The Nairobi Declaration on Climatic Change

International Conference on Global Warming and Climatic Change: African Perspectives 2-4 May 1990

Organized by
African Centre for Technology Studies, Nairobi, Kenya and
Woods Hole Research Center, Woods Hole, Massachusetts, USA

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The African Centre for Technology Studies (ACTS) is a non-partisan, not-for-profit institution established to conduct policy and practical research in technological innovation and environmental management. The Centre promotes the view that technological change, environmental management, and institutional innovation are crucial to sustainable development and should be at the core of all development efforts. ACTS has a national focus and a regional view and collaborates with United Nations, governmental, inter-governmental, private, academic and other research institutions with similar objectives. Acts Press is an autonomous wing of ACTS and operates under an independent editorial policy.

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Executive Summary

Over the last 100 years, the global mean surface air temperature has increased by 0.3–0.6°C and the global average warmest years have been in the 1980s. The global sea level has increased by 10–20 cm over the same period. These are indicators of global climatic change resulting largely from human activity. The entire world now faces climatic changes with potentially disastrous effects largely as a result of activities in the industrialized countries, particularly high levels of fossil fuel use. African countries, which have contributed the least to the problem, may suffer disproportionately from its consequences, in part because of their limited financial and technological resources and institutional capability, and their continuing need to deal with other development issues.

There is broad consensus among scientists that climatic change will occur, will have unpredictable and severe effects on ecosystems, and has the potential to have a devastating effect on developing regions such as Africa unless anticipatory measures are taken now.

The International Conference on Global Warming and Climatic Change: African Perspectives was held at the United Nations Environment Programme (UNEP) headquarters in Nairobi, Kenya (May 2–4, 1990) to examine the possible impacts of global climatic change on the ecosystems, economies and infrastructure of African countries. Participants from the continent and other researchers from around the world presented the most recent data, models and case studies on the anticipated global warming and its impacts. The Declaration is addressed particularly to African policy-makers and researchers as well as to governments and interested parties globally. The Declaration calls for immediate action on policies to support research, review of planned development, strengthening of ongoing environmental conservation measures and cancellation of international debt as well as revision of trade policies to enable African countries to apply their resources to adjusting to climatic change.

- More specifically, the African countries are called upon to introduce policies which promote diversification and flexibility in the economy as a means of reducing economic and social vulnerability. They are further urged to enhance reforestation and family planning efforts and to participate fully in international negotiations on climatic change and environmental management.
- The industrialized countries are called upon to reduce their emission of greenhouse gases substantially, reduce barriers to access to environmentally-sound technologies, facilitate research on climatic issues and move faster in cancelling external debt owed by the developing countries.
- The United Nations system is called upon to support the participation of African countries in international negotiations, enhance training activities on climatic change and increase the dissemination of relevant information on the subject in particular, and on sustainable development in general.
- The non-governmental organizations (NGOs) are called upon to increase their efforts in raising public awareness on environmental issues, promoting environmental education and mobilizing local communities to undertake measures such as energy conservation and reforestation. They are also urged to follow closely and participate in the current negotiations on climatic change.
- The private sector is urged to increase its research efforts to develop environmentally-sound technologies and management practices and to disseminate these as widely as possible.

In the final analysis, governments all over the world have a duty to formulate policies and establish institutional measures which will promote the proposed strategies. Individuals have a duty to take the first steps towards a more sustainable world through their own actions. Scientists are predicting a gloomy future; it is the duty of every person on earth to change this picture. The task ahead is enormous; action must start now.

"It is going to be difficult for the African countries to fully adjust their economies if they do not have access to environmentally-sound technologies and scientific knowledge on ways of managing the environment."

— President Daniel arap Moi
Republic of Kenya

Conference Declaration

For thousands of years prior to the industrial revolution, the concentration of "greenhouse gases", such as carbon dioxide, methane, and nitrous oxide was relatively constant and maintained the earth at a fairly stable temperature. However, as the world's population increased and became more industrialized, the abundance of these gases increased markedly. Scientific data indicate that increased atmospheric concentration of greenhouse gases will raise the global temperature, and may have already begun to do so. This is due to their ability to trap heat radiating from the earth, acting as a layer, much like the glass of a greenhouse, which prevents heat from escaping while allowing continued solar radiation. This change in the earth's atmosphere is occurring at a time when many of the world's life-support systems are already stressed by population growth, industrial pollution, increasing intensity of agricultural land use and the unsustainable exploitation of natural resources. Global warming will induce changes in precipitation and wind patterns, changes in the frequency and intensity of storms, ecosystem stress and species loss, reduced availability of fresh water, and a rising global mean sea-level. It is clear that the African continent will experience the direct impact of such climate changes.

There is broad consensus among scientists that the warming will proceed rapidly and present a serious threat to the human race. International concern is increasing and greenhouse gas-induced climatic change has been the subject of several recent international conferences, including in Toronto (June 1988), New Delhi (February 1989), the Noordwijk Ministerial Conference (November 1989), Cairo (December 1989). These conferences have all produced clear and detailed statements calling for early action to reduce emissions of carbon dioxide by reducing fossil fuel use and by improving forest management. Their goal was to reduce the rate of climatic change in the next decade to a rate similar to those experienced over recent centuries. All of these discussions of both effects and corrective actions have recognized the special interests of the developing nations.

In November 1988, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) to assess present scientific knowledge, socio-economic impacts, and options for policy responses by the world's nations. The UN General Assembly in December 1988 adopted a resolution calling for the preservation of global climate as part of the common heritage of humankind. It also adopted a resolution convening a UN Conference on Environment and Development in 1992. Preparatory work has begun and the first substantive meeting will be held in Nairobi in August 1990. The purpose of the 1992 conference is to put in place a coherent international programme of action for a complete integration of environmental and developmental issues.

In 1989 the UN General Assembly called upon WMO and UNEP to prepare for the negotiation of a global framework convention on climate, using the first assessment report of IPCC due in August 1990. The Second World Climate Conference in November 1990 will provide a major opportunity for international follow-up to the IPCC report at technical and political levels, to lead to opening formal negotiations on a convention before the end of 1990. Specialists and policy analysts from African countries have participated in the work of IPCC, and all nations will need to develop policy positions as the formal negotiation of a global convention on climate change proceeds.

"Experience tells us that climate can kill. It has wasted the lives of tens of thousands in the Sahel through a decade of drought."

— William Mansfield
United Nations Environment Programme, Nairobi, Kenya

Global climatic change is fundamentally different from the conventional environmental agenda where the practice has been to react and correct. The challenge now is to anticipate and prevent. Climatic change has the potential to have an impact on ecological, economic, and political systems which can only be called catastrophic. These changes, once started, would be irreversible within a timescale of social,

"Africa's participation [in international negotiation for a framework convention on climate change] is of vital importance. But Africa must negotiate with knowledge."

— G.O.P. Obasi
World Meteorological Organization, Geneva

political, and economic relevance. Currently there are no conventional pollution control measures to reduce emissions from the major sources of greenhouse gases: emissions can only be reduced by reducing the level of the activities which give rise to them. The greenhouse gas emissions of yesterday are history, and we must learn to live with their consequences. The emissions of tomorrow are ours to decide, and if we act promptly we may be able to limit the effects.

The New Delhi Conference in 1989 was the first convened to address the particular concerns of the developing nations. Nearly four billion of the present human population of five billion live in developing countries. They need accelerated economic growth but on an environmentally sustainable basis. The Nairobi Conference was convened to address the particular concerns of African nations. It is against this background that the participants of the International Conference on Global Warming and Climatic Change: African Perspectives met at the United Nations Environment Programme Headquarters in Nairobi, Kenya, from May 2–4, 1990, and presented the following analysis and recommendations.

"Future climate devastation may be as dramatic as a nuclear holocaust . . ."

— William Mansfield
United Nations Environment Programme, Nairobi, Kenya

1. The Nature of the Problem

The global warming problem has three distinct but strongly inter-related parts: global chemical pollution; the greenhouse effect of these pollutants; and the global climatic change resulting from the greenhouse effect. Significant scientific progress has been made in observing, understanding and documenting many of these effects. This progress has led to an international consensus among scientists on the significance and the seriousness of the potential global-scale warming and the accompanying rise in sea-level. The predicted warming rates for the next several decades are unprecedented in terms of climate changes of the last several thousand years.

