

Protection of the Atmosphere: Environmental Policy Consideration

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Introduction

The earth's atmosphere is not confined to national boundaries. The protection of the atmosphere must, therefore, be a global effort. Global efforts at the protection of the atmosphere have so far consisted of the Montreal Protocol on substances that deplete the ozone layer and the United Nations Framework Convention on Climate Change which largely addresses the emission of greenhouse gases into the atmosphere. The presence of ozone depleting substances and greenhouse gases in the atmosphere has a major impact on climate change.

Global Warming

Growing scientific evidence points out to the occurrence of enhanced greenhouse effect leading to the earth being warmer than it would be without the effect. In order to appreciate the phenomenon of the enhanced greenhouse effect, it is important to understand the natural phenomenon of greenhouse effect.

The temperature on the surface of the earth is determined by the balance between solar energy absorbed by the earth and that which is emitted by the earth's surface into the atmosphere. The former is short wave radiation passing through the atmosphere almost unimpeded while the latter, long-wave radiation, is partially absorbed by greenhouse gases in the atmosphere and is later re-emitted. The re-emitted radiation has the effect of keeping the surface of the earth and the atmosphere warmer than it would otherwise be. It is in effect 33°C warmer than it would be without greenhouse gases.^{1,11}

There has been, in the past 100 years, an increase in the concentration of greenhouse gases: carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs). These increased concentrations, arising out of human activities, have led to an enhanced greenhouse effect and increased warming of the earth's surface.

Scientific studies on climate change supported by extensive observations show that the global mean surface temperature has risen by 0.3°C to 0.6°C over the past 100 years. It is also known that the warmest years over this period have occurred in the 1980's.² Similarly, over the past century, average sea level has increased by 10-20 cm.

Scientific studies on global warming and climate change¹ indicate that if emissions of greenhouse gases due to anthropogenic activities continue unabated, the global mean temperature will increase by 0.3°C per decade resulting into a rise of 1°C by the year 2025. Under this business-as-usual scenario, it is expected that the sea level will rise by 6cm per decade over the next 100 years, rising by about 20 cm by the year 2030.^{1,2}

Greenhouse Gases

Important greenhouse gases include carbon dioxide, methane and nitrous oxide. Other gases include water vapour and ozone. Of all greenhouse gases, water vapour has the greatest greenhouse effect. However, human activity does not affect concentrations of water vapour even though warming of the atmosphere will increase water vapour and, therefore, increase its effect even further.¹¹ Quantification of the changes in the concentration of ozone in the stratosphere and atmosphere due to human activities is difficult. Current efforts to understand the interaction between human activity and greenhouse gas emissions, therefore, have concentrated on carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFC's).

Concentration of greenhouse gases in the atmosphere has been increasing since the 18th century. For example, IPCC² has estimated that the pre-industrial atmospheric concentrations of carbon dioxide, methane and nitrous oxide were 280 and 0.8 parts per million by volume (ppmv) and 288 parts per billion by volume (ppbv), respectively. By 1990 the atmospheric concentrations of these gases were 353 ppmv, 1.72 ppmv and 310 ppbv for carbon dioxide methane and nitrous oxide, respectively. These gases are increasing in the atmosphere at the respective rates of 0.5%, 0.9% and 0.25% annually. Carbon dioxide is the most predominant of all the greenhouse gases, accounting for nearly half of the atmospheric warming from greenhouse gases. It is, however, the least active per molecule. If the relative thermal effect of carbon dioxide is normalized to 1, methane's effect is 30 and nitrous oxide, 200.

Chlorofluorocarbons (CFC's) are a recent addition to anthropogenic greenhouse gas emission. Invented in 1928, they have been used since 1950 in aerosols, fridges, freezers, air conditioners, and blowing foams. Their immense stability, inflammable nature and ease of production are useful characteristics to industry and to consumers. Yet it is the extreme, stable nature of these substances that enables them to attack the protective ozone layer in the troposphere and the stratosphere. In the stratosphere, intense ultra violet-C (UV-C) radiation releases chlorine from CFC's which reacts with ozone thereby breaking a molecule of ozone into an atom which releases oxygen in the process. In relative terms CFC's are the most potent of greenhouse gases. Their relative thermal effect compared to carbon dioxide is 22,000.

