# 8TH ANNUAL MEETING OF AFRICAN SCIENCE ACADEMIES (AMASA 8)

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## JOINT STATEMENT BY AFRICAN SCIENCE ACADEMIES

## RAISING THE AFRICAN VOICE

## CLIMATE CHANGE IN AFRICA: USING SCIENCE TO REDUCE CLIMATE RISKS

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***We, the Science Academies in Africa†, issue this statement to draw attention to the special features of Africa in relation to climate change, the great uncertainties that exist in understanding how climate change impacts on Africa's climatic, natural and human systems, and the contributions that the scientific community can make in addressing the challenge and exploiting opportunities arising from climate change. We focus especially on impacts on the livelihoods of communities, as they relate to agriculture, food security and health, as well as on developing the capacity for mitigating these impacts and the increasing frequency and intensity of climate change-related disasters in Africa.***

### BACKGROUND AND URGENCY

The realization that climate change will impact more severely on Africa, than on most other regions of the world, compels urgent action to understand the phenomenon better in relation to the peculiarities of the Africa region. Such understanding is a prerequisite to formulating effective responses to reduce the exposure and the vulnerability of the continent to climate change. Science-based information is critical in generating such understanding and formulating effective responses. A hallmark of science-based information is that it is founded more on critically analysed evidence than on experience. There is concern that the African continent has been short in contributing such science-based information to the global analysis, debate, and effort to combat climate change. As a consequence, Africa has not effectively participated in setting the agenda in the global debate, or benefitted adequately from available global opportunities, for addressing climate change.

Despite a few dissenting voices, there is a strong and growing scientific consensus that the current climate change stems from global warming, caused by the accumulation of greenhouse gases, notably carbon dioxide, methane, nitrous oxide, human-made CFCs (chlorofluorocarbons) and a few other gases, largely emitted into the atmosphere by human activity. Africa's contribution to these anthropogenic emissions that exacerbate global warming and climate change historically is minor (about 3% of total anthropogenic emissions) and, because of the continuing low level of industrial activity on the continent as compared with other regions, will continue to be minor far into the future. It is only when global emission is disaggregated by specific sources of emission, that Africa's emission from land use change goes up to 20% of world emission from this source, exceeding that of other regions. In sharp contrast to the low level of contribution to causing the problem, Africa will be disproportionately and severely affected by climate change because it has the least capacity, in terms of adequate information, awareness, preparedness, technology, financial resources and freedom from other stresses, to adapt to the adverse effects

of climate change, putting at great risk the development efforts of the continent towards combating poverty and meeting aspirations such as the Millennium Development Goals.

## SPECIAL FEATURES OF AFRICA IN THE CONTEXT OF CLIMATE CHANGE

When dealing with climate change, some features separate Africa from other regions. We focus here on features that have relevance for scientific intervention. First is the large (30.2 million $km^2$) land mass, stretching approximately from Latitude $37^0$ North to Latitude $35^0$ South. The land mass of Africa is greater than the land masses of the USA, UK, China, Spain, Germany, France, Italy, Eastern Europe, India and Japan combined[1], yet Africa contributes only three percent of the human emissions that accelerate global warming.

### Geographic Variability of African Climates

Africa's land mass encompasses sub-tropical and tropical climatic regions covering a wide variety of climates that range from the humid tropics to the hyper-arid Sahara, and include winter rainfall regions at the northern and southern extremes. The existence of a variety of climates complicates the understanding of the climatic effects of climate change in Africa, especially as the various climates are regulated by different global drivers. While the whole of Africa is known to be warming in this century at a rate faster than the global average, the warming is not uniform in all parts of the continent. The Inter-Governmental Panel on Climate Change (IPCC) observes that the drier sub-tropical regions will be warming faster than the humid tropics. Effects on rainfall will also be varied, so that some parts of the continent will become drier while others become wetter. Most important for the role that science is expected to play is the existence of great uncertainties about how climate change will affect the climates of Africa, largely because of lack of adequate information.