"Visions of environmental catastrophe and the collapse of society [have been] awakened. These are alluring scenes, if only because the failure of large regions and complex societies is evident in our history."

— Thomas E. Downing
University of Birmingham, UK

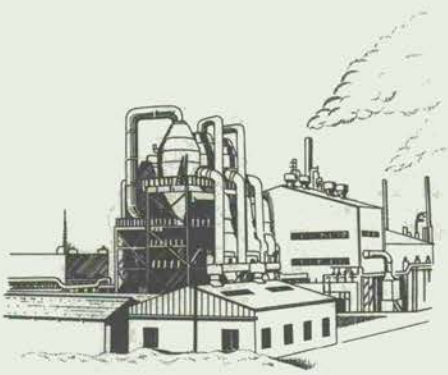
Global Chemical Pollution

Monitoring of the atmosphere has demonstrated that the concentrations of several trace gases, such as carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons—CFCs (CF_2Cl_2, $CFCl_3$ and others), tropospheric ozone (O_3) and nitrous oxide (N_2O) have increased significantly during the last century and are continuing to increase. Until the 1960s, carbon dioxide had been seen as the most significant greenhouse gas, however the role of methane is now becoming increasingly important. The methane concentration in the atmosphere is currently growing by an estimated 1.1% per year, released primarily from rice paddies, and also from ruminants, marshes and natural gas exploration. While carbon dioxide is the most abundant greenhouse gas, methane, nitrous oxide and CFCs are far more efficient at "trapping heat" and thus contribute significantly to global warming although they are in relatively small concentrations. CFCs are primarily used in spray cans and refrigeration. Nitrous oxide is mainly produced through biotic processes, including use of nitrogen fertilizers.

While most of the emitted carbon dioxide is naturally absorbed by the oceans, the increasing rate of emissions has resulted in increasing atmospheric concentrations. Trees and other vegetation also absorb carbon dioxide, but then release it when destroyed by burning or decomposition. However, they naturally act as net carbon sinks since the rate of organic matter production exceeds the rate of decomposition.

Over the last thirty years or so, the combustion of fossil fuels has been the main source of carbon dioxide emissions. Between 1960 and 1987 fossil fuel contribution to atmospheric carbon rose 124% (from 2.5 billion tonnes annually to 5.6 billion tonnes annually). Another major source is deforestation and land clearance, accounting for over 20% of carbon dioxide emissions. Currently fossil fuel burning alone accounts for a release of about 6 billion tonnes of carbon per year, while deforestation and land clearing account for another 1 billion tonnes.

The Greenhouse Effect of the Pollutants



The probability that the world's climate would change due to fluctuations in atmospheric carbon dioxide concentration was postulated by S. Arrhenius, the Swedish Nobel Prize chemist in 1896. However, studies on this subject have only assumed great significance within the last few years since the 1985 Villach meeting in Austria. The scientists attending the conference announced, "As a result of the increasing concentrations of 'greenhouse gases', it is now believed that in the first half of the next century, a rise in global mean temperature could occur which is greater than any in man's history." They predicted a rise in global temperature of 1.5–4.5°C. While there is consensus that global climate change will occur, the nature of climate change at the regional level is not yet well understood.

Recent analyses indicate that the earth as a whole has warmed by about 0.3–0.6°C over the past century. It is expected that this rate will increase significantly, by 0.5–1.0°C per decade through the next few decades, if human activities which emit greenhouse gases continue unabated. The industrialized countries contribute over

"Present energy policies are inconsistent with reducing greenhouse gas emissions and limiting global climatic change."

— Dean Abrahamson
University of Minnesota, USA

75% of the carbon dioxide added to the atmosphere through fossil fuel burning. However, from 1950–1984 the carbon dioxide released by burning of fossil fuels in developing countries increased at a rate of 2.2% per year. While still small in absolute terms, the African consumption of fossil fuels is increasing rapidly. Of the greenhouse gases, carbon dioxide is responsible for 66% of the global warming. The pre-industrial concentration of atmospheric carbon dioxide was 280 ppm; in 1989, it was 351 ppm and by the year 2030 it is expected to rise to 560 ppm.

Global Warming and Climate Changes

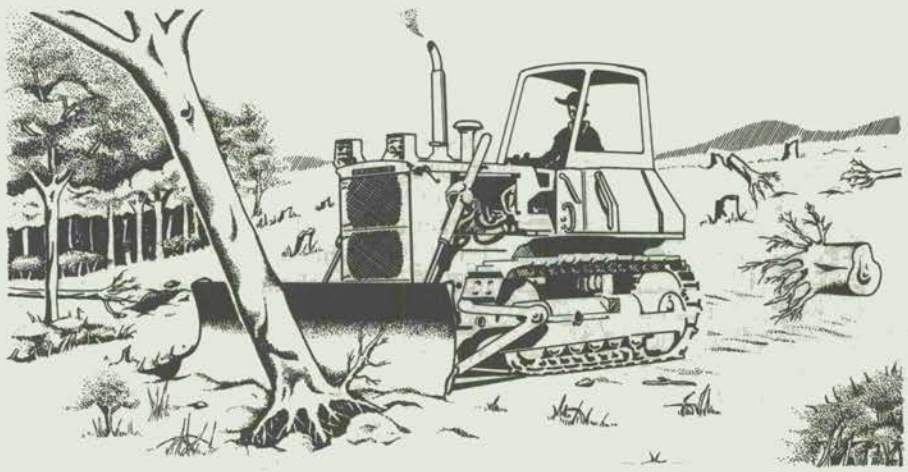
The most direct effect of the increased trapping of heat radiation is a global warming. The warming will not be globally uniform but will differ significantly between geographical regions; in addition, the warming may vary between seasons. As a result, the altered temperature gradients will change the pattern of winds and precipitation distribution regionally. The details of these localized changes are not clearly understood. It is expected, however, that the interiors of continents will become drier and climatic zones will shift, displacing current patterns of agricultural production.

The observed global temperature records, including ocean and land readings, reveal a warming trend during this century of a magnitude within the range predicted by models. Furthermore, the latter half of the 1980s registered the warmest temperatures on record. The warming of the oceans is expected to lead to a rise in the sea-level through thermal expansion, as well as addition of water through the melting of ice sheets and glaciers.

Major Scientific Issues to be Resolved

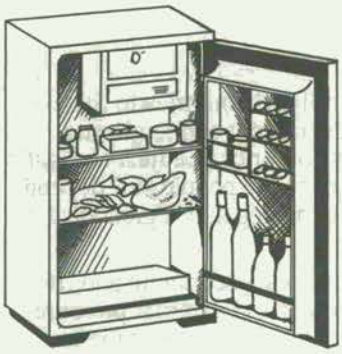
Respiration. The biosphere controls the atmospheric concentration of greenhouse gases such as carbon dioxide and methane, and biotic processes such as respiration are regulated by ambient temperature. Interactions between the biosphere and climate can play a significant role in determining the future concentrations of greenhouse gases like carbon dioxide and methane. The possibility and effects of increased respiration, plant growth and decomposition need to be assessed.

Clouds. One of the largest sources of uncertainty in predicting regional and global climatic changes is the response of clouds to the warming. The tropical monsoon cloud-systems are one of the major factors regulating the global heat budget and these clouds respond significantly to small changes in ocean temperatures. Analysis of the role of clouds is needed.



"The day of complete scientific certainty may not come."

— Andronico Adede
United Nations Office of Legal Affairs, New York, USA



Gas concentrations. Another large source of uncertainty is the expected rates of increase in the concentration of greenhouse gases in the atmosphere. These will depend on the scenarios adopted for future energy demands and supplies and other human activities.

Biomass. We need to assess how localized changes from deforestation, biomass burning and emission of particles, which have a profound influence on the regional climate, interact with the global-scale warming effect of the gaseous pollutants. Of particular interest in the case of Africa is the grasslands.

