population. Twenty per cent is poorly watered and carries 18% of the population; and 62% is very poorly watered and carries 1% of the population. About four fifths of the population today is concentrated or only one fifth of its land.

The population density which can be sustained on a given area

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[26]Rugumamu, W. and Kishimba, A.H. Population growth and land degradation in Tanzania. **Population, Environment and Development in Tanzania. Dar es Salaam, Demographic Unit, University of Dar es Salaam (draft).**

depends on the fertility of the land and the productivity of agricultural systems to exploit it. Advanced agricultural practices allow for comparatively higher densities than the traditional long-term bush fallow method. With more innovations adopted in crop husbandry, soil conservation, irrigation and fertilization, the carrying capacity of the land can be increased. If population growth is not accompanied by agricultural intensification and devices to restore soil fertility, over-utilization of resources is likely to occur. Increasing density in concentrated settlements tends to disturb the delicate population-resource balance. Farmers' responses to population growth include measures which are detrimental to proper land use, soil conservation and restoration of soil fertility.

In pre-colonial Tanzania, agricultural systems were characterized by mixed livestock keeping and crop cultivation. Over time, because of increasing population pressure, shifting cultivation is no longer widespread in Tanzania. The majority of smallholder producers resorted long ago to short fallow and permanent cultivation in the zones of high pote tial agriculture. The population density in these areas is significantly higher, and farming systems have evolved towards intensification with increasing use of methods like terracing, contour farming, planting perennial crops, ridging and irrigation. The majority of smallholder producers in Tanzania find agricultural intensification more and more difficult. Labour shortages are commonly experienced

in villages due to increasing distances between homesteads and farms, fuel-wood and water resources. Migration of the young to towns and cities aggravates the situation.

### 3.1 Health, mortality and morbidity

Concentration of people, as happens in cities, makes it difficult to dispose of household wastes without polluting water supplies. Demand for more goods and food that accompanies growing population growth increases wastes from industrial and agricultural production often to be discharged or drained into rivers, lakes, or aquifers. Faecal wastes may pose the more widespread health threat in the developing world at this time, but industrial discharges are more persistent.

Many cities in developing countries now spend more than 30% of their budgets on refuse collection and waste disposal[27]. These efforts still leave 30% to 50% of all solid wastes in developing countries such as Tanzania, uncollected. In some cities such as Dar es Salaam, solid wastes can be observed left in the streets or in vacant lots. In some cities of developing countries many city residents lack basic services such as sanitary drainage systems. Rapidly growing cities will greatly worsen existing solid waste disposal problems, since urban dwellers produce more waste per

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[27]World Resources Institute. and International Institute for Environment and Development. and United Nations Development Programme. World resources 1988-89. New York, Basic books, 1988. p.372.

capita than rural people. The amount of solid wastes generated by cities and industries in developing countries is projected to double from 0.6 billion metric tons to 1.2 billion metric tons between 1985 and 2025 due to population growth alone. As a result, the proportion of the world's municipal and industrial solid wastes generated in developing countries is projected to grow from 25% in 1985 to 35% in 2025. This share could exceed 50% by 2025 if, in addition, their economies develop at about 3% annually, as they did between 1960 and 1985[28].

The developing countries constitute a major new source of pollution due to both rapid population growth and rising incomes. Within 35 years they could be producing half of the world's municipal solid wastes, up from one-quarter in 1985[29]. With an annual increase of 87 million people, the developing countries account for 95% of world population growth. At their current population growth rate of 2.1% per year, their population is projected to rise to 4.2 billion in 1992 to 7.2 billion by the year 2025[30].

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[28]Shaw, R.P. Rapid population growth and environmental degradation: Ultimate versus proximate factors. Environmental conservation 16(3): p.199-208. Autumn 1989.

[29]Shaw, R.P. Rapid population growth and environmental degradation: Ultimate versus proximate factors. Environmental Conservation 16(3). Autumn 1989. p. 199-208.

[30]United Nations (UN). World population prospects 1990. New York, UN, 1991 p. 608.

## 3.2 Environmental refugees

Madulu et al notes that land degradation is one of the greatest threats to people in developing countries[31]. It strikes at the basic resource for human survival. The degradation process has grown so acute in Africa that millions of people have fallen into poverty and have suffered famine and sometimes death. In Tanzania land degradation is a growing problem, especially in the semi-arid areas of the country. Parts of Dodoma, Arusha, and Shinyanga regions have been seriously affected by deforestation, overstocking, overgrazing, and inappropriate agricultural techniques. Land degradation appears in the form of rapid decline in agricultural production, land fragmentation, extension of agriculture into traditional grazing areas, overgrazing, increasing soil erosion in the upper catchment areas, and subsequent siltation and floods in the plains. With rapid population growth, land has become a scarce resource. Competition and conflict over land use have become chronic.

Increased population density, shortage of pasture, expansion of agriculture, lack of water, shortage of food, epidemics (to both livestock and human), scarcity of arable land, and social conflicts push people from their original lands. Correspondingly, availability of land and water, low population density, and high

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[31]madulu N.F. et al. Environmental impacts of migration in rural Tanzania. Population, Environment and Development in Tanzania. Dar es Salaam, Demographic Unit, University of Dar es Salaam (draft).

agricultural productivity pull the population into new land areas. In urban areas, employment opportunities in the modern sector, education and other social facilities, and the rise of the informal sector attract people from rural areas. Some migrants move to the area of destination because of anticipated employment (speculative migration).