### Global Drivers of African Climates

The climates of Africa are driven by three global systems - the Inter-Tropical Convergence Zone, the El Nino Southern Oscillation and the West African Monsoon. Rainfall in the Sahel is also affected by changes in Sea Surface Temperatures. But how the global drivers interact and how they will be affected by climate change are not well understood, beyond the certainty that their outcomes will work to increase 'the incidence and severity of the droughts, floods and other extreme weather events they produce'[2]. The IPCC further identified shortcomings of models applied to understand the effects of climate change on the African climates to include:

- non- inclusion of vegetation and aerosol feedbacks;
- not taking account of land surface changes;
- poor understanding of the limitations of empirical downscaling models; and
- insufficient information for assessing possible changes in the spatial distribution and frequencies of tropical cyclones affecting Africa.

Planning to respond effectively to climate change requires that present and future climate conditions be described as accurately as possible. Global Climate Models do so reasonably well for climate conditions at the global scale, but are too coarse for application at regional or local levels. Therefore, global models must be made applicable, or "downscaled," to describe projections of climate conditions at local or regional scales. When local data are incorporated in the downscaling process, uncertainties can be greatly minimized. Local data are also needed to verify or validate downscaled projections.

In the shortcomings associated with models applied for understanding climate change in Africa, as identified by the IPCC, the importance of vegetation feedback and land surface changes is accentuated by the large land mass of the continent, over which the predominant

economic activity is agriculture, which, though critically important for meeting food security needs and contributing to climate change mitigation, constantly interferes with vegetation and land cover. Aerosols are also a significant component of the African atmosphere given at least the dust storms that prevail over the Sahara desert, while the insufficiency of information for understanding downscaling limitations and the behaviour of tropical cyclones is a matter that can be addressed by intensifying local observations. It is emphasized that understanding the effects of climate change on the climates across Africa is fundamental for effective planning and design of responses to those effects.

## Advantage from large land mass

The significance of Africa's large land mass spills over to the consideration of Africa's potential role in combating climate change through afforestation and reforestation (A/R), and through agriculture. Forests serve as sinks and reservoirs for the dominant greenhouse gas, carbon dioxide. Hence, together with agriculture, creating forests through afforestation and reforestation is an activity supported by the Clean Development Mechanism of the Kyoto Protocol for mitigation of climate change. The abundant land mass and large areas of past deforestation, coupled with relatively cheap labour, low land rents, and faster growth rate of trees that translates to shorter rotation time for achieving maximum accumulation of carbon, give Africa a distinct advantage over other key actors in climate change mitigation through A/R under the Clean Development Mechanism.[3] The same factors coupled with the strong traditional and cultural linkages of people with trees and forests in Africa, also give the continent a distinct advantage in embracing the emerging mechanism of **R**educing **E**mission from **D**eforestation and forest **D**egradation in developing countries (REDD). But it is stressed that realizing the advantage conferred by the abundant land mass and supporting factors will depend on Africa meeting criteria, such as good forest governance and effective land use policies, laid down for participating in the two mechanisms. African scientists are challenged to raise persuasive scientific arguments, based on the great diversity and complexity of land use systems on the continent, to modify these criteria to permit greater participation of Africa in these and other UNFCCC financial instruments.

## Climate Change, Agriculture and Food Security

Next to land mass as a special feature is the heavy dependence of the African economy on climate. Agriculture is the dominant economic activity employing more than 60% of the people and accounting for up to 50% of the GDP in some countries.[2] Most of the agriculture, both crop and livestock, is strongly weather- and climate-dependent and crop farming is dominated by small-scale subsistence farmers, augmenting their livelihoods by drawing from their natural resource base. Both agriculture and the natural resource base are highly susceptible to changes in temperature, precipitation, sea level rise and the incidence of extreme weather events that are associated with climate change. Artisanal fisheries and aquaculture are also susceptible to rising water temperatures, sea level rise and storm surges, while $CO_2$ fertilization from rising carbon dioxide levels in the atmosphere may partly offset adverse effects of other factors on plant production.