Oceans. The oceans play a dominant role in governing the timing and the rate of the warming because of the enormous heat capacity of oceans compared to the land. We are at the very early stages of understanding the interactions between the greenhouse warming and the dynamics of the oceans. Significant improvement in understanding this problem is needed to improve the predictions of regional climate changes.

2. Implications for Africa

Economic Vulnerability

African countries are more vulnerable than the industrialized countries to the effects of climatic change for two main reasons. First, the current economic and ecological crises have weakened the capacity of many countries to adjust to drastic economic and ecological changes. Second, the majority of the people still depend on agriculture for their livelihood. Agricultural production depends a great deal on climatic patterns.

Global warming is occurring at a time when many of Africa's economic and life-support systems are under stress from a number of internal and external pressures. Most of the continent has experienced poor economic performance over the last three decades. Sub-Saharan Africa is as poor today as it was 30 years ago. Africa's worsening economic crisis has been characterised by low agricultural growth, declining industrial output, poor export performance, rising debt and increasing environmental degradation.

These internal and external factors have made the African economies more vulnerable to market and ecological fluctuations. Instability in international markets has made it difficult for these countries to diversify their economies and reduce their dependence on the export of a narrow range of products. Africa's long-term debt has risen considerably since 1970 and it is now almost equal to the region's gross national product (GNP).

"The possible relocation of resources . . . across national borders may . . . increase insecurity and thus undermine the current efforts to bring peace and stability to the [African] continent."

— President Daniel arap Moi
Republic of Kenya

In many African countries public expenditure on social services is dropping, school enrollment is declining, infant mortality is rising, nutrition standards are worsening, and road networks are in a state of disrepair. Unemployment is on the rise in various countries and population pressure is threatening natural resources. Environmental degradation has become a symptom of the deepening economic and ecological crises. The lack of adequate financial resources is also leading to institutional decay.

The vulnerability of Africa as a region may mask the vulnerability of certain social groups within the countries. The very poor in these countries are more likely to suffer most from the economic effects of climatic change. Furthermore, the situation of currently vulnerable social groups such women and children is likely to worsen as a result of the economic and ecological effects of climatic change. If present trends continue, the economic effects of climatic change could result in the re-distribution of productive resources which could in turn influence the distribution of power and income. Such changes could have far-reaching political implications.

Despite the seeming despair, there are governments, non-governmental organizations and international institutions seeking alternative ways to promote economic renewal in Africa. Alternative economic policies are being tried out in numerous countries and governments are introducing a wide range of measures aimed at stemming the decline.

However, some of the economic policies being introduced in Africa are contributing indirectly to environmental degradation. Some countries under pressure to in-

"The high-diversity, mid-rainfall zones, where Africa's most important parks are are located will be particularly vulnerable to any climatic change."

— David Western
Wildlife Conservation International, Nairobi, Kenya

"Whatever meagre resources that are available to any African nation . . . should be judiciously applied to solving the basic welfare needs of the country's population."

— Stella Ogbuagu
University of Calabar, Nigeria

crease their foreign exchange earnings and pay their external debt are increasing their export of natural resources such as wood and minerals. This has often resulted in extensive deforestation as a result of logging and clearing of forests to establish mines. Such activities compromise the ability of the continent to act as a sink for carbon dioxide.

Amid the seemingly catastrophic situation are numerous signs of hope: while governments search for alternative economic policies, local communities are starting to harness their resources to deal with their immediate problems. Experiments with re-vegetation, alternative fuels and technologies and different production systems are becoming the order of the day in many communities across the continent.

Governments and local institutions have been dealing with short-term economic and ecological problems. Concerns about the effects of global warming and climatic change are emerging at a time when Africa is starting to re-think its future. These concerns not only make the development agenda more complicated, but they add to the urgency of finding solutions to the persistent problems and preparing the populations to deal with the long-term effects of climatic change.

However, state preparedness and information bases are still weak and their capability to mobilize resources to deal with environmental problems are still limited. But despite these concerns, Africa cannot wait. Indeed, reducing the vulnerability of these countries calls for urgent policy measures.

Expected Impacts

The climate of a region or sub-region cannot be assumed to be a steady unchanging phenomenon. During this century, the African continent has experienced marked fluctuations in rainfall patterns. However, the seriousness and severity of the 1968–73 Sahelian drought (which has lingered on until 1985), brought to the world attention through the public media, was most acutely felt in 15 African countries.

Droughts and floods. Today, 36 African countries are affected by drought; five states in the northern Sahara region, 21 in the Sudano-Sahelian region and 10 in the Kalahari desert area. Some 19 out of the 36 countries fall under the category of least developed countries. Indeed, drought has had a profound effect on the socio-economic activities of these countries, including migration of pastoralists to the urban centres as well as triggering reductions in crop yields. There is consensus among scientists that global warming will make the dry areas drier and wet areas wetter, bringing about a global climate of extremes.

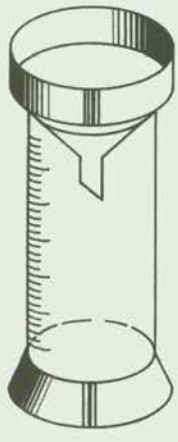
Since humans are unable to prevent droughts or storms, the next best option is to predict their occurrence so that appropriate actions can be taken to mitigate their adverse effects. In Africa, climate exerts significant control over development programmes. Further developments will have to be planned carefully bearing in mind the sensitivity of the region to climatic variations. For example, irrigation and hydroelectric schemes may be found to have inadequate or excessive water supplies

"The need for immediate foreign exchange to repay unending debts forces developing countries into environmentally-exploitative economic practices."

— Okyeama Ampadu-Agyei, Environmental Protection Council, Ghana

"All the sandy beaches of Tanzania show a rate of retreat of 3-5 metres per year. Settlements which are located in these areas are threatened with erosion or flooding. The expected rise in sea level might result in the loss of a strip of several hundred metres of coastal land."

— Mario Fay
University of Dar es Salaam, Tanzania



and plans for new schemes may need to be re-evaluated. Where rainfall increases, floods could damage scheme infrastructure or endanger nearby human settlements.

Crops which are currently major exports, like tea and coffee, or important staples may experience major drops in yield as agro-climatic zones shift. Changes in rainfall and temperature distribution will change the patterns of wildlife habitat and migrations. This could have a severe impact on national parks, the surrounding agricultural land, wildlife conservation and tourism.

In 1988 UNEP sponsored a meeting of experts which noted the already existing seasonal and annual climatic variations in the semi-arid tropics. Also noted is the decline in rainfall resulting in drought and desertification. It is predicted that future climatic change will deepen the crisis in food, water and energy. Because of shifts in natural ecological zones (crop and forest belts moving to higher latitudes), pressure will increase on the use of marginal and virgin ecosystems. The experts also predicted that due to enhanced evapotranspiration, the humid tropics will become drier.

Sea-level. As a result of climate change, it is expected that the sea-level will rise (about 25–140 cm) which will increase flooding and salinization. In addition, port facilities and airport runways will have to be adjusted to higher ground. A recent study by Delft Hydraulics (1989) on behalf of UNEP on vulnerability to sea-level rise, indicated that of the 27 vulnerable countries globally, five African countries (Egypt, Kenya, Mozambique, Senegal and the Gambia) will be affected by the sea-level rise. When more refined criteria of vulnerability were used, the resulting ten most vulnerable countries to the impact of sea-level rise included Egypt, Mozambique, Senegal and the Gambia. It has been predicted that the sea-level rise will affect about 20% of Egypt's 35,000 sq. km. of arable land.

Another area which is likely to be affected by the sea-level rise is the Limpopo River basin in Mozambique. The population of the river basin has doubled within the past few years, with approximately 25,000 ha of land under irrigation in the valley. When the freshwater-level in the Limpopo River drops due to dry conditions in the catchment area, the sea water flows inland. The farmers use this salt containing water for irrigation resulting in salinization. The expected sea-level rise will markedly disrupt the social and economic structures of this and other productive river basins. Undoubtedly, the sea-level rise will disrupt settlements, agriculture, industry, forests, fisheries and wildlife habitats as well as increasing salinity of groundwater and drinking water supplies, rivers and bays in the humid tropics.