Madulu et al. continues to observe that during colonial period, Tanzania could be divided into losing zones (labour reserves) and gaining zones. The labour reserves were located in Central, Southern and South-Western Tanzania, the gaining zones were in the Eastern, North-Eastern and some isolated parts of Southern Highlands. They cite the Sukuma tribesmen who migrated from Mwanza region to Shinyanga region where population density was low and there was excessive land available. Arusha region, where the Maasai and Barbaig tribesmen lived, was a net migration-gaining region. Nevertheless, it is surrounded by net migration-losing regions like Kilimanjaro, Dodoma and Singida. As more people settle in Maasailand, the Maasai themselves search for good grazing lands for their cattle in the Coast, Iringa, Morogoro and Mbeya regions. Sharing boundaries with sedentary population has led to several conflicts on land use. Cattle rustling is a common problem in Mara, Arusha, Mwanza and Shinyanga regions of Tanzania. Sometimes it has led to loss of life.

## 3.3 Poverty and quality of life

Environmental damage in developing nations has several sources: poverty among some parts of the population and rising affluence among others, skewed systems of land tenure, uncontrolled commercialization of natural resources, inadequate control of polluting industries, destructive farming techniques, and urbanization. Poverty is clearly a major factor. More than one billion - about one fifth of the world's population - live in absolute poverty[32]. In their struggle for survival, poor people have no choice but to destroy their surroundings by cutting down trees, overworking the soil, overgrazing rangelands and over fishing.

The pressure on land has been exacerbated by people's needs to gather firewood and graze their livestock. Fuel-wood accounts for about 80% of energy needs in Sub-Saharan Africa, and it is in very short supply. As the situation worsens, farmers have to burn animal dung and crop residues instead of using them to enrich the soil. With an estimated 160 million head of cattle in Africa, overgrazing is acute. More than one-quarter of Sub-Saharan Africa's land area of 750 million hectares is moderately to very severely decertified. The agricultural potential in these areas may have been lost for years.

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[32]World Bank. World Development Report 1990. Oxford, Oxford University Press, 1990. p.272.

3.4 Rural-urban place of residence

Green suggests that cities are most visible evidence of population pressure[33]. By the turn of the century about three billion people, or nearly half of the world's population, are expected to live in cities. One in every five of these urban dwellers will live in cities of more than two million people. The number of cities containing at least 10 million people will rise from 11 in 1985 to 24 in 2000.

While in developed areas 73% of the population lives in cities, in developing countries cities are growing at an unprecedented rate, and the pace is accelerating. As noted earlier about 60% of urban population growth comes from natural increases and about 40% results from migration into cities from rural areas. With in-migration and natural increase both fuelling population growth, the world's cities often present the starkest, most dramatic picture of environmental damage and its impact on human health and welfare.

The rapid urban population growth damages the environment in several ways. First, as cities spread, they convert agricultural land to industrial and residential use. Where land is scarce, urban growth can undermine efforts to increase food production.

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[33]Green, C.P. The Environment and Population growth: Decade for Action. **Population Reports**, Series M, No. 10. Baltimore, Johns Hopkins University, Population Information Program, May 1992. p. 21.

Egypt is a case in point where expanding cities have claimed more than 10% of the most productive farmland in the past three decades[34].

City dwellers use more water and energy and generate more wastes than rural residents. For example, many urban dwellers burn charcoal, which has lost more than half of its energy as rural villagers who burn wood directly. Cities also use large amounts of energy to import food, water, and fuel; collect garbage; and treat sewage.

Large densely settled populations produce massive and concentrated amounts of air and water pollution, overwhelming the absorptive capacity of natural ecosystems. Much of the pollution come from industry, which of course is located where workers are. As city size increases, the cost to maintain environmental quality (such as providing clean water, treating sewage, and disposing other wastes) also increases. Limited resources available to cities in developing countries lead to the failure of urban councils to provide these services. The result is frequent outbreak of epidemics with the resulting loss of life which keep mortality rates high.

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[34]Harboy, J.E. and Satterthwaite, D.E. Third World cities and the environment of poverty: in: Repetto, R., ed. The global possible: Resources, development, and new century. New Haven, Connecticut, Yale University Press, 1985. p.171-210.

## 4. ENVIRONMENT AND POPULATION INTERACTION

The World Bank notes that rapid population growth, agricultural stagnation, and environmental degradation are closely interrelated and mutually reinforcing[35]. Until recently, it was generally believed that controlling population was not a priority in Sub-Saharan Africa, where population density is low and land is abundant. However, population density and land availability vary greatly across countries in the region. Countries with low per capita arable land and high population growth are experiencing an economic and environmental crisis of agricultural stagnation, deforestation, land degradation, and decertification. Per capita arable land declined from 0.5 hectare per person in 1965 to 0.3 in 1987. The traditional system of shifting cultivation is under stress as land has become more scarce, and fallow periods are gradually being reduced. Soil fertility is not being allowed to be restored and crop yields have fallen as a result. People are forced to migrate into marginal land in semi-arid areas and into tropical forests to establish new farms, so population pressure is causing not only soil degradation, but also deforestation, decertification, and falling agricultural output. Thus environmental degradation has feedback effects on population that is discussed in this part of the study.