International Response to Global Warming

In October 1985, scientists from 29 countries - industrialised and developing countries - met in Villach, Austria to review evidence on the greenhouse effect. The meeting which was held under the auspices of the World Meteorological Organisation (WMO), the United Nations Environment Programme (UNEP), and the International Council of Scientific Unions (ICSU), ended on a sombre note that on the strength of evidence obtained, climate change should be considered a 'plausible and serious probability'².

One of the most comprehensive reviews of environmental challenges facing the world was undertaken by the World Commission on Environment and Development. The concept of sustainable development has been defined as that required 'to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs'.⁴ A change in climate would, therefore, make development at best uncertain and, in all probability, unsustainable. In this context, and in discussing responses to climate change, the World Commission on Environment and Development proposed that even with the uncertainties surrounding some of the issues of climate, nations should not wait for climate change to be demonstrated before taking preventive actions. In this regard the Commission proposed a four-track strategy concerning climate change, including⁴:

- (i) improved monitoring and assessment of evolving phenomena;
- (ii) increased research to improve knowledge about origins, mechanisms, and effects of the phenomena;
- (iii) the development of internationally agreed policies for the reduction of causative gases; and
- (iv) adoption of strategies needed to minimize damage and cope with the climate changes and rising sea level.

Environmental concerns were also brought to the attention of the Vancouver meeting of the Commonwealth Heads of State and Government in 1987. Major disasters, including the inundation of the Maldives and floods of Bangladesh, were central in the discussions which led to the formation of an expert group which examined and reported on climate change, sea level rise and flooding. In their report titled 'Climate Change -Meeting the Challenge', submitted to the Secretary General in 1989, the Expert Group made three broad and major recommendations. These can be summarised thus³:

- (i) Action must be taken to reduce the burden of uncertainty which hampers policy formulation. Investment in scientific study and public awareness creation must be underscored;
- (ii) Adjustments need to be made in development patterns and activities in order to adapt to climate change;
- (iii) Action must be taken in order to reduce emissions of greenhouse gases and stabilize their atmospheric concentrations.

Growing scientific evidence concerning the possibility of global climate change led to calls for a global treaty for the world community to collectively address and deal with the problem. Towards that end, UNEP and WMO jointly established the Inter-governmental Panel on Climate Change (IPCC) in 1988. IPCC was mandated to²:

- (i) assess scientific information that is related to various components of the climate change, such as emissions of major greenhouse gases and modification of the earth's radiation balance resulting therefrom, and that needed to enable environmental and socio-economic consequences of climate change to be evaluated; and
- (ii) to formulate realistic response strategies for the management of the climate change.

In order to undertake its responsibilities, IPCC established three working groups (Working Group I, II, and III). Working Group I is responsible for the assessment of available scientific information on climate change. Working Group II is responsible for assessing environmental and socio-economic impacts of climate change, and Working Group III is responsible for the formulation of response strategies.

The United Nations Framework Convention on Climate Change

Following on the work of IPCC and the recommendations of the 1990 Second World Climate Conference, the United Nations General Assembly, at its 1990 session, set up the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC) and mandated the Committee to draft a framework convention and related legal instruments. Between February 1991 and May 1992, 150 nations held five sessions and adopted the United Nations Framework Convention on Climate Change on 9th May 1992, in New York.