Storm damage. A major impact of global warming is expected to be an increasing severity of storms due to changing ocean temperatures and the resulting shifts in ocean and air currents. Extensive damage is anticipated along coastlines, accelerating the already problematic rates of coastal erosion along the West and Eastern Africa shorelines, among other areas. Storm damage to structures and agriculture and loss of life must be considered in development plans for coastal areas and those bordering large inland waters.

"Within Africa, the most vulnerable areas to global warming and sea level rise, outside the deltaic regions, would be the small islands."

— Vijaya L. Saha
Ministry of Lands, Mauritius

Islands. Islands will suffer the combined effects of both sea-level rise and storm damage. In small island nations, such as Mauritius and Seychelles, much of the infrastructure and productive resources and activities (such as fisheries, agriculture and tourism) are located along the shoreline. It can be anticipated that these will be devastated and parts of their human populations may need to be relocated, to other countries in some cases.

Biomass and energy. It has been estimated that fossil-fuel burning and deforestation contribute 2.4% and 0.9% carbon dioxide respectively to the atmosphere annually. The African nations contribute towards a rise in atmospheric carbon dioxide and other trace gases (except CFCs) through deforestation and biomass burning. Halting deforestation world-wide will reduce carbon dioxide emission to the atmosphere by about 2.5 billion tons per year, the amount needed to stabilize atmospheric composition. It is believed that reforestation of 1–2 million sq. km. will result in annual storage of 1 billion tons of carbon dioxide.

However, the 1985 Villach workshop on developing policies for responding to climatic change concluded that "large scale afforestation has a limited potential to slow down carbon dioxide increases in the atmosphere and buy time to reduce fossil fuel emissions." It may be safely concluded that the greatest potential for preventing climatic change lies in the energy and industrial sectors of the developed and developing nations. As industrialized countries contribute over 75% of the carbon dioxide added to the atmosphere through fossil fuel burning, it has been suggested that they should replace fossil fuel with alternative energy sources such as solar and wind energy, hydroelectric power, tidal and ocean thermal conversion. These energy sources should continue to be encouraged in developing countries in part as alternatives to future fossil fuel use, but also as alternatives to woodfuel.

It is estimated that in Africa, about 3.6 million ha of forests are cleared each year. Côte d'Ivoire has the highest deforestation rate in Africa. Other African countries with significant deforestation rates include the Gambia, Burundi, Guinea-Bissau, Liberia, Nigeria and Kenya. African grasslands are commonly burned to improve productivity and release significant amounts of carbon dioxide. Decomposition of organic matter is another source of carbon dioxide and a rise in temperature in forested zones will result in a corresponding increase in carbon dioxide release due to decay. How much of the added carbon dioxide will be absorbed by forest trees is not well known. It is possible that global warming will stimulate forest growth, but this is unlikely due to the other factors limiting carbon dioxide assimilation such as low level of nutrients, evapotranspiration, wind speed, soil impoverishment, precipitation and cloudiness.

"It is essential that the role of grasslands in African carbon cycling and in maintaining sustainable agro-ecosystems should be thoroughly studied, both for practical and theoretical reasons. Such investigations cannot be done by short-term research."

— David O. Hall
Kings College, London, UK

3. Policy Perspectives

The main aspiration of most African countries is to raise the living standards of the majority of the population through the application of science and technology to development. Many of these countries have already recognized the importance of meeting the basic needs of current generations without undermining the ability of future generations to do so. Sustainable development is increasingly becoming a guiding principle for the development strategies of these countries.

However, African countries are currently undergoing major environmental, ecological and economic crises. Economic pressures have weakened their ability to manage their natural resources well. Changes in the patterns of ownership of basic resources such as land may have also made the ecological systems more vulnerable to climatic change. Reforms in management policies may take many years. This is happening at a time when the traditional strategies of coping with adverse ecological changes are already breaking down.

The African economies are currently based on a narrow range of economic activities, most of which are highly vulnerable to climatic variability and change. Their participation in the international economy is also based on the export of a narrow range of commodities. Many of the countries rely on energy supply and industrial output from a small number of large plants, and lack the technological diversity required to ensure economic flexibility.

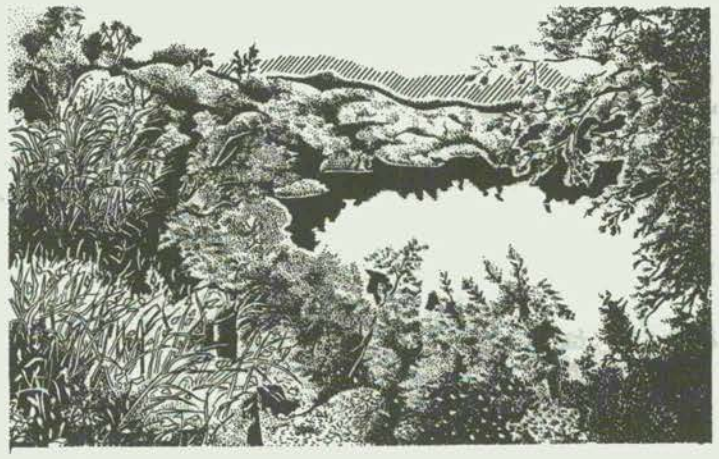
"Responding to the greenhouse problem . . . will involve wide-ranging changes in government policy in fundamental areas."

— P.M. Kelly and G. Falmer
University of East Anglia, UK

Despite these challenges, many of the measures required to move towards a more sustainable development strategy are already being tried out in various countries. These efforts need to be intensified. Strong policies on soil degradation, afforestation, and other environmental issues have already been implemented by some governments on the continent. Like many other problems facing Africa, the issue is how the African countries manage their future under conditions of uncertainty and climatic change.

Economic adjustment to deal with the possible effects of climatic change can only be sustained if it originates from the continent itself. Efforts must be integrated with the overall development activities in these countries. Success in dealing with economic and environmental problems in Africa has often been associated with the rate at which nations, communities and individuals have been able to respond with appropriate and viable measures. The flexibility and preparedness required by the African countries to deal with crises needs to be strengthened.

The challenges of climatic change pose new problems for African planners. Since current economic and environmental trends may not continue in the future, planners will need to re-think conventional approaches. The need for for integrated planning approaches which take into account environmental issues will need to become a priority.



"The ability of the developing countries to adapt to the expected [climatic] changes will require major investments in alternative economic activities."

— President Daniel arap Moi
Republic of Kenya

"African countries need to be flexible, innovative and adaptive to change."

— Calestous Juma
African Centre for Technology Studies, Nairobi, Kenya

Dealing with long-term effects of climatic change will require Africa to develop flexible economic systems and institutions which can anticipate change and adapt relatively fast to emerging trends. Economic systems and institutions will therefore need to be innovative, flexible, adaptive and diversified. Enhancing the adaptive capability of the African countries will require significant increases in the application of science and technology to development and the willingness to reform existing institutions to reflect the need for constant change. A higher premium will need to be placed on social learning.

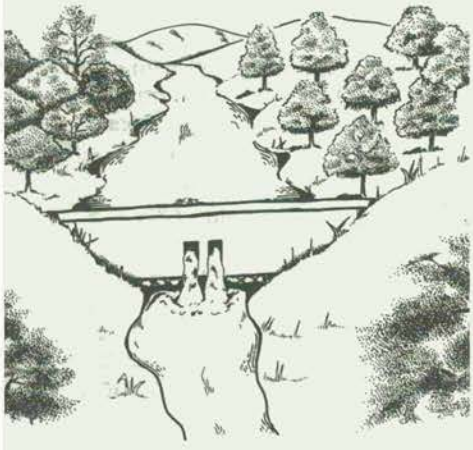
Research and Training

One of the key aspects of the Conference was that while researchers from the industrialized countries based their presentations on modelling, African researchers presented case studies of recent trends in ecological and geomorphological change. The two approaches are complementary to each other and create suitable conditions for research collaboration. It is therefore recommended that collaborative research be supported and encouraged. Furthermore, Africa needs to collaborate with researchers in other parts of the world to carry out baseline studies to provide a basis for anticipating the changes in ecosystems and geomorphology.