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[35]The World Bank, World Development Report 1991: The Challenge of Development, Oxford University Press, New York, 1991, p. 61.

Agricultural stagnation and environmental degradation also affect population growth. High infant and child mortality rates caused by food shortage and malnutrition induce men and women to have more children partly to ensure that some survive to support them in old age. Fertility is high in the region, at 6.6 children for an average woman, compared with 4 in other developing countries. To break the vicious circle, policies are urgently needed to control population; increase agricultural productivity without damaging the environment; and reduce malnutrition, poverty, and infant and child mortality.

To study the effect of environment on population, Cleaver and Schreiber made quantitative analyses of the determinants of high Total Fertility Rates (TFR) across countries of Sub-Saharan Africa, and variations between countries in crop yields[36]. Data from 38 countries were used.

In regression analysis and accompanying statistical tests, TFRs as dependent variable were hypothesized to be related to the independent variables as follows: positively to infant mortality, negatively to food security, negatively to female primary school enrolment, positively to the cultivable land per person, and positively to the rate of deforestation. The results were as follows:

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[36]Cleaver K.M. and Shreiber G.A. The Population, Agriculture and Environment Nexus in Sub-Saharan Africa. World Bank. May 1992. Oxford University Press.

| Independent variable | Coefficient | T-statistic | Significance test (2-tail) |
|---|---|---|---|
| Constant | 6.5 | 4.2 | 1% |
| Female primary school enrolment rate | -0.005 | 0.9 | 37% |
| Cultivated ha per person[a] | 0.16[b] | 0.6 | 53% |
| Infant mortality rate | 0.01 | 2.0 | 6% |
| Calorie supply as % of requirement | -0.02 | 1.2 | 25% |
| Deforestation rate | 0.29 | 2.4 | 2% |

Adjusted R squared = 0.4
F statistic = 5.5

Notes: (a) Converted to natural logarithm.
(b) Represents elasticity.

The signs of the coefficients are consistent with the hypotheses, but only infant mortality, and the rate of deforestation are significant at or above the 90% confidence level (i.e. with a 2-tail significance test of 10% or lower). According to the authors, the relatively poor fit of the equation and some of the variables may be explained by the poor quality of the data, and that there probably is also considerably more to explain the TFRs than captured in the data used.

The statistical results suggest that the TFR is lower as female primary school enrolment is higher (although the coefficient is not statistically significant). The greater the area cultivated per person, the higher is the TFR (but again the coefficient is not significant). The higher the infant mortality, the higher is the TFR. The better the level of nutrition, the lower is the TFR;

better nutrition translates into better maternal and child health (and, hence, into lower infant and child mortality), but also improves the ability to feed one's family with the available factors of production, including household labour, and this in turn lowers the demand for child labour. A correlation between better nutrition and lower TFRs may also reflect the beginnings of the demographic transition - as better-off people (with access to more food) reduce their family size. The highly significant positive association between the rate of deforestation and the TFR is noteworthy: this may reflect, the greater demand for child labour as environments deteriorate (more labour required to obtain fuel-wood and water and to produce sufficient food as the productivity of farmland deteriorated due to deforestation). Unfortunately, this type of analysis cannot establish causality, which may be running in the opposite direction.

In studying the variation in Crop Yields between 38 Sub-Saharan countries, Cleaver and Schreiber were trying to establish the plausibility of the following hypotheses:

a. Crop yields must be higher where population is growing most rapidly relative to cultivated land. People begin to intensify agriculture as cultivable area per person declines. Hence, statistical analysis should show an inverse relationship between area cultivated per person and crop yields (all things being equal). However, the rate of growth

in yields stimulated by declining availability of cultivable land per person will be significantly lower than the rate of population growth.

b. Efforts to stimulate intensification, through the use of fertilizer, for example, will significantly accelerate the increase in crop yields beyond the growth rate stimulated by rising population density alone. This should be observed as higher yields in countries using more fertilizer (all other things being equal).

c. Primary school education, of men and women, should facilitate firmer adoption of intensive farming techniques and therefore associated with higher crop yields.

d. All things being equal, countries with more rapid degradation of their natural resource endowment, as reflected in higher rates of deforestation, should have lower crop yields.

e. Finally, countries with a policy environment more accommodating for profitable market-oriented farming should have higher crop yields than countries with less conducive policies.

The hypotheses were tested by determining the statistical

relationship between cereal yields (averages for 1984-86) as the dependent variable, using as independent variables: cultivated area per person (average 1965-1987), fertilizer use per ha in 1987/88 (fertilizer use remained fairly stable in the 1980s), percentage of school-age population in primary school (average 1965-1987), the rate of deforestation in the 1980s, and the general "appropriateness" of agricultural policy during the period 1980-1987. Appropriateness of policy rating is according to the categorization of the World Bank which is highly subjective. The results were as follows:

| Independent variable | Coefficient | T-statistic | Significance test (2-tail) |
|---|---|---|---|
| Constant | 5.45 | 10.1 | 1% |
| Cultivated ha per person[a] | -0.33[b] | 2.5 | 2% |
| Fertilizer use per ha[a] | 0.10[b] | 1.7 | 10% |
| Primary School enrolment rate[a] | 0.17[b] | 1.2 | 24% |
| Deforestation rate | -0.05 | 0.9 | 39% |
| Agricultural policy dummy | 0.30 | 1.9 | 7% |

Adjusted R squared = 0.45
F statistic = 7.0

Notes: ([a]) Converted to natural logarithm.
([b]) Represents elasticity.