The UNFCCC was signed in Rio de Janeiro Brazil by over 150 nations that attended the 'Earth Summit' in June, 1992. The main objective of the convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system³. Achievement of stabilization of these concentrations has a time frame. According to the convention the time frame is one which is "sufficient to allow eco-systems to adapt naturally to climate change to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."⁵ The signatories to the convention are guided by the following principles:⁵

- (i) protection of the climate system for the benefit of present and future generations on the basis of equity;
- (ii) giving full consideration to the specific needs and special circumstances of

developing countries, especially those that are vulnerable to the adverse effects of climate change;

- (iii) taking precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects;
- (iv) promotion of sustainable development, taking into account that economic development is essential for adopting measures to address climate change; and
- (v) promotion of an international economic system that leads to sustainable growth and development.

The United Nations Framework Convention on Climate Change,¹ in Article 4, commits the signatories to:

- (i) Develop, periodically update, publish and make available national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;
- (ii) Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;
- (iii) Promote and cooperate in the development, application and diffusion, including transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;
- (iv) Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;
- (v) Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

- (vi) Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods - for example impact assessments - formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change;
- (vii) Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies;
- (viii) Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies;
- (ix) Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organisations; and
- (x) Communicate to the Conference of the Parties information related to implementation, in accordance with Article 12 of UNFCCC.

Countries which are especially vulnerable to climate change are recognised by the Convention. These include:

- (i) Small Island Countries;
- (ii) Countries with low-lying coastal areas;
- (iii) Countries with arid and semi-arid areas, forested areas, and areas liable to forest decay;
- (iv) Countries with areas prone to natural disasters;
- (v) Countries with areas of high urban atmospheric pollution;
- (vi) Countries with areas of fragile ecosystems, including mountainous ecosystems;
- (vii) Countries whose economies are highly dependent on income on consumption of fossil fuels and associated energy-intensive products; and
- (viii) Land-locked and transit countries.

Articles 5 and 6 of the Convention relate to support for, and promotion of, research, data collection, strengthening of scientific and technical capacities, education, training and promotion of public awareness and access to information

on climate change and its effects. Article 7 of the Convention establishes the Conference of the Parties (CoP) as the supreme organ of the Convention and lays down its mandate. Article 8 provides for the creation of a secretariat for the CoP. The details of its functioning are left to the first meeting of the CoP. Article 11 of the Convention provides for the establishment of a financial mechanism for providing financial resources on a grant or concessionary basis to enable developing countries and countries with economies in transition meet their commitments to the Convention. This window is additional to other bilateral, regional and multilateral channels. The Global Environment Facility whose operations have been entrusted to the World Bank, the United Nations Development Programme (UNDP) and UNEP has been nominated an interim measure until a decision is made by the CoP, to implement the provisions of this Article. Articles 12 and 13 provide for communication of information related to the implementation of the Convention, and resolution of questions related to implementation through a multilateral consultative process, respectively. Article 14 is on settlement of disputes. Other Articles relate to adoption and amendment of annexes, protocols, voting rights, depository, signature, interim arrangements, ratification, withdrawal, and authenticity of texts.

The Convention was required to come into force three months after the date of ratification of the fiftieth member state. The fifteenth state ratified the Convention on 21st March, 1994. The Convention stipulates that the first session of the CoP should be convened and should take place not later than one year after the date of entry into force of the Convention. The first Conference of Parties was called for March, 1995 in Berlin, the Federal Republic of Germany.

Developing countries are required by the Convention to take a leading role in the global efforts to reduce and stabilize greenhouse gases. In this regard the convention requires them to report within six months of the Convention's coming into force and periodically thereafter, policies and measures they are taking so as to return to levels of 1990 their anthropogenic emissions of those greenhouse gas emission not covered by the Montreal Protocol. Developed countries are further required to provide developing countries with new and additional resources to meet the full costs that will be incurred by these countries while complying with the requirement of the Convention regarding information related to implementation of the Convention. The Convention commits developed countries to provide financial resources and transfer of technology needed by developing countries in order for them to meet what will be agreed as full incremental costs of meeting the developing countries' commitments to the convention.