Climate change effects on agriculture may be direct or indirect. Direct effects include expected depression of crop yield and agricultural productivity by increasing temperature, in the African tropics and sub-tropics, where, more than in other regions, crops have reached their maximum tolerance limits[2, 4]. Crop yields decline for any increase in temperature beyond these limits. Temperature changes also influence livestock productivity directly through effects on the balance between body heat production and heat dissipation, while crop and animal damage

by extreme weather events such as flooding can also directly depress agricultural production. By interfering with the timing of farmers' operations, climate change-induced unreliability of the weather also directly affects agricultural production. Many effects of climate change on agriculture are indirect and are made manifest through (a) limitations on water availability caused by protracted reduction in rainfall, droughts and temperature-induced high evapotranspiration; (b) temperature–induced proliferation of crop and livestock pests, and increase in post-harvest losses in conditions of unrefrigerated storage; (c) deficits in soil moisture that translate to diminished soil nutrient supply, which in turn affect plant production, including production of feed and fodder for livestock, and (d) shortage of farm labour due to depressing effects of climate change on human health.

The high dependence of the rural poor on natural resources for livelihood is a special feature to note in considering effects of climate change in Africa. The natural ecosystems (mainly forests, woodlands and the Sahel) relied on for support, especially when climate change depresses agriculture, are themselves threatened by over-exploitation and now also by climate change. Deterioration in these natural systems is reflected in loss of biodiversity and degradation of catchment areas that are crucial for water supply to farmlands, rivers and humans. Africa will face increasing water scarcity and stress with a subsequent potential increase of water conflicts as almost all of the 50 river basins in Africa are transboundary[5] Degraded natural systems further diminish the capacity of rural people to cope with climate change.

By depressing agricultural productivity and eroding the natural resource base for augmenting agriculture, climate change has the potential to worsen the supply side of the food security equation. Urgent action is needed to build the resilience of the agricultural and natural resource systems in Africa to combat the effects of climate change. Science can positively intervene by informing the development of resilient crop varieties and animal breeds, improving the management of the resources that serve as necessary inputs in agriculture and helping to install sustainable management regimes for natural ecosystems. Developing drought-adapted crops and animals, flood-tolerant crops, as well as salt-tolerant varieties in the coastal regions; designing short-term weather forecasting facilities that can be readily operated by farmers, and refining such forecasts; devising better methods of water management and soil nutrient conservation; developing safer post-harvest products storage technologies; researching to expand the crop base for agriculture; enhancing efforts at supplementing agricultural production and exploitation from the wild with domesticated production, and developing sustainable methods of natural resources utilization, emerge as some of the critical ways by which science can intervene to counter the threat of climate change to food security in Africa. African scientists also recognize the importance of working to improve the integrated agro-production systems of the predominantly subsistence farmers on the continent, which combine conservation agriculture, organic farming, agro-forestry and traditional knowledge, to yield both adaptation and mitigation benefits.

## CLIMATE CHANGE AND HEALTH

The stability of the health sector in Africa against climate change is already seriously compromised by a heavy burden of disease and disability. The Intergovernmental Panel on Climate Change cites Africa in commenting on the importance of the health of a population as an element of adaptive capacity. The Panel observes that the future of the HIV/AIDS epidemic in Africa, for example, will determine how well African populations cope with challenges like the spread of climate-related vector and water-borne infections, food shortages and increased frequency (and intensity)

of storms, floods and droughts. The key concerns in the health sector are not only with the diseases, whose prevalence and virulence may be affected/exacerbated by climate change, but also with the health systems that could be readily overwhelmed by the health-care demands of populations impacted by climate change. We deal here with effects on diseases alone. For vector- and water-borne diseases, emphasis is on the effect of climate change on their transmission dynamics. Studies already show that changes in temperature and precipitation could alter the geographical distribution of malaria, with previously unsuitable areas of dense human populations becoming suitable for transmission. Scenario studies also project altitudinal shifts in malaria distribution in east African highlands by 2050, while a recent simulation study in Nigeria[6] found the risk of malaria epidemic to be linked with projected high relative humidity and rainfall, which support an increase in breeding sites. The point is readily made that by expanding conditions that are conducive to the existence of vectors or by leading to an increase in breeding sites, climate change may enhance disease risk. The exact nature of the impact of climate change on malaria and other diseases, however, remains to be firmly established by detailed concurrent historical studies of climate and each disease, taking account of the influence of interaction with other factors like immunity, drug resistance, malnutrition, poverty and even civil strife and war. The IPCC makes the point that many challenges remain in Africa for climatic- and health-impact and adaptation research.