The equation explains 45% of the differences in cereal yields among the 38 countries. The authors suggest that the unexplained portion may be due to rainfall differences between countries, to differences in the role of women in agricultural production system, to differences in land tenure problems, to differences in soil

among districts in Kenya[37]. As dependent variables, he took infant mortality rates of 1969 and 1979 and the change between the two, and the adult life expectancy at age 20 years. Among the independent variables used, the ones which showed significance at 85% level or above in at least one of the four equations were: percentage of females educated, ages 25-29; population density; high-potential agricultural land, kilometres of road; percentage urban; and ecological zone. The results of computation are shown above.

The signs of the coefficients are consistent with the hypotheses that: higher percentage of females educated is associated with low infant mortality rates and a higher adult life expectancy, a high population density is associated with low infant mortality, high per capita high-potential agricultural land is associated with low infant mortality and high adult life expectancy, and a high number of kilometres of road per 1,000 sq km is associated with high infant mortality rates. The regression equations of IMRs and the adult life expectancy explain a good proportion of the variation.

Education on women enables them to provide better care to their children and families, which explains its association with

[37]Ewbank D., Henin R., and Kekovole J. An Integration of Demographic and Epidemiologic Research on Mortality in Kenya in Determinants of Mortality Change and Differentials in Developing Countries.

low infant mortality rates and higher adult life expectancy. The association of high population density with low infant mortality is a result of better provision of health facilities in areas with higher populations i.e. towns compared to rural areas. The association of high per capita high-potential agricultural land to low infant mortality rates are due to the fact that people living in better endowed land are likely to have higher incomes from better productivity of the land and have better nutrition leading to better health. However, it is difficult to explain the association between high number of kilometres of road per land area with high infant mortality rates.

## 5.1 Degradation (decertification, deforestation)

As the world's population and per capita consumption grow, the human race is using resources and generating waste faster and wider. Pollution of the air and water, destruction of forests, and loss of fertile soil are becoming critical problems, with serious consequences for health, food production, productivity, and perhaps even ability of the earth to support human life.

Deforestation is becoming increasingly critical in developing countries. Tropical forests are vanishing at an estimated rate of 17 million hectares annually. Asia is losing its forests fastest, at a rate of 1.2% annually, while Latin America is losing 0.9%

annually, and Africa, 0.8%. Countries that have lost more than half of a million hectares of forests annually between 1981 and 1985 include Brazil, Colombia, Cote d'Ivore, Indonesia, Mexico, and Sudan[38]. These estimates exclude logging, a major source of forest destruction. By the year 2000 three billion people - three in every five people in developing countries - may be short of fuel-wood.

Misana et al.[39] reports that Africa which has the fastest population growth in the world, has also experienced high rates of deforestation, especially in the open forests. Over the past ten years, an estimated 1.3 million hectares of closed broad-leaved forests were cleared annually, and another 2.3 million hectares of open woodlands were deforested each year between 1980 and 1985. Ivory Coast has the world's highest deforestation rate of 5.2% and is believed to have lost over 56% of its forest cover about since 1965. While Tanzania has an overall deforestation rate of only 0.3% or 130,000 hectares per year for open forests, since 1954 as much as 70% of the Usambara Mountain rain forests has been destroyed.

Forests are an important resource base upon which the lives of

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[38]World Resources Institute. World resources 1992-93: A guide to the global environment. New York, Oxford University Press, 1992. p. 385.

[39]Misana, S.B. and Nyaki, F.R. Population and Deforestation in Tanzania. **Population, Environment and Development in Tanzania. Dar es Salaam, Demographic Unit, University of Dar es Salaam. (draft).**

many people depend. By conserving soil and water, they foster suitable conditions for sustainable agricultural production, as well as providing wood for timber and energy. Misana et al. notes that in Tanzania, other valuable forest products include honey, beeswax, palm-nuts, fruits, tannin extract, gum, sansevieria fibre, resin, sand-wood oils and medicines[40]. Tanzanian forests supply about 97% of the total fuel-wood consumed. Of the total energy used in Tanzania, wood accounts for 90%. While the supply of wood is dwindling, demand is rapidly increasing with population growth. For most people in Tanzania, as in other developing countries, the real energy crisis is not oil, but fuel-wood.

According to Tesha et al. local people use many forest plants for medicinal purposes[41]. Traditional herbalists gather only those of a plant they will use for treatment. If the leaves of a certain species are known to have medicinal value, only these are normally harvested, leaving the rest of the plant to regenerate. In modern times, many of these same plants are destroyed in an attempt to screen not only the leaves, but also the stems, che bark and even the roots, killing the plant completely.