Specific areas in Africa which require research attention are starting to emerge. For example, the role of African grasslands in the global carbon cycle is not well understood. While forests have received considerable attention in climatic change discussions, African grasslands are an unknown quantity. Large sections of these grasslands are burnt annually to promote new shoots and to destroy pests and insects. Further pressure on African grasslands results from overgrazing and soil erosion. The role of grasslands in the global climatic change equation needs urgent attention and research programmes to generate reliable and long-term data need to be formulated and supported.

Other issues which require urgent research attention include the relationship between the El-Niño oscillation phenomenon (ENSO) in the South Pacific Ocean and climatic anomalies in Africa, monitoring the concentration of greenhouse gases, regional climatic modelling, health effects of climatic variability and identification of adaptive strategies for the continent.

Technological Innovation



A silent revolution in environmentally-sound technology and sustainable resource use is under way in the industrialized countries. This revolution has profound implications for global warming, solving local environmental problems and for overall sustainable economic development. There is a grave danger that the economies of Africa and other developing regions may be excluded from having access to the emerging environmentally-sound technologies. Africa is in danger of being trapped by inefficient and polluting technologies.

The transition towards sustainable development will require a commitment to developing alternative technologies. This calls for closer collaboration between researchers and the private sector which plays a key role in bringing alternative technologies into the market place. Already, environmental conservation is starting to become a selling point for many firms. This trend is expected to continue, especially with specific incentives to re-direct research and development (R&D) towards generating environmentally-sound technologies.

One of the most significant characteristics of Africa is the low level of the application of science and technology to development. The measures required to limit the emission of greenhouse gases and adapt to the expected changes will require

"It is important for the international community to listen to the concerns expressed by the developing countries over the fate and state of their economies and environment."

— President Daniel arap Moi
Republic of Kenya

changes in the current composition of technology and industrial activities. Africa will need to increase its economic efficiency through the wider use of technology. In addition, Africa will need to have access to energy-efficient and environmentally-sound technologies. In this respect, there is a need to review the global intellectual property regime to enable African countries to have access to technologies that can facilitate the transition towards sustainable development. The first prerequisite for acquiring such technologies is to be able to undertake global technology searches.

In addition to international technology acquisition, Africa needs to participate more actively in research for environmentally-sound technologies. The wide range of genetic resources in Africa may hold the key to identifying alternatives to some of the volatile materials being released into the atmosphere. Already, scientists report that a shrub of Kenyan and Ethiopian origin, *Vernonia galamensis*, has such potential. African countries should therefore make efforts to contribute to the global stock of environmentally-sound technologies.

The expected climatic changes may require significant adaptations in agriculture, forestry and industry. In this respect, techniques such as biotechnology may become important tools for introducing new biological products into the economy within short timescales. However, such research should be environmentally-sound so as to reduce the ecological and health risks of introducing new life forms into the environment.

"Non-governmental organizations can make an important contribution to the process of raising environmental awareness and education. They are in a position to link scientists, policy makers, industrialists and other members of the community they work in."

— Ann Heidenreich
Environment Liaison Centre International, Nairobi, Kenya

Public Awareness and Participation

Public awareness and popular participation in climatic change issues is crucial to the success of the proposed measures. So far only a handful of countries have embarked on raising public awareness on climatic change issues. Non-governmental organizations (NGOs) can make an important contribution to the process of raising environmental awareness and education. They are in a position to provide links between scientists, policy makers, industrialists and other members of the community in which they work. NGOs also have the capability to mobilize local populations to engage in relevant measures such as reforestation and family planning. Where community awareness of problems such as land degradation already exists, the new dimension of climatic change adds urgency to their activities.

Institutional Reforms

Making the necessary adjustments to deal with the expected effects of climatic change will require significant institutional reforms in Africa. Implementing many of the recommended policy measures will require strengthening some existing institutions and creating some new ones. As stated above, the current financial problems in Africa have led to the decline of institutional capability in some countries. Preparing to deal with the effects of climatic change will require strengthening the capacity of existing institutions to deal with the expected changes. The institutions will need to be flexible enough to adapt. Institutions are the depositories of social knowledge and therefore institutional reform will need to be closely linked to research and information dissemination.

It is not possible to undertake institutional reform programmes without understanding the strengths and weaknesses of the current institutions. It is therefore necessary to undertake studies on the ability of current institutions to deal with climatic change. Such a review should be extended to the legal systems of the various countries and conventions governing international relations. It has been noted that reducing the effects of climatic change may require review of existing land tenure systems. The current land use patterns are not flexible enough, for example, to allow for the migration of wildlife under conditions of ecological stress. It is recommended that flexibility in land use practices and laws may reduce the effects

"African governments need to introduce flexible land tenure systems that will enable them to adapt their agricultural activities and conservation efforts to changed climatic conditions."

— H.W.O. Okoth-Ogendo
University of Nairobi, Kenya

of climatic change on ecosystems.

Other areas that need institutional reform include fiscal and financial practices. For example, current prices do not normally include the environmental costs of production. Taxation policies are normally aimed at raising revenue but not necessarily aimed at discouraging practices which undermine environmental integrity. It is necessary to devise taxation and other fiscal measures which do not reduce the resources available but help to move economies towards sustainable development.

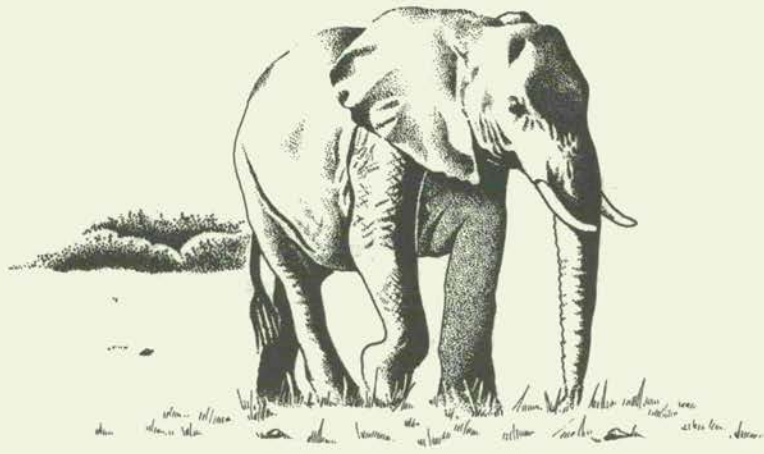
Efforts are already underway in the United Nations system to come up with new institutional arrangements for promoting sustainable development. Such arrangements, which include the Sustainable Development Network (SDN) and Environmental Management Guidelines (EMG) of the United Nations Development Programme (UNDP), need to be strengthened and replicated.

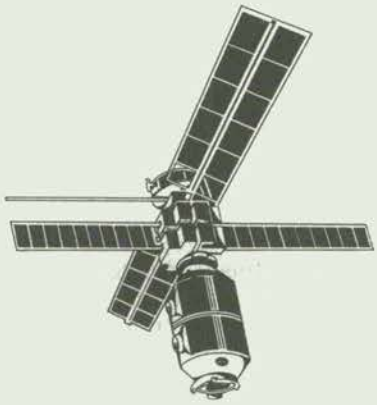
The starting point for institutional development in Africa should be to strengthen the already existing governmental and non-governmental institutions working on specific climatic issues. These include the national meteorological services, and environmental agencies, regional institutions and UN programmes. The regional institutions include the Regional Centre for Services in Surveying Mapping and Remote Sensing (RCSSMRS) in Nairobi, the Regional Centre for Aerospacial Surveys (RECTAS) at Ile-Ife, Nigeria, the Regional Remote Sensing Centre (RRSC) in Ougadougou, Burkina Faso, the Africa Centre of Meteorological Applications for Development (ACMAD) in Niamey, Niger and the proposed Observatory of the Sahara and the Sahel (OSS).

The United Nations Environment Programme (UNEP) operates the Global Environmental Monitoring System (GEMS) and Global Resources Information Data Base (GRID) which provide data on renewable resources, climate changes, health problems and transboundary pollution. African non-governmental research institutions such as the African Centre for Technology Studies (ACTS) are building policy research capability in issues of climatic change.