## EXTREME CLIMATE-RELATED EVENTS

The frequent prolonged droughts and famines that have ravaged the Sahel and other parts of Africa episodically since the 1970s are extreme climate-related events that cannot be ignored in discussing the impacts of climate change on the continent. Flooding from excessive rainfall, sea level rise and storm surges are climate -related extreme events currently ravaging many parts of the world, with devastating outcomes in Africa. Cases of land or mud- slides, wild fires or pest epidemics have also been reported. The consequences of these events include extensive destruction of settlements with their infrastructure, extensive damage of farmlands, fisheries and other means of livelihood, massive displacements and movements of people, food shortages, disease epidemics and the breakdown in social order sometimes leading to combative conflicts. Displacement and movement of people may occur internally within countries, creating the category of Internally Displaced Refugees (IDRs) or across borders among the 50 countries of the continental land mass of Africa in various patterns of migration. These extreme climate-related events create challenges for disaster risk reduction and management that need to be studied to understand how climatic extremes, human factors and the environment interact to influence disaster outcomes. Provision of the scientific bases for preparing against, and minimizing, the risk of these disasters is the primary challenge to Science.

Actions required of Science include contributions to the development of risk assessments and mapping for various anticipated climate-related extreme events. The refinement of modeling techniques, taking account also of natural systems and traditional knowledge, in developing early warning systems contributes to strengthen risk reduction. Science is also expected to intervene in developing effective and efficient disaster management systems. Ultimately, resolution of the uncertainties in the science of climate extreme - human factor - environment interaction, is the key to developing the adaptive capacity for meeting the challenges of climate-related extreme events on the continent. Detailed observations, assessments and models using climate as the driving factor are needed in this regard.

## ROLES OF AFRICAN SCIENCE ACADEMIES

Science is well suited to address Africa's urgent developmental needs, including challenges presented by climate change. Global effort to combat climate change is based on the United Nations Framework Convention on Climate Change (UNFCCC), which primarily aims to stabilize 'greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. The current target, pursued by various local and global mitigation efforts, is to prevent global warming from exceeding 2°C above pre-industrial levels. But the greenhouse gases already emitted into the atmosphere expose the world to global warming with the potential to cause the climate change impacts now being observed. Given the inertia in the climate system, benefits of successful emission reduction efforts are not likely to be realized for a long time. Meanwhile, current climate change impacts, which are more immediately apparent in Africa than they are in most other parts of the world where they are delayed and are not yet certain[2], continue to impede development in Africa. Africa will gain from its scientists working to improve on activities that yield both mitigation and adaptation benefits, such as the integrated agro-production systems that dominate land use on the continent. At the same time, there is need to address urgently climate change impacts that now threaten development on the continent, beginning with elevating the baseline understanding of what climate change means today and will mean to Africa in the future.

Filling the gaps in knowledge about the effects of climate change on the African climate system, so that future scenarios can be effectively modeled, is the first requirement for sound planning of adaptation measures. Extensive, systematic observation and monitoring of climatic events, over a much greater density of hydro-meteorological observation stations is needed to build up the mass of local observations needed to overcome the problems of downscaling global models to local levels. The resulting increases in local data, measurements, and observations could be used in downscaling processes and help reduce the uncertainties about the effect of climate change on African climates, and facilitate planning of interventions to moderate the impacts of climate change.

Expanded observation of local events correlated with monitoring of climatic elements can clear uncertainties and improve the understanding of the impact of climate change on health, agriculture and food security. It will also serve to improve understanding of the interaction of climatic-extremes, human factors and the environment in explaining the nature of climate-related disasters. Effective reporting of these observations will serve to elevate the African voice internationally in climate change debates and negotiations, and contribute to improving African participation in setting the agenda and in the utilization of opportunities for addressing climate change.

Individual scientists already play critical roles in assisting their countries in meeting obligations as parties to the UNFCCC. They are prominent in providing the information, especially the greenhouse gas inventories, required in returning national communications to the Convention. The scientific communities, through the Science Academies, should be prominent in helping countries formulate their climate change response strategies or plans, utilizing evidence-based information, developed from extensive observations and studies of the situation and the technical aspects of adaptation options in each country. In both the health and the agriculture sectors, the Science Academies are challenged to lead in the development of practices that moderate the adverse effects of climate change, take advantage of beneficial opportunities, and help to build the adaptive capacities and resilience of the people.