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[40]Misana S.B. and Nyki F.R. Population and Deforestation in Tanzania. **Population, Environment and Development in Tanzania. Dar es Salaam, Demographic Unit, University of Dar es Salaam. (draft).**

[41]Tesha, A.J. and Muhunnah, R.L.A. Conserving Rare and Endangered Plant species in Tanzania. **Population, Environment and Development in Tanzania.** Dar es Salaam, Demographic Unit, University of Dar es Salaam. (draft).

Tesha et al continue to note that Tanzania is blessed with a very high diversity of plant species. Its forests contain over 10,000 species of which 1,122 are endemic species found nowhere else in the world. It is estimated that the Tanzanian forests contain as many endemic as those found in Kenya, Malawi, Uganda and Mozambique, combined. The rare plant species found in Tanzania's forests may be of potential benefit by providing unique gene pool for use in the improvement of agricultural crops, for the extraction of hitherto unknown medicines and for enhancing the ecological stability of otherwise fragile systems.

In recent times there has been an increased demand for plant-based drugs against the various diseases for which a cure has so far proved elusive, notably cancer and HIV/AIDS. This has resulted in the destructive harvesting of many plants, including some rare ones. As the demand for drugs increases so will the harvesting of these plants, leading in the long run to their extinction. The result is a permanent loss of sources of medicines that could cure diseases that have so far proved incurable and have become major causes of death, hence reversing progress in reducing mortality rates and threatening the survival chance of the people.

Environmental pollution causes deaths to millions of people and makes many others suffer from chronic disabilities. The poor suffer more because they have to face unsanitary living conditions, malnourishment, exposure to infectious organisms and toxic

chemicals, and lack of health services. In urban areas, the poor live in high density areas where contagious diseases such as tuberculosis and viral infections spread rapidly. Migrants, attracted to urban industrial areas by the hope of gainful employment, are forced to drink unsafe water and inhale toxic fumes prevalent in these areas open to squatter settlements which are often highly polluted places shunned by the affluent.

Poor sanitary conditions lead to poor health. Repeated outbreaks of contagious diseases such as cholera, and diarrhoea are common. The conditions have greater impact on infants, children and pregnant mothers leading to high infant and child mortality, morbidity and maternal mortality rates. The child and infant mortality rates of SADC countries are given in table 5.

Table 5: Child and Infant Mortality Rates in SADC Countries

| Country | Under-5 Mortality | | Infant Mortality | |
|---|---|---|---|---|
| | 1960 | 1991 | 1960 | 1991 |
| Angola | 345 | 292 | 208 | 170 |
| Botswana | 169 | 85 | 116 | 62 |
| Lesotho | 210 | 137 | 149 | 82 |
| Malawi | 365 | 228 | 206 | 144 |
| Mozambique | 331 | 292 | 190 | 170 |
| Namibia | 248 | 120 | 146 | 73 |
| Swaziland | 220[a] | 140[a] | * | * |
| Tanzania | 249 | 178 | 147 | 112 |
| Zambia | 220 | 200 | 135 | 112 |
| Zimbabwe | 181 | 88 | 109 | 61 |

Note: ([a]) Source different from that indicated.
Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

The estimates clearly suggest that infant and child mortality remains a health problem among SADC countries. In some countries, like Zambia, Malawi and Tanzania rapid pace of mortality decline has decelerated. Some changes in environmental factors and reversal development health policies are some of the factors cause resurgence of poor health conditions.

## 5.2 Agriculture and land carrying capacities

United Nations Food and Agricultural Organization predicts that more than half of developing countries may not be able to feed their projected populations from their own land by the year 2000 using current low levels of farming technology[42]. Some countries can afford to import food, but this is more expensive than local production. It also uses foreign exchange that could be used for other development purposes such as importing capital equipment for manufacturing. More advanced farming techniques will be needed in the future to offset projected population increases. Worldwide, the average amount of cropland per person is projected to decline from 0.28 ha to 0.17 hectares by the year 2025[43]. Declines will be especially sharp in developing countries. Green further suggests three factors that will determine whether food production

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[42]United Nations Food and Agriculture Organization (FAO). Land, food and people. Rome, FAO, 1984. p. 100.

[43]Green, C.P. The Environment and Population Growth: Decade for Action. **Population Reports**, Series M, No. 10. Baltimore, Johns Hopkins University, Population Information Program, May 1992. p.13.

can be increased fast enough to keep up with population growth:

a. **Croplands.** Currently, the new land put into production each year may equal in size the amount that is rendered unusable by erosion, dryness, salt deposits, or water saturation. Also, large amounts of land are being taken over by expanding urban areas, including housing, roads, and industry.

b. **Water.** Agricultural demand for water is expected to double between 1970 and 2000. Half of this increase is needed just to keep up with population growth, while half would allow increased food production. Most countries in Africa, the Near East, and north Asia face serious water shortages.

c. **Fertilizers and pesticides.** Use of chemicals to boost crop yields and kill insects is likely to increase in order to meet growing food demand. Already, however, excessive or careless use of these chemicals may kill several thousand people, most of them agricultural workers, and injure an estimated one to two million others in developing countries annually.