The Convention has recognized the special character and history of countries in the process of transition to a market economy. These include mainly Eastern European countries and countries of the former Union of Soviet Socialist Republics providing to them flexibility in the implementation of their commitments to the convention. The special needs of developing countries are also recognized. In particular, the Convention, recognizes the fact that economic and social development and poverty eradication are the overriding

priorities of developing countries. Under the Convention considerations will be given to these countries including such actions as transfer of technology, insurance and funding. The Global Environment Facility has been entrusted with the operation of the financial mechanism for the provision of financial resources on a grant or concessional basis. Under Article 4(2)(a) of the Convention, it is provided that developed country Parties may implement policies and measures on mitigation of climate change jointly with other Parties. In Article 4(2)(d), it is further stipulated that the Conference of Parties shall decide on criteria for joint implementation. Joint implementation, as a concept and as a practice, will feature prominently in bilateral North-South relations on mitigation of greenhouse gas emissions and could surpass the Global Environment Facility in involvement in total funding, and technology transfer issues. It is expected to be one of the most important issues for consideration by the Conference of Parties to the Convention.

The Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances That Deplete the Ozone Layer

The first theory blaming CFCs for destroying stratospheric ozone was presented in 1974 by Sherwood Rowland, of the University of California and his collaborator, Mario Molina.¹² Their ideas were not taken up immediately; but by 1981, in accordance with a United Nations Environment Programme (UNEP) Governing Council decision, a working group of government legal and technical experts drafted a "Convention for the Protection of the Ozone Layer."¹² In 1985 this draft was adopted by 21 states and the European Community as the Vienna Convention.

Parallel plans for a protocol containing specific regulatory measures were laid down in the Convention. Impetus towards the drafting of a protocol was given in 1985 when the British Antarctic Survey published irrefutable evidence of the ozone hole over Antarctica. The Montreal Protocol¹² was finalized and approved on 16 September, 1987 and came into force in January, 1989. The Protocol, then ratified by 36 countries accounting for about 80 percent of global CFC consumption, called for reducing the production and use of specified CFCs and a freeze on the consumption of halons. The aim was to achieve the 1986 level of CFC use by July 1989, 80 percent of that level by July 1993, and 50 percent of the 1986 level of consumption by July 1998.

Parties to the protocol agreed to limit halon use to 1986 levels after 1992. Significantly also, they agreed to list products containing controlled substances by January 1992, and a ban in the following year. Parties have also been urged to consider import control measures for goods produced with (but not themselves containing) controlled substances. Finding substitutes seemed an impossible task in 1987; but the progress made and further research on ozone loss were recognized by the first Conference of Parties held in Helsinki in 1989, the second Conference of Protocol Parties, held in London in June 1990¹³ and the third meeting of Parties held in Nairobi in 1991.⁶ Tanzania signed and ratified the Montreal Protocol in 1992. The Montreal Protocol, in its original form, was aimed at phasing out the production of CFCs, halons, carbon tetrachloride and methyl chloroform completely by the year 2005. If

this were achieved, levels of chlorine compounds in the atmosphere would be slightly below today's levels by 2050.

As mentioned earlier, the Montreal Protocol was adopted in 1987 and new scientific findings indicated that the Protocol control measures were inadequate to restore the ozone layer. In addition, developing countries expressed concern over the vague language both regarding technology transfer to developing countries and regarding financial assistance. The first meeting of the Parties to the Protocol in Helsinki in 1989 recognized these concerns.⁶ The Parties declared their intention to phase out ozone depleting substances by the year 2000, and a working group was set up to create a financial mechanism to help the developing countries. Another group was set up to work out amendments and adjustments to the Protocol. Assessment panels were established to report on the scientific and environmental effects and the technological and economic aspects of ozone before the end of 1989.

The second meeting of the Parties to the Montreal Protocol was held in London in June, 1990. Amendments were made to increase the number of controlled substances and to increase the speed of substitution. Similarly, amendments were made to provide for a financial mechanism to enable developing countries meet their obligations under the Protocol.