"The idea of an environmental tax reform is to put a tax burden on resource use and pollution and . . . remove equivalent tax burdens from the more desirable production factors, labour and capital."

— Ernst von Weizsäcker
Institute for European Environmental Policy, Federal Republic of Germany





4. International Context

Developed Country Actions

African countries have repeatedly expressed the concern that the industrialized countries, which are the main sources of greenhouse gases, should take urgent measures to limit the release of such gases. The commitment of the industrialized countries to ecological security is compromised by the slow pace at which they are introducing measures which reduce the release of greenhouse gases into the atmosphere.

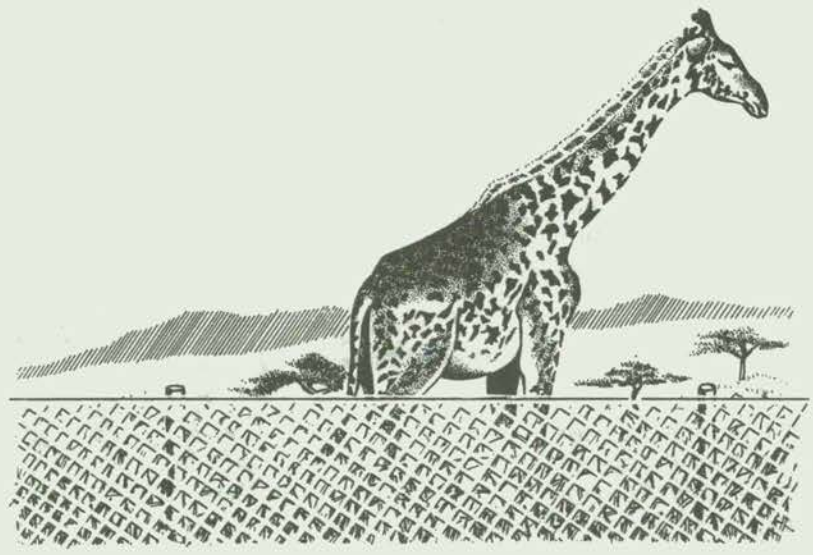
The African countries urge the industrialized nations to act on this matter with the same vigour with which they expect the developing nations to to reduce deforestation and population growth rates. The African countries, in return, have the responsibility to avoid the path taken by the industrialized countries. Technological options for starting on sustainable development routes now exist.

The ability of the African countries to take this route will be determined largely by the level of access to environmentally-sound technologies. The industrialized countries are therefore urged to look into ways of ensuring that environmentally-sound technologies are available to the African countries. This may require relaxing the current intellectual property regimes as well as licensing arrangements.

An institutional obstacle to technology acquisition is the current impact of external debt on the ability to acquire environmentally-sound technologies. The issue of international debt, which is closely linked to natural resource management in Africa, requires more urgent attention by the industrialized countries. While these countries have taken steps to write off debt through bilateral negotiations, the process should be facilitated so as to give the African countries a chance to harness their financial resources and utilize them to move towards sustainable development.

While African countries have the option to move towards sustainable development, it is equally important for the industrialized countries to provide the support for this transition. Such support is required to initiate and implement structural adjustments needed for effective responses to the identified impacts of climatic change.

Support is needed for the African countries to acquire and assess the relevant scientific data that would enable them to make informed decisions and be prepared to take part meaningfully in international negotiations and conferences on climatic change and other environmental issues. The African countries also need support (equipment, communication and transportation systems as well as trained manpower) to ensure the rational management and protection of natural resources.



"The developed and less developed nations share common interests in tropical forests—a nexus between climate change problems and debt problems. These interests could be furthered by expanding debt cancellation and debt-for-forest swaps."

— Okyeama Ampadu-Agyei
Environmental Protection Council, Ghana

"Prices should tell the ecological truth."

— Ernst von Weizsäcker
Institute for European Environmental Policy, Federal Republic of Germany

The Private Sector

The involvement of the private sector in moving society towards sustainable development is as important as the role of other sectors. The trajectory of R&D is largely shaped by corporate decisions. Given suitable policy environments and incentives, the private sector can play a major role in facilitating the transition towards sustainable development. It is notable that the challenges of climatic change are emerging at a time when the role of the private sector is being increasingly appreciated and various countries are introducing policy reforms to support its development.

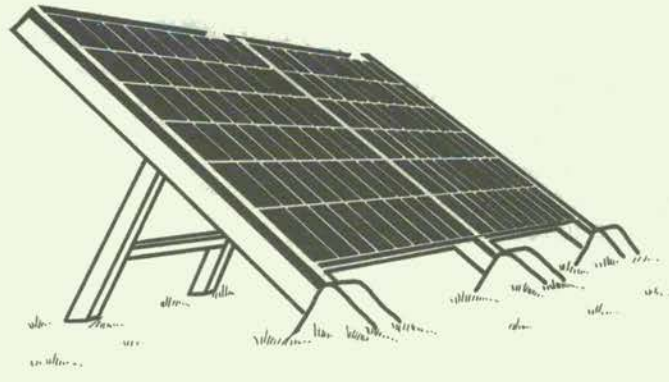
While numerous African countries are introducing policies which support private initiatives, the state is still a dominant investor. Under such conditions, it is important for governments to recognize the importance of accountability and transparency. They should facilitate the transition towards effective ecological governance. Concerns are emerging on whether environmental regulations would be implemented effectively where the government is the largest investor and consumer.

On the whole, developing countries in general, and African nations in particular, need to involve the private sector more fully in making the transition towards more sustainable development paths through R&D, entrepreneurship and diffusion of new technologies. Governments, on the other hand, have a duty to provide a suitable policy environment for innovation and entrepreneurship.

But for governments to respond effectively to the interests of the private sector, there is an urgent need for the sector to increase its concern for the long-term integrity of the environment. There is a need to re-think the conventional business ethos to include the principles of sustainability.

"Africa must maintain and even increase her tempo of development, but must take measures to improve on energy efficiency."

— G.O.P. Obasi
World Meteorological Organization, Geneva



"There is only one global atmosphere and it belongs to all nations of the world."

— Hendrick Othieno
Kenyatta University, Kenya

The United Nations System

At the international level, the UN General Assembly has anticipated the key issues related to global warming and climatic change and incorporated them into the preparation of the 1992 United Nations Conference on Environment and Development. One of the working groups for the conference has been assigned to deal with "(a) protection of the atmosphere by combating climate change, depletion of the ozone layer and transboundary air pollution, (b) protection and management of land resources by, *inter alia*, combating deforestation, desertification and drought".

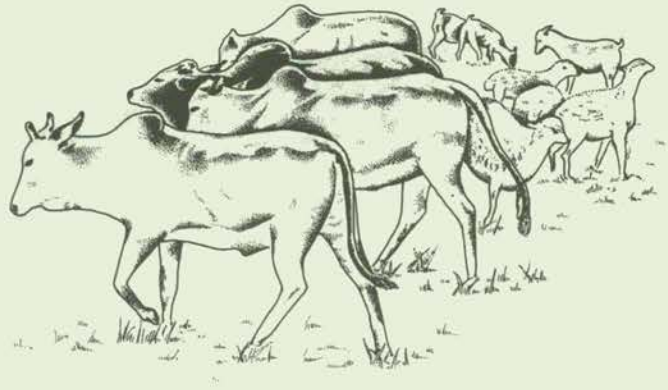
It will be necessary to put into place appropriate legal instruments for international responses to the problems of climate change in the context of the objectives of attaining food security (quality and quantity) and protecting human health and improving quality of life by eradicating poverty with an appropriate link to the population issue. The suggested international legal framework should also provide the basis for international responses which require development and transfer of environmentally-sound technology on terms which take into account the special interests of developing countries.

Seven areas have been identified where treaty-law should be further developed or negotiated with full participation of developing countries, as follows:

- protection of the atmosphere by combating climate change, depletion of the ozone layer and transboundary air pollution
- protection of the quality and supply of freshwater resources
- protection of the oceans and all kinds of seas, including enclosed and semi-enclosed seas, and of coastal areas and the protection, rational use and development of their living resources
- protection and management of land resources by, *inter alia*, combating deforestation, desertification and drought
- conservation of biological diversity
- environmentally-sound management of biotechnology
- environmentally-sound management of wastes, particularly hazardous wastes, and of toxic chemicals, as well as prevention of illegal international traffic in toxic and dangerous products and wastes

"Halting deforestation would help maintain the genetic diversity of the planet, reduce erosion, stabilize local and regional climates, and cleanse water and air. Steps taken to reduce one problem help to reduce others."