Though the Green Revolution technology, namely (1) mechanization, (2) new seed varieties, (3) fertilizer, and (4) irrigation; greatly increased food production during the past few

decades, the prospects for a second Green Revolution in the next few decades are limited. Most developing countries continue to use traditional farming methods. Raising crop yields further will be costly and environmentally damaging. Existing croplands in many areas are not suited to Green Revolution techniques due to their climate, terrain, or soil. According to FAO projection, even with farming methods like those in Western Europe, 18 developing countries, including most of the Near East and North Africa, would still be unable to feed their projected populations from their own lands in the year 2000[44].

Table 6: Population Fed in Year 2000 (%)

| Country | Population Fed (%) |
|---|---|
| Angola | 451 |
| Botswana | 63 |
| Lesotho | 26 |
| Malawi | 61 |
| Mozambique | 22 |
| Namibia | 43 |
| Tanzania | 112 |
| Zambia | 468 |
| Zimbabwe | 95 |

Source: Environment and Population. Supplement to **Population Reports**. The Environment and Population Growth: Decade for Action by Cynthia P. Green, Series M, Number 10 (Vol. XX, No.2), May 1992.

From table 16 it can be observed that six of the SADC countries will be unable to feed their populations using current technology. These are Botswana, Lesotho, Malawi, Mozambique,

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[44]United Nations Food and Agriculture Organization(FAO), Land, food and people, Rome, FAO, 1984. p.100.

Namibia and Zimbabwe. Tanzania is estimated to be able to feed 112% of its population in the year 2000. Food inadequacy is associated with malnutrition and death, particularly among children.

## 5.3 Technology, industrialization and settlements

Over the years it has become necessary to increase production of goods and services in order to sustain the growing population. When it was felt that existing technology was reaching its maximum for production, man had to struggle to invent new technologies if the growing population was to be sustained. Old industries were replaced by new ones which produced more and better goods and were used to improve crop yield in agriculture. As a result farming machinery, chemical fertilizers, pesticides, and herbicides were used. While the new technologies have had considerable positive contribution to mankind, it has become apparent that some of the new technologies have had negative effects which can no longer be ignored.

Industries are allowed to release harmful pollutants excessively. Millions of people throughout the world are exposed to hazardous wastes from industrial plants, power generating stations, refineries, tanneries, and hospitals. Once these chemicals have been dispersed into waterways, landfills, and air it is difficult and very expensive to remove them. Health effects of

exposure to hazardous wastes include cancer, birth defects, and damage to the liver, kidney, brain, skin, nervous system, and eyes.

Modern intensive farming technologies replace traditional land conservation techniques. Fertilizers and pesticides may cause severe illness in people. Farm workers are at the highest risk, but waterways carry fertilizer and pesticide residues long distances and pollute aquifers.

Other human activities including burning of coal and oil, clearing forests and grasslands, and using motor vehicles, refrigerators and air conditioners release a growing amount of polluting gases into the atmosphere. These pollutants are suspected of causing grave environmental damage in the form of the greenhouse effect which causes warming up of the earth, depletion of the ozone layer and acid rains. Carbon dioxide, chlorofluorocarbons (CFCs) and methane are thought to cause 95% of the greenhouse effect[45]. CFCs and halon cause the depletion of the ozone[46]. Acid rain is caused by sulphur dioxide and nitric oxide released into the air from electric-generating plants, industries, and vehicles. The gases that cause acid rain may be quickly blown long distances making acid rain an international problem.

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[45]World Meteorological Organization (WMO). and United Nations Environmental Program (UNEP). Climate Change: The IPCC response strategies. Geneva and Nairobi, WMO and UNEP, 1990. p.xxix--xxxii.

[46]United Nations Environmental Programme (UNEP). Action on ozone. Nairobi, UNEP, 1989. p.16.

Depending on the way the wind blows, one nation's air pollution causes another nation's acid rain.

In developing countries industrial expansion, intensive farming methods and use of chemical fertilizers with little regard for pollution control result in unhealthy levels of air and water pollution. Chemicals and industrial technology banned in developed countries for their negative environmental effects find their way into some developing countries. Developing countries produce 45% of the gases that cause global warming[47]. Burning of grass and forests - a common event in many developing countries - accounts for 18% of greenhouse gases emissions. Tanzania, for example, has an asbestos factory in Dar es Salaam which is operating to date. It was built during a time when developed countries had banned the production of asbestos. Currently there is a hot debate on the construction of a pesticide plant in Moshi which is being protested by residents of the town for its environmental effects.

Realizing the polluting effects of past industrialization, a growing number of developed nations are making efforts to reduce pollution by enacting and enforcing environmental regulations. Water and air pollution levels are gradually decreasing[48]. There

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[47]World Resources Institute. World resources 1992-93: A guide to the global environment. New York, Oxford University Press, 1992. p.385.

[48]Repetto, R. Population, resources, environment: An uncertain future. Population Bulletin 42(2): 1-44, Jul.1987.

is need of changing energy consumption patterns, and adoption of new environmental friendly industrial technologies if countries want to reduce pollution levels.

### 4.4 Rural-Urban place of residence

Both rural and urban population groups contribute their fair shares of environmental degradation. While effects of some of the actions are localized, effects of others go beyond the local environment.