The third meeting of parties was held in Nairobi in June 1991 while the fourth meeting of the parties was held in Copenhagen in November, 1992 to consider the panel reports.⁷ It was agreed to phase out all CFCs, carbon tetrachloride and chloroform by 1996. Halons, whose phasing out was originally considered to be most difficult, as there are no substitutes, was supposed to be phased out by 1994. It was also agreed, in respect of methyl bromide, a fumigant, that consumption would be frozen by 1995.

Both the Convention and the Protocol are guided by regular meetings of Parties. The Parties to the Protocol meet every year and the Parties to the Convention meet once every three years. The Convention focuses on research on the ozone layer while the Protocol implements control measures on ozone depleting substances.

The Control Measures

All the Parties are obliged to phase out the five original CFCs (CFC-11, CFC-12, CFC-113, CFC-115) by 1996 and the three halons (halon - 1211, halon-1301, halon-2402) by 1994. All the other CFCs, carbon tetrachloride and methyl chloroform are to be phased out by the year 1996 by all the parties to the London Amendment. Those who ratified the Copenhagen Amendment will, in addition, phase out hydrobromofluoro-carbons (HBFCs) by 1996 and HCFCs by the year 2030. These parties will also freeze the consumption of methyl bromide by the year 1995 at 1991 levels.

For each of the substances, the producers are allowed to manufacture 10% to 15% more than the allowed amount so that developing countries can meet their basic domestic needs for these substances. A provision has been made to permit small quantities of production and consumption to meet essential needs such as research and medical uses after the dates of phase out.

In recognition of the special situation of developing countries, a provision has been made in the Protocol whereby developing countries, with an annual consumption of controlled substances of less than 0.3 kg per capita until the year 1999, are allowed a ten-year grace period for implementing the provisions of the Protocol.

Any developing country which notifies the Parties that it cannot implement the Protocol because of inadequate technology transfer or lack of finance, is entitled to a hearing by a meeting of the Parties, without fear of being considered guilty of non-compliance.

Alternative Substances and Technologies

Many of the technologies to replace CFCs are not through alternative chemicals but through alternative processes. It has been estimated that about 40% of the replacement of CFCs will be through alternative chemicals and the rest through conservation practices⁶.

National Response

Tanzania is a signatory to the United Nations Framework Convention on Climate Change and the Montreal Protocol. In order to implement provisions of the Convention, and the Protocol, information is needed to assess emissions as a basis for abatement actions. In respect of the convention, the first stage is the creation of an inventory of emission of greenhouse gases by source and removal by sinks.

In order to prepare an inventory of sources and sinks of greenhouse gases, and with the benefit of grants from the United Nations Environment Programme (UNEP) and the International Development Research Centre of Canada (IDRC) to the Government and to the University of Dar es Salaam, respectively, a team of researchers was organised under the auspices of the Centre for Energy, Environment, Science and Technology (CEEST). To facilitate implementation of the study, and following on the guidelines based on a methodology developed by UNEP, the Organisation of Economic Cooperation and Development (OECD) and the International Panel on Climate Change (IPCC), the study was organised on the basis of the sectors of energy and transport, industry, agriculture, forestry and land-use, commerce and household, and solid waste and waste water management.

Estimates on emission of greenhouse gases from the energy sector is based on the study of energy use in the various industry sub-sectors classified according to the standard industrial classification system namely; food; beverage and tobacco; textile, leather and sisal; metal and engineering; chemical, wood products and printing; and non-metal mineral products; energy use in thermal power stations; and energy use in the transport sector.

Categories of land-use change activities which contribute to emission of greenhouse gases which have been considered include: forestry clearing for permanent cropland or pasture; conversion of grassland into cultivated land; regrowth in lands which were previously managed but were abandoned; forest management; shifting cultivation; and flooding of lands.