For addressing disasters caused by climate-

related extreme events, the Science Academies are challenged to play a leading role not only in convincing their countries but also in working with their national or local governments to develop tools and approaches to better understand and reduce disaster risks, or for elevating resilience to disasters caused by extreme weather events related to climate change and their attendant conditions. Across Africa, increases in the intensity or frequency of floods, mud- or land-slides, drought, ocean surge along the coastlines, and pest and disease epidemics are expected. The Academies should also work to improve and make more effective local early-warning systems and effective ways of communicating early warnings to reduce the risk, losses, and costs of disasters on all African communities, especially those that are considered to be vulnerable. Disaster Risk Reduction work should be accompanied with intervention to improve Disaster Risk Management practices.

An effective platform for pursuing the roles outlined above is the emerging Future Earth initiative of the International Council of Science (ICSU), that builds on the success of existing programmes such as the International Geosphere-Biosphere Programme (IGBP). African Science Academies should be closely linked with this, and other similar programmes, for the study of global environmental change, of which climate change is part. Linkage through ICSU programmes will enable the academies to gain from networking and exchange of information and resources among themselves. Through such a platform, national science academies should maintain a continuing engagement with their governments for providing quality technical advice to decision-makers on climate change. African Science Academies should also open up to greater collaboration with social scientists in order to deal effectively with the multidisciplinary challenges presented by climate change Support from governments and the Africa Union is crucial for deepening and sustaining the engagement of the Science Academies on climate change research.

## KEY MESSAGES

- Although Africa contributes marginally to anthropogenic greenhouse gas emissions that accelerate global warming and climate change, Africa will be more severely affected by climate change than most other regions of the world, because of her low adaptive capacity, engendered by inadequate information, low level of awareness and preparedness, inadequate technology, financial constraints and the burden of other developmental stresses especially widespread poverty.

- Africa's contribution of scientific information for understanding climate change has been meagre. In consequence, Africa has not effectively participated in setting the agenda in the global debate, or benefitted adequately from available global opportunities, for addressing climate change.

- The large land mass of Africa, which complicates the understanding of how climate change affects the climates of Africa, the heavy dependence of the African economy, led by agriculture, on weather and climate, and the heavy burden of disease and disability, which seriously compromise the stability of the health sector against climate change, separate Africa from other regions when dealing with climate change.

- Expanded observation of local events correlated with monitoring of climatic elements can clear uncertainties and improve the understanding of the impact of climate change on health, agriculture and food security. It can also serve to improve understanding of the interaction of climatic-extremes, human factors and the environment in explaining the nature of

climate-related disasters.

- The greenhouse gases already emitted into the atmosphere expose the world to global warming with the potential to cause the climate change impacts now being observed. Given the inertia in the climate system, benefits of successful emission reduction efforts are unlikely to be realized for a long time. Meanwhile, current climate change impacts impede development in Africa. While working to improve activities that offer both mitigation and adaptation benefits, there is need to increase baseline understanding of current and future climate change in Africa, so that climate change impacts now threatening development on the continent can be urgently mitigated.

- Science Academies in Africa are challenged to lead in helping their countries formulate their climate change response strategies or plans, utilizing evidence-based information, developed from extensive observations and studies of the situation and the technical aspects of adaptation options in each country. In both the health and the agriculture sectors, the Science Academies are challenged to lead in the development of practices that moderate the adverse effects of climate change, take advantage of beneficial opportunities, and help to build the adaptive capacities and resilience of the people.

- The scientific community in Africa, led by the Science Academies should intensify detailed observations, assessments and modeling, using climate as the driving factor to resolve the uncertainties in the science of climate extreme - human factor - environment interactions, ultimately helping to develop the adaptive capacity of the continent for meeting the challenges of climate-related extreme events.

- Governments in Africa and the Africa Union should provide and increase their support for scientific research on climate change, and foster a continuing engagement with national Science Academies for providing technical advice on climate change.

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