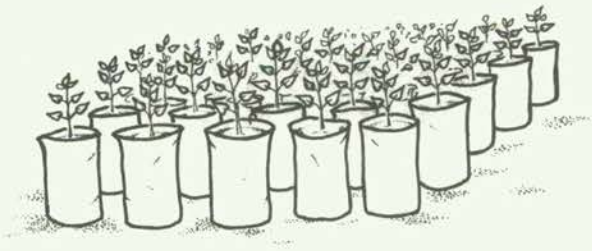
— R.A. Houghton
Woods Hole Research Center, USA



5. A Call for Action

The expected effects of climatic change on the African economies call for urgent action on the part of governments. In the past humankind has relied on the practice of reacting and correcting. But climatic change requires new forms of practice which include anticipating and preventing the expected effects. So far there is no clear evidence on the issue of global warming. So it can be argued that the costs of taking preventive measures are too high to be justified without convincing evidence.

But for Africa, such a position is untenable for three reasons. First, by the time the scientists generate convincing evidence, it might be too late to take any preventive measures. Second, the magnitude of the effects of climatic change would be so large as to require preventive measures to be taken at the earliest possible moment. That moment is now. Third, most of the measures proposed for dealing with the problem are necessary anyway for shifting towards sustainable development. The current problems facing Africa need urgent attention. The realization that climatic change might worsen these problems calls for remedial measures to be introduced as a matter of priority.



6. Recommendations

There is sufficient scientific data to justify action being taken now to reduce greenhouse gas emissions and implement strategic planning to deal with the anticipated effects of climatic change.

Governments of African countries are called upon to adopt and implement policies which:

1. Encourage economic diversification and flexibility through technological innovation and institutional re-organization, specifically to:
   - reduce economic and social vulnerability of society at large
   - increase adaptability to environmental, economic and social changes
2. Initiate and promote afforestation and reforestation activities.
3. Initiate and promote family planning and population management programmes.
4. Support research on climatic change, in particular:
   - increase environmental monitoring and analysis, development and utilization of environmentally-sound energy technologies; study impacts of climatic change on coastal areas, fresh water supplies, agricultural and livestock production and food security
   - assess the impact on proposed infrastructure development, such as ports, dams, roads, and location of industries
   - increase research on the role of African grasslands in the carbon cycle
   - research and develop alternative agricultural production and processing industries based on new biotechnologies
   - draw upon traditional indigenous knowledge in the search for appropriate coping strategies
5. Support accelerated implementation of soil, water, energy and genetic resources conservation programmes as a matter of urgency. Locally-based efforts and community education should be emphasized, including appropriate family planning programmes.
6. Incorporate the implications of climatic change and environmental degradation into decisions on investment, taxation and tariffs, technology acquisition, and economic and social development.
7. Involve non-governmental organizations in implementing both research and community action programmes, including information dissemination and education.
8. Encourage the local private sector to develop and market environmentally-sound and energy-efficient technologies within their own countries and regionally.
9. Ratify international protocols on climatic change and support relevant regional institutions.

"Since the impacts of climatic change are not going to be uniform, it is important that preventive measures are taken based on good information. Each country should establish national centres for research and monitoring of climatic change so that scarce resources are not wasted on wrong measures or structures that might never work."

— Stella Ogbuagu
University of Calabar, Nigeria

Governments of the industrialized countries are called upon to adopt and implement policies which:

10. Reduce emissions of greenhouse gases substantially by the year 2005.
11. Eliminate trade barriers to the flow of environmentally-sound technologies to the developing countries. Industrial property protection regimes must be relaxed to allow African countries access to information necessary to develop and use such technologies.

"There is a dire need for African scientists to carry out research on several facets of climate change to enable them to predict more precisely the social, economic and environmental consequences of climate change."

— S.K. Imbamba
Economic Commission for Africa, Ethiopia

12. Support collaborative research on climatic change between institutions of the industrialized countries and those of the developing countries.
13. Facilitate the cancellation of Third World debt and establish fair trade practices and commodity prices to enable developing countries to use their resources for development.
14. Support African countries in their efforts to conduct research and build institutional scientific capability to carry out the research needed in (4) above.

The United Nations system is called upon to adopt and implement policies which:

15. Ensure support for the IPCC and for negotiation of a climate convention, and support of African participation.
16. Support and coordinate training programmes, scientific research, and systematic measurements of climate and ecosystems, especially through the World Climate Programme,and the International Geosphere and Biosphere Programme.
17. Support development of regional institutions in this field in Africa and promote information exchanges on the latest scientific results and adaptations strategies.
18. Support activities and networks aimed at promoting sustainable development at the national level.

The non-governmental community is called upon to:

19. Mobilize local communities and individuals to take measures that will reduce the effects of climatic change.
20. Increase their efforts in raising public awareness on issues of climatic change.
21. Work closely with governments in promoting measures that will reduce the effects of climatic change.
22. Follow and contribute to the work of IPCC, Second World Climate, preparation leading to the UN Conference on Environment and Development.

"A silent revolution in energy technology and use is under way. There is a grave danger that the evolving economies of Africa may be excluded from this revolution and remain trapped by obsolete technology."

— William Moomaw
Tufts University, USA

The private sector is called upon to:

23. Increase its efforts in developing environmentally-sound technologies and management practices.
24. Work closely with governments, NGOs and other agencies to ensure that the technologies are widely adopted.
25. Incorporate environmental considerations into their corporate strategies and planning.

Programme

"Africa's contribution to the war against greenhouse gas warming does not have to wait until the framework convention on climate change has been adopted and signed. We can . . . make a critical examination of some of our activities and identify those areas where a contribution can be made."

— G.O.P. Obasi
World Meteorological Organization, Geneva

May 2, 1990

	Welcoming Address
09:00–09:10	Professor S.H. Ominde *Chairman, Kenya Reinsurance Corporation, Nairobi* *Professor, University of Nairobi, Kenya*
09:10–09:20	Dr. George Woodwell *Director, Woods Hole Research Center,* *Woods Hole, Massachusetts, USA*
09:20–09:40	Dr. G.O.P. Obasi Secretary-General *World Meteorological Organization, Geneva*
09:40–10:00	Mr. William Mansfield *Assistant Executive Director, United Nations* *Environment Programme, Nairobi*
10:00–10:30	Hon. J.J.M. Nyagah, EGH, MP *Minister for Environment and Natural Resources,* *Kenya*
10:30–10:35	Break
10:35–10:45	Theme address: Dr. George Woodwell *Director, Woods Hole Research Center,* *Woods Hole, Massachusetts, USA*
10:45–11:00	Break

Session 2: Evidence and Effects of Climatic Change

11:00–11:05	Chairperson: Dr. Evans Mukolwe *Kenya Meteorological Service, Nairobi*
11:05–11:25	Dr. Jerry Mahlman *Princeton University, New Jersey, USA*
11:25–11:45	Dr. Mick Kelly *University of East Anglia, England*
11:45–12:05	Dr. David Gates *University of Michigan, USA*
12:05–12:25	Dr. Thomas Downing *University of Birmingham, UK*
12:25–12:55	Discussion
12:50–13:00	Rapporteur: Dr. John Ng'ang'a
12:00–14:30	Lunch

Session 3: African Sources of Global Warming

14:30–14:35	Chairperson: Dr. Reuben Olembo *United Nations Environment Programme, Nairobi*
14:35–14:50	Greenhouse Gases from Energy Use and Production Dr. H. Othieno *Kenyatta University, Nairobi, Kenya*
14:50–15:05	Sources of Ozone and Greenhouse Gases Prof. John Ng'ang'a *University of Nairobi, Kenya*
15:05–15:20	African Forests and Grasslands: Sources or Sinks of Greenhouse Gases Prof. David O. Hall *Kings College, London, UK*

"Responding to the greenhouse problem . . . will involve wide-ranging changes in government policy in fundamental areas."