A summary of estimates of greenhouse gas emission by source and removal by sinks is as shown in the attached table. Results indicate that land use changes and forestry and the energy sector contribute the largest share of greenhouse gas emissions in Tanzania. However, in respect of land-use and forestry changes, data uncertainties are such that the results should, at this stage, be considered indicative. More work, including the refinement of data and the underlying assumptions required for the estimation of emissions and removal of greenhouse gases is required before the results are used as a basis for definitive policy action.

Another limitation of the study has been the use of emission factors based on default values provided by IPCC because of the absence of country-specific emission factors and emission ratios. It is, therefore recommended, that a programme be put in place to conduct studies aimed at obtaining country-specific emission factors. Furthermore, it is recommended that the completion of the exercise of creating an inventory of sources and sinks has to lead to the creation of a mechanism for its regular updating.

These observations and recommendations were endorsed by the "National Workshop on Sources and Sinks of Greenhouse Gases in Tanzania" convened by CEEST and held at the Tanzania Commission for Science and Technology from 26/9/1994 to 27/9/1994. In addition, the workshop stressed the need for capacity building and capacity sharing in climate studies in developing countries. The workshop recommended that proactive and precautionary measures be taken by the government to reduce vulnerability to climate change and climate variations. The workshop further recommended that even with uncertainties of data highlighted in the study, a good basis exists for the country to embark on studies on mitigation of emission and assessment of vulnerability. It was stressed that climate change and climate vulnerability should be incorporated into development policy initiatives, plans and programmes. Caution was, however, added that for this exercises to be relevant, there must be a linkage between the objective of poverty alleviation and improvement of Tanzania's socio-economic situation and other developing countries.

One of the provisions of the Montreal Protocol on substances that deplete the ozone layer is that each Party is required to make an assessment of the consumption of the ozone layer depleting substances. In this regard, the Ministry of Tourism, Natural Resources and Environment; the Environment Management Council and CEEST are collaborating in the assessment of ozone layer depleting substances in Tanzania. A pilot phase, involving the assessment of Ozone Depleting Substances (ODS) in Dar es Salaam has been completed.

Roundtable discussions on ozone depleting substances in Tanzania were held on 24 August, 1994. Results of the pilot phase of ascertaining ODS in Dar es Salaam were presented and the following recommendations made:

- (i) There is a need to carry out a complete inventory of stocks of ODS in order to quantify CFC's currently in the country.
- (ii) A baseline study should be carried out on existing air conditioning plants and workshops in order to identify technologies in use and possibilities of retrofitting or replacement in order to meet targets of the Montreal Protocol.

- (iii) There is an urgent need to develop a national strategy and action plan on the implementation of the Montreal Protocol.
- (iv) It is desirable to carry out feasibility studies on the use of non-technical solutions of the problem of ODS in Tanzania.
- (v) Tax and other incentives be given in order to motivate implementation by industry of a programme to move from ODS-based to non-ODS producing technologies.
- (vi) There is need to increase awareness of the problem arising from the production of ODS among policy makers, politicians and the general public.
- (vii) Use should be made of the multilateral fund established to assist developing countries in the implementation of the Montreal Protocol.

Rationale for Climate Change Studies

In a world where developing countries are beset with an array of problems which at times put to test the very existence of some of these nations, climate change would appear, at first glance to be an "esoteric" subject, a concern for the future for those whom poverty is a thing of the past. There are those who also hold that the developed countries had utter disregard - knowingly or unknowingly - of the "global commons." During the early stages of development and long thereafter, concern for the environment was secondary to the drive for industrialization. Indeed, considering historic and present emissions of greenhouse gases, developed countries are responsible for ²/₃ of the emissions due to anthropogenic activities and, therefore, the associated forcing potential. The responsibility for "cleaning up the mess", it is argued, is therefore that of the developed countries. Should or should not developing countries be involved in issues of climate changes? We submit, and without reservations, that they should do so and take proactive measures for that matter. The reasons for doing so are many and include, among others, those given in the following paragraphs.