Poor farming systems, overgrazing, use of harmful chemical fertilizers, herbicides and pesticides and overuse of chemical fertilizers, herbicides and pesticides are the major contribution of the rural sector to environmental pollution. Their direct effects on health affects mainly the rural population. Their effect on reduction of soil fertility and crop yield, air and water pollution go beyond the rural population and may cover the urban population as well. Deforestation resulting from logging takes place in rural areas, but people who destroy forests could come from both rural and urban areas. The resulting decertification affects both rural and urban areas.

## 5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Looking at the population situation in SADC countries and comparing it to other parts of the world could suggest that

population density per area is not very high in nearly all, except for Malawi. Noting that SADC countries depend on agriculture, it is more appropriate to consider area of arable land per capita than density, per ser.The latter is rather very low. The fact that farming technology in use is still primitive, there is concern that current rates of population growth are too high to sustain human development.

The study has shown that with existing farming technology, increases in population would lead to expansion in farming area leading to environmental degradation in terms of deforestation, depletion of water resources, desertification and soil erosion, all factors having implication for food production, hence malnutrition and resulting mortality, particularly for children. While improved technology may improve productivity, use and overuse of fertilizers, herbicides, pesticides, and chemicals would pollute rivers, aquifers and the atmosphere. While percentages of population provided with safe water and adequate sanitation are still very low, an apparent resulting high infant and child mortality and the consequent higher fertility to meet the demand for child, it has also resulted in the high rate of growth for both urban and rural population, which is worsening the problem of relationship between population and environment.

Deforestation and desertification adds greater demand for labour to produce from poorer soil and, collection of fuel-wood and

water from longer distances. Since most of this work is done by women and children, women have had to work harder to the detriment of their health. Environmental pollution leading to unsafe water and poor sanitation results in poor mother and child health and raises infant and child and maternal mortalities. Low child survival rates lead increases in total fertility rates which in turn leads to poor health of the mothers.

Despite scarcity of quantitative data on environment and poor quality of the inadequate data available, initial analyses of the results available do suggest the existence of inter-relationships between population and environment which influence mortality to warrant further studies and to warrant consideration of African governments to take action. Factors that have been identified to influence environment are: population growth and population density per area of arable land, education of the population (enrolment of school-going age in primary schools), and agricultural policy. Factors that influence environment and population growth are: environmental degradation (i.e. deforestation, decertification, soil erosion, and pollution), education of women (enrolment of school-going age females), infant and child mortality (which are sensitive indicators of sanitation, availability of safe water, and cleanliness of the air).

The modern concept of national development has gone beyond mere economic growth and carried with it improvement of quality of

life of the population. African countries have to act before population densities and environmental degradation puts African countries in general and SADC countries in particular in more serious environmental crises as some countries elsewhere are facing. Findings of the study lead to a recommendation for the national governments to have programs of action that would harmonize economic development and environmental conservation. Such harmonization would lead to development that can be sustained. The inter-relationship between population and environment would require the programmes of action to include the following:

a. Measures that would help reduce population growth. These may include family planning programmes.

b. Measures that would increase child survival rates (i.e. reduce infant and child mortality). This would include programmes of child and mother immunization, improvement in pre- and ante-natal services and improvement in sanitary conditions. These measures will help to reduce fertility.

c. Measures that would increase enrolment in primary schools for school-going age children with special attention being given to the enrolment of females.

d. Inclusion in school curricula such topics as the need and methods of conserving the environment and the need of having a small healthy family.

e. Putting in place environmental conservation regulations and enforcing them in the process of modernization of

agriculture and industrialization.

f. Measures that would reduce the rate of growth of urbanization. Programmes that improves social and development infrastructure in rural areas such as health facilities, transport, clean water, rural electrification, efficient marketing system for agricultural crops etc, would make life in rural areas attractive and discourage people from migrating to towns.

# ANNEX

Table A.1: Births and Deaths in SADC countries

| Country | Crude Birth Rate (per 1,000) | | Crude Death Rate (per 1,000) | |
|---|---|---|---|---|
| | 1960 | 1991 | 1960 | 1991 |
| Angola | 49 | 51 | 31 | 21 |
| Botswana | 52 | 39 | 20 | 10 |
| Lesotho | 43 | 35 | 24 | 10 |
| Malawi | 54 | 55 | 28 | 21 |
| Mozambique | 47 | 45 | 26 | 18 |
| Namibia | 45 | 43 | 22 | 11 |
| Swaziland | * | * | * | * |
| Tanzania | 51 | 48 | 23 | 15 |
| Zambia | 50 | 47 | 22 | 17 |
| Zimbabwe | 53 | 41 | 20 | 11 |
| Average (SADC) | 45 | 45 | 24 | 15 |

Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

Table A.2: Total Fertility Rates in SADC countries

| Country | Total Fertility Rate | |
|---|---|---|
| | 1965 | 1990 |
| Angola | 6.4 | 6.5 |
| Botswana | 6.9 | 4.7 |
| Lesotho | 5.8 | 5.6 |
| Malawi | 7.8 | 7.6 |
| Mozambique | 6.8 | 6.4 |
| Namibia | * | * |
| Swaziland | * | * |
| Tanzania | 6.6 | 6.6 |
| Zambia | 6.6 | 6.7 |
| Zimbabwe | 8.0 | 4.9 |

Source: The Population, Agriculture and Environment Nexus in Sub-Saharan Africa by Kevin M. Cleaver and Gotz A. Schreiber. May, 1992.