— P.M. Kelly and G. Falmer
University of East Anglia, UK

"Nature has bought us time. The impacts of global warming would be incremental. Let us use this time wisely by research, monitoring and implementation of of a combination of both limitation and adaptation strategies."

— Vijaya L. Saha
Ministry of Lands, Mauritius

15:20–15:35	Discussion
15:35–15:40	Rapporteur
15:40–15:50	Break

Session 4: Potential Impacts of Climate Change

15:50–15:55	Chairperson: Dr. Rajendra Pachauri *Tata Energy Research Institute, New Delhi, India*
15:55–16:15	Physical Dynamics of Climatic Change Dr. Laban Ogallo *University of Nairobi, Kenya*
16:15–16:35	Agriculture and Forests Dr. J.O. Nyabundi *University of Nairobi, Kenya*
16:35–16:55	Hydrological Processes and Water Resources Dr. George Nai *Director of Hydrology, Ghana*
16:55–17:15	Small Islands Dr. Vijaya L. Saha *Ministry of Land, Port Louis, Mauritius*
17:15–17:35	Deltas and Coastal Zones Dr. Isabelle Niang *Department of Geology, C.A. Diop University, Senegal*
17:35–17:55	Sea Level Rise Dr. Lawrence Awosika *Nigerian Institute of Oceanography, Nigeria*
17:55–18:25	Discussion
18:25–18:35	Rapporteur
18:35–19:30	Reception
	Dinner Speaker: Dr. Gilbert White *University of Colorado, USA*

May 3, 1990

Session 4: Potential Impacts of Climatic Change

08:30–08:35	Chairperson: Dr. Wanjiku Mwagiru *National Environment Secretariat, Kenya*
08:35–08:55	Biological Diversity Dr. David Western *Wildlife Conservation International, Nairobi*
08:55–09:15	Changes in Shorelines Dr. Mario Fay *University of Dar es Salaam, Tanzania*
09:15–09:35	Geomorphology and Oceanography Dr. Mahmoud Kh. El-Sayed *Alexandria University, Alexandria, Egypt*
09:35–09:50	Break
09:50–10:10	Investment and International Trade Dr. Peter Kiguta *Ministry of Planning, Kenya*

"Wildlife and biological diversity will suffer whatever the climatic change due to increasing human pressure and the fixicity of protected area boundaries."

— David Western
Wildlife Conservation International, Nairobi, Kenya

"We in the West have to change radically our economic objectives; we have to strive for a new model of wealth that can be emulated . . . without destroying the basis of life of Earth."

— Ernst von Weizsäcker
Institute for European Environmental Policy, Federal Republic of Germany

10:10–10:30	UNEP Activities on Climatic Impact Dr. Wokineh Degefu *Meteorological Services, Addis Ababa, Ethiopia*
10:30–11:00	Discussion
11:00–11:10	Rapporteur

Session 5: Policy Responses

Part 1: The Policy Context

11:10–11:15	Chairperson: Dr. J.O. Adejokun *Meteorological Services, Lagos, Nigeria*
11:15–11:35	Policy Framework, in the African Context Prof. H.W.O. Okoth-Ogendo *Population Studies and Research Institute* *University of Nairobi, Kenya*
11:35–11:55	Dr. Sharon Camp *Population Crisis Committee, Washington, DC*
11:55–12:25	Discussion
12:25–12:35	Rapporteur: Prof. J.B. Ojwang *Faculty of Law, University of Nairobi*
12:35–14:00	Lunch

Part 2: Biomass and Agricultural Resources

14:00–14:05	Chairperson: Dr. Ernst von Weizsäcker *Institute for European Environmental Policy, Bonn, Federal Republic of Germany*
14:05–14:25	Dr. Richard Houghton *Woods Hole Research Center, USA*
14:25–14:45	Dr. Ernst von Weizsäcker *Institute for European Environmental Policy, Bonn*
14:45–15:05	Agroforestry and Climatic Change Dr. E.O. Asare *International Council for Research in Agroforestry, Nairobi, Kenya*
15:05–15:25	Debt, Forests and Climatic Change Dr. Okyeama Ampadu-Agyei *Environmental Protection Council, Ghana*
15:25–15:40	Break

Part 3: Regional Planning

15:40–16:00	Urban and Regional Planning Dr. Stella Ogbuagu *University of Calabar, Nigeria*
16:00–16:20	Climatic Change and Coastal Settlements Dr. E.C. Njau *University of Dar es Salaam, Tanzania*
16:20–16:40	Climatic Change and Smallholder Agriculture Dr. Joshua Akong'a *Moi University, Eldoret, Kenya*
16:40–17:00	Dr. Gerald Leach *Stockholm Environment Institute, London*
17:00–17:30	Discussion
17:30–17:50	Rapporteur: Robert Munro

"Agroforestry could be the most promising approach to reforestation, supply of fuelwood and intensification of agriculture."

— E.O. Asare
International Council for Research in Agroforestry, Nairobi, Kenya

"The next decades can bring a full flowering of a sustainable global energy system."

— Dean Abrahamson
University of Minnesota, USA

May 4, 1990

Session 5: Policy Responses (continued)

Part 4: Energy

08:30—08:35	Chairperson: Dr. Ross Sandler
08:35—08:55	Energy and Climatic Change Dr. Charles Werko Brobby *Centre for Energy and Environmental Development, Accra, Ghana*
08:55–09:15	Prof. Robert Williams *Princeton University, USA*
09:15–09:35	Prof. Dean Abrahamson *University of Minnesota, USA*
09:35–09:55	Prof. Richard Odingo *University of Nairobi, Kenya*
09:55–10:15	Dr. William Moomaw *Tufts University, USA*
10:15–10:35	Discussion
10:35–10:45	Rapporteur
10:45–11:00	Break

Session 6: Research and Public Awareness

11:00–11:05	Chairperson: Dr. Michael Korir-Koech *Kenyatta University, Nairobi, Kenya*
11:05–11:25	Gaps in Knowledge Prof. Shem Wandiga *University of Nairobi, Kenya*
11:25–11:45	Research Capability Prof. Simeon Imbamba *Economic Commission for Africa, Addis Ababa, Ethiopia*
11:45–12:05	Public Awareness and Education Ms. Ann Heidenreich *Environment Liaison Centre International, Kenya*
12:05–12:25	Discussion
12:25–12:35	Rapporteur
12:35–14:00	Lunch

Session 7: Institutional and Policy reforms

14:00–14:05	Chairperson: Dr. Calestous Juma *African Centre for Technology Studies, Nairobi, Kenya*
14:05–14:20	International Context of Policy Reform Dr. A. Adede *United Nations Office of Legal Affairs, New York, USA*
14:20–14:35	Dr. C. Ian Jackson *Institute for Research in Public Policy, Ottawa, Canada*
14:35–14:50	Dr. Alan Miller *University of Maryland, USA*
14:50–15:05	Dr. Erik Helland-Hansen *United Nations Development Programme, New York, USA*

"One of the major difficulties in reaching an accord on global warming is that there is no overall mechanism for building international cooperation on the global environment."

— Ian Jackson
Institute for Research on Public Policy, Ottawa, Canada

"Africa's contribution to the war against greenhouse gas warming does not have to wait until the framework convention on climate change has been adopted and signed. We can . . . make a critical examination of some of our activities and identify those areas where a contribution can be made."

— G.O.P. Obasi
World Meteorological Organization, Geneva

15:05–15:20	Climatic Change and Political Decision-making Prof. Peter Anyang Nyong'o *African Academy of Sciences, Nairobi*
15:20–15:30	Rapporteur: Dr. Kilaparti Ramakrishna *Woods Hole Research Center, USA*
15:30–15:45	Break

Session 8: Conference Statement

15:45–17:45	Chairpersons: Professor S.H. Ominde Dr. George Woodwell Dr. James B. Bruce, Ottawa, Canada Prof. Richard Odingo, University of Nairobi Prof. Reuben Olembo, UNEP, Nairobi Rapporteurs: Dr. Kilaparti Ramakrishna Dr. Calestous Juma

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