The atmosphere is indivisible. Nations, even the most developed ones, have no control over the complex forces of nature which govern the diffusion of emissions in the atmosphere and circulation of air masses. In respect of emissions, the atmosphere is one global common. Developing countries, including Tanzania, are part, albeit a small part of that global common. What happens elsewhere in that global common has an effect and impacts on our countries. In respect of climate change, therefore, we are and should be an interested party.

The International Panel on Climate Change (IPCC) admits that there are many uncertainties in the predictions of climate change and especially with regard to the timing, magnitude and regional patterns of climate change. Even with these uncertainties, evidence still points to a changing climate. Climate variability being experienced by many countries is an illustration, in the short term, of impacts of long term climate change. Droughts, floods, extreme temperatures and tropical typhoons are but some of the manifestations of climate variability. The ability of countries like Tanzania to withstand or to adapt to the impacts of these variations is at best minimal. It is precisely because

of this inability to cope, or adapt, that developing countries need to understand, and participate in order to find out, what may or may not be going on in the atmospheric system. There is a need, therefore, for developing countries to formulate cross-sectoral and sectoral policies which achieve developmental objectives and also lead to mitigation of emissions and take into account the vulnerability of countries to climate variations and climate change. It should, therefore, be possible for nations to explore policy options and strategies which achieve the goals of economic development and poverty alleviation while also contributing to the stabilization of the climate.

Climate change studies are about understanding complex phenomena and their impact on mankind. By their very nature they are, therefore, interdisciplinary and multidisciplinary in character. They provide an opportunity for unification and application of the natural sciences, the social sciences and engineering. They provide an avenue for exploring and exploiting important synergies among sectors. Energy and agricultural strategies, for example, if geared towards sustainable development will involve rational choices and rational utilisation of natural resources which should result in the reduction of emissions of greenhouse gases.

Furthermore, now that Tanzania and other developing countries are Parties to the UNFCCC, compliance with its provisions is mandatory. The legal requirements provide a basis for our participation in climate change studies and policy formulation. The UNFCCC is a legally binding document providing a normative guide to all the parties with regard to responsibilities of each and to each other.

Africa and Climate Change Studies

Despite initial scepticism on the part of many African nations, the publication of the Report on the World Environment and Development and the participation by many of the nations in the preparatory meetings of the UNCED coincided with, and in part stimulated, a number of initiatives in climate studies in Africa.

In 1990 a group of researchers from the University of Dar es Salaam, Tanzania, and the Zimbabwe Institute of Development Studies, drew up a proposal for a collaborative study on greenhouse gas emissions from food and energy production and utilization. Funded by the International Development Research Centre (IDRC) and Environment Canada, this initiative was one of the first attempts by researchers in the two countries to identify sources and sinks of greenhouse gas emissions and entry points for policy interventions.

In 1990, the African Centre for Technology Studies - a Nairobi based non-governmental institute - organised, in collaboration with Woods Hole Research Centre of Massachusetts, USA, an international conference on global warming and climate change. Held in Nairobi, Kenya, the conference warned of unpredictable and severe effects of climate change on the ecosystem of developing regions such as Africa and called for anticipatory measures. In a declaration that was addressed to African policy makers and researchers, it was emphasised that immediate action needs to be taken to support research, to review development plans and to strengthen environmental conservation

measures. The conference further underscored the need for the cancellation of international debts and revision of trade policies in order to enable African countries adjust to climate variations and change.

Between 1991 and 1993, Zimbabwe and Senegal participated in the UNEP Greenhouse Gas Abatement Costing Studies. The UNEP project, in which Zimbabwe participated was intended to clarify some of the economic issues involved in the assessment of the costs of limiting greenhouse gas emissions and to come up with a methodological framework for assessing national costing of abatement in order to allow for comparability.