Table A.3: Life Expectancy at birth in SADC countries

| Country | Life Expectancy at Birth | |
|---|---|---|
| | 1960 | 1991 |
| Angola | 33 | 46 |
| Botswana | 46 | 60 |
| Lesotho | 43 | 60 |
| Malawi | 38 | 45 |
| Mozambique | 37 | 45 |
| Namibia | 42 | 58 |
| Swaziland | * | * |
| Tanzania | 41 | 51 |
| Zambia | 42 | 45 |
| Zimbabwe | 45 | 56 |

Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

Table A.4: Population Growth in SADC countries

| Country | Average annual Growth (%) | |
|---|---|---|
| | 1965-80 | 1980-90 |
| Angola | 2.8 | 2.5 |
| Botswana | 3.5 | 3.4 |
| Lesotho | 2.3 | 2.7 |
| Malawi | 2.9 | 3.4 |
| Mozambique | 2.5 | 2.7 |
| Namibia | * | * |
| Swaziland | 2.8 | 3.3 |
| Tanzania | 3.3 | 3.5 |
| Zambia | 3.0 | 3.9 |
| Zimbabwe | 3.1 | 3.7 |

Source: The Population, Agriculture and Environment Nexus in Sub-Saharan Africa by Kevin M. Cleaver and Gotz A. Schreiber. May, 1992.

Table A.5: Population Doubling Time (Years)

| Country | Population Doubling Time |
|---|---|
| Angola | 25 |
| Botswana | 23 |
| Lesotho | 24 |
| Malawi | 20 |
| Mozambique | 26 |
| Namibia | 22 |
| Tanzania | 20 |
| Zambia | 18 |
| Zimbabwe | 22 |

Source: Environment and Population. Supplement to **Population Reports**. The Environment and Population Growth: Decade for Action by Cynthia P. Green, Series M, Number 10 (Vol. XX, No.2), May 1992.

Table A.6: Population Density in SADC countries (Mid-1990)

| Country | Population Density per sq. km.) |
|---|---|
| Angola | 8 |
| Botswana | 2 |
| Lesotho | 60 |
| Malawi | 72 |
| Mozambique | 20 |
| Namibia | * |
| Swaziland | * |
| Tanzania | 26 |
| Zambia | 11 |
| Zimbabwe | 36 |

Source: The Population, Agriculture and Environment Nexus in Sub-Saharan Africa by Kevin M. Cleaver and Gotz A. Schreiber. May, 1992.

Table A.7: Tanzania Population Density by Region and Year

| Region | Density (per sq km) 1967 | 1978 | 1988 |
|---|---|---|---|
| Dodoma | 17 | 24 | 30 |
| Arusha | 7 | 11 | 16 |
| Kilimanjaro | 49 | 68 | 83 |
| Tanga | 29 | 39 | 48 |
| Morogoro | 10 | 13 | 17 |
| Coast | 13 | 16 | 20 |
| Dar es Salaam | 256 | 605 | 977 |
| Lindi | 6 | 8 | 10 |
| Mtwara | 37 | 46 | 53 |
| Ruvuma | 6 | 9 | 12 |
| Iringa | 12 | 16 | 21 |
| Mbeya | 12 | 18 | 25 |
| Singida | 9 | 12 | 16 |
| Tabora | 7 | 11 | 14 |
| Rukwa | 4 | 7 | 10 |
| Kigoma | 13 | 18 | 23 |
| Shinyanga | 18 | 26 | 35 |
| Kagera | 23 | 36 | 47 |
| Mwanza | 54 | 74 | 96 |
| Mara | 28 | 37 | 50 |
| Mainland | 14 | 19 | 26 |
| Kaskazini-Unguja | 124 | 169 | 206 |
| Kusini-Unguja | 47 | 62 | 82 |
| Mjini-Magharibi | 428 | 640 | 906 |
| Kaskazini-Pemba | 157 | 232 | 239 |
| Kusini-Pemba | 226 | 242 | 385 |
| Zanzibar | 149 | 201 | 260 |
| Tanzania | 14 | 20 | 26 |

Source: Bureau of Statistics, 1988 Population Census: Preliminary Report, Table 2.

Table A.8: Urban Population and its Growth in SADC Countries

| Country | % of Total | Average Annual Growth % | |
|---|---|---|---|
| | 1991 | 1965-80 | 1980-91 |
| Angola | 27 | 6.4 | 5.9 |
| Botswana | 24 | 15.4 | 8.2 |
| Lesotho | 19 | 14.6 | 6.5 |
| Malawi | 11 | 7.8 | 6.9 |
| Mozambique | 25 | 11.8 | 8.8 |
| Namibia | 27 | 1.9 | 5.1 |
| Swaziland | * | * | * |
| Tanzania | 20 | 8.7 | 6.8 |
| Zambia | 42 | 7.1 | 4.0 |
| Zimbabwe | 28 | 7.5 | 5.8 |

Source: The State of the World's Children 1993. UNICEF. Oxford University Press.

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