The UNFCCC requires countries ratifying the Convention to communicate to the conference of the Parties national inventories of anthropogenic emissions, by sources and sinks, of all greenhouse gas emissions that have not been covered by the Montreal Protocol on Substances that Deplete the Ozone Layer. In order to support the goals of the UNFCCC, the Global Environmental Facility (GEF), through UNEP has supported the development of national inventories in Uganda, Tanzania, Nigeria, Gambia, Senegal, Mali and Egypt.

As part of its obligations under the UNFCCC, the United States of America is supporting a number of countries to undertake studies on climate change. For the first round of studies which began in October, 1993, the following African countries are participating out of 26: Algeria, Egypt, Ethiopia, Gambia, Nigeria and Zimbabwe. The second round of studies was expected to start in October, 1994 and the following African countries are likely to be supported: Botswana, Ivory Coast, Kenya, Malawi, Mauritius, Mozambique, Tanzania, Uganda and Zambia. Lesotho, Seychelles, Sierra Leone and Togo have been earmarked for the third round. The Federal Republic of Germany is supporting country studies in climate change in Zambia and Tanzania.

Apart from these major country programmes, there are a number of institutional collaborative initiatives. One of these is the Link Acts and the Stockholm Environment Institute; the Zimbabwe Energy Research Organisation (ZERO) of Zimbabwe; Audit Planification Expertise (APEX) of Tunisia; the African Energy Policy Research Network (AFREPREN); Nairobi; ENDA of Dakar Senegal and others. These institutions are conducting a study on climate and Africa aimed at assisting Africa in its preparations for the Conference of the Parties. The study, is being funded by the Government of Sweden. The African Conference on Global Climate Change, scheduled for December 5-8, 1994 and organised under the auspices of the project "Climate and Africa" is part of a process to assist African countries prepare for negotiations at the first Conference of the Parties to the UNFCCC.

Conclusion: Issues for Policy Consideration

It is generally accepted by the scientific community that issues surrounding climate change and climate vulnerability are complex and that present knowledge must be improved upon in order to reduce the uncertainty which could hamper policy formulation. In respect of Tanzania, and as shown above,

studies are being undertaken to improve the knowledge level in order to allow scientifically based/informed policy formulation. Even at this early stage a number of policy related issues emerge.

In countries that are beset with numerous developmental problems, the issue of the relevance of atmospheric changes and their impacts cannot be ignored. However, it has been shown that it is precisely because of the inability of developing countries to respond to even the slightest changes or variations, that priority must be accorded to the understanding of linkages between climate change and climate variation and development.

Climate variation is perhaps easier to appreciate because its impacts are felt in the short term - floods and droughts are an example. By and large, developing countries have agricultural based economies relying mostly on rain-fed agriculture. The amounts, temporal and spatial distribution of rainfall are critical to agriculture. Crops are temperature dependent. Any change in atmospheric temperatures will affect negatively or positively crop production. There is need, therefore, to recognize in policy formulation, the cross-sectoral linkages and exploit synergies so that climate variation does not hinder development.

Climate change is not easy to discern in the short run. Increases in sea levels by a few centimeters may take a century. For sustainable development, a concept which takes into account inter-generational equity, the international community has decided to take preventive and precautionary measures to mitigate emission levels of greenhouse gases and to encourage and support studies and actions on assessment of vulnerability, and adaptation to climate change.

Instruments or agents for effecting policy in climate change and climate variation include institutions to implement policies and the medium of transmission of policies, plans, and knowledge in the subject matter. Awareness creation on issues of climate change and atmospheric protection has been underscored.

International and bilateral cooperation is increasingly evolving around issues of environmental protection, including protection of the atmosphere. Mechanisms such as the Global Environment Facility and Joint Implementation in respect of the UNFCCC and the Multilateral Fund in respect of the Montreal Protocol will become new avenues of cooperation on issues such as research, exchange of information, transfer of technology and as channels for new investment.

Tanzania has signed the UNFCCC and is a Party to the Montreal Protocol. It is strongly recommended that Tanzania ratify the UNFCCC as soon as possible.