

Is the changing climate changing African ecosystems?

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Climate change has assumed a very large presence in the global debate in recent times. The Intergovernmental Panel on Climate Change (IPCC) has had an enormous influence over world thinking on climate change. In its latest publication (AR5), the IPCC notes that greenhouse gas (GHG) emissions growth in the decade leading to 2010 has been larger, averaging an increase of 2.2% per year, than in the previous three decades from 1970 to 2000, where annual increase was at 1.3%. With these emissions, temperatures have continued to rise, with each of the past three decades being successively warmer than the preceding decades since 1850. Impacts on physical systems, such as coastal erosion, melting glaciers, receding rivers and lakes, and increased drought incidences, have been accompanied by changes in extreme events; for instance, the increasing reported frequency of heat waves in large parts of Europe, Asia, and Australia, or a 0.50°C increase in near-surface temperatures over most of Africa and a reduction in precipitation.

While Africa's emissions are negligible relative to major emitters, the IPCC AR4 observes that the continent stands out as one of the most vulnerable regions to climate change. The far-ranging impacts articulated by the IPCC AR5 include socioeconomic impacts where climate change has been reported to inhibit the enjoyment of human rights in Africa, as well as adversely affecting progress toward attaining the Millennium Development Goals (MDGs), as it not only increases the pressure on economic activities, such as agriculture (the main economic activity in terms of employment), which is 98% rain-fed (hence vulnerable to climate change) and which has experienced stagnant yields in light of the region's rapid population growth (especially youth population), and fishing, but also adversely affects urban areas located in coastal zones. On food security, the Africa Adaptation Gap Report reiterates a bleak future. Its data on the effect of climate change on crop yields for key staples in Africa point to mean yield changes by the 2050s of -17% for wheat, -5% for maize, -15% for sorghum, and -10% for millet.

African Ecosystems Feeling the Heat Already?

Ecosystem provisioning (food/water), regulating (water/flooding), cultural (spiritual/tourism), and supporting (biodiversity) services underpin Africa's socioeconomic development and support human well-being. This is especially critical in light of the millions of poor. Almost one in every two Africans lives in extreme poverty today, and with the current trend, by 2030 it is projected that a vast majority of the world's poor will be located in Africa. Many of these poor, who live on less than US\$2 per day, depend on natural resources for livelihoods and general well-being.

Ecosystems also provide valuable adaptation mechanisms such as flood protection, protection from coastal erosion through mangroves, storm surge protection, carbon sequestration services, and provision of clean water, among others. With regard to hydrological balancing, it is worth noting that the macroeconomic impacts of hydrological variability can be considerable. For instance, water-related shocks have been reported to depress Mozambique's GDP by more than 1% each year. In Zambia, variability of rainfall lowers the country's agricultural growth by one percentage point each year and will cost the country US\$4.3 billion in lost GDP over 10 years. In Kenya, it is estimated that the 1997–1998 El Niño-related floods affected 1 million persons and had economic costs ranging between US\$0.8 and US\$1.2 billion as a result of damage to infrastructure (roads, buildings, and communications), public health effects, and loss of crops. Such costs may be extrapolated as similar to other Greater Horn of Africa countries.

With the important role ecosystems can play in averting such risks and losses, they are reported as increasingly vulnerable to climate change.

Terrestrial Ecosystems

The IPCC AR5 reports a decrease in vegetation cover across the continent, largely driven by anthropogenic land-use change, particularly the expansion of agriculture, livestock grazing, and fuel wood. These complex interactions make it difficult to determine the role of climate change in isolation from the other drivers. Across sub-Saharan Africa, a 57% increase in agricultural areas and a 15% increase in barren areas was accompanied by a 16% decrease in total forest cover and a 5% decrease in total non-forest cover. Increasing CO₂, changing precipitation patterns, and increasing temperatures have driven the climate change component of these changes.

At the individual country level, on Mt. Kilimanjaro, increased vulnerability to anthropogenic fires has driven a 9% decrease in montane forest and an 83% decrease in subalpine forest. Changing precipitation patterns and increasing temperatures have driven the climate change component of these changes. In the Democratic Republic of Congo, total forest cover declined by 2.3%, with most losses in secondary humid forest.

Across western Africa, central Africa, and Madagascar, net deforestation was 0.28% per year for 1990–2000 and 0.14% per year for 2000–2010. In addition, long-term declines in the density of trees and shrubs in the Sahel zone of Senegal and Mali were reported. Declines in tree density in Senegal and declines in tree species richness and changes in species composition in Mauritania, Mali, Burkina Faso, Niger, and Chad were also reported. Increasing temperatures and decreasing precipitation have driven the climate change component of these changes.

Going forward, it is projected that continuing changes in precipitation, temperature, and CO₂ associated with climate change are very likely to drive important future changes in terrestrial ecosystems throughout Africa.

Freshwater Ecosystems

The IPCC AR5 reports human-related activities, including anthropogenic land-use change, overextraction of water and diversions from rivers and lakes, and increased pollution and sedimentation loading in water bodies as the main sources of risk. Regarding the climate change component, it is reported that small variations in climate cause wide fluctuations in the thermal dynamics of freshwaters. Specifics include elevated water temperatures reported in surface waters of Lakes Kariba, Kivu, Tanganyika, Victoria, and Malawi.

Impacts of this thermal stratification in the region's lakes include, for instance, isolation of nutrients from the euphotic zone that is strongly linked to hydrodynamic and climatic conditions. Moderate warming may be contributing to reduced lake water inflows and therefore nutrients, which subsequently destabilizes plankton dynamics and thereby adversely affects food resources for higher trophic levels of mainly planktivorous fish.

Coastal Ecosystems

The IPCC AR5 reports that climate change will act by exacerbating challenges from existing stressors, including overexploitation of resources, habitat degradation, loss of biodiversity, salinization, pollution, and coastal erosion. Impacts will primarily be due to sea level rise (SLR) combined with storm swells. For example, in Durban, South Africa, a storm swell of up to 14 m due to winds generated by a cyclone combined with a high astronomic tide at 2.2 m led to damages estimated at US\$100 million in 1997. Other climate change impacts, such as flooding of river deltas or an increased migration toward coastal towns due to increased drought induced by climate change, will also affect coastal zones.

Ocean acidification due to increased CO₂ in the atmosphere is projected to cause a severe impairment of reef accretion by organisms such as corals and coralline algae. The further combined effects of global warming and ocean acidification have been demonstrated to lower both coral reef productivity and resilience. These effects will have consequences for reef biodiversity, ecology, and ecosystem services.

In Africa, fisheries, a key source of livelihood, mainly depend on either coral reefs (on the eastern coast) or coastal upwelling (on the western coast). These two ecosystems will be affected by climate change through ocean acidification, a rise in sea surface temperatures, and changes in upwelling.

Charting the Way Forward: Toward Building Resilient African Ecosystems

Ecosystems play a pivotal role in building resilience and development through service provision. Their continued threat from climate change should alert policy makers across the region, both at national and sub-regional levels, to put in place appropriate measures to facilitate their sustainable use. To this end, foremost, there is a need for changed mind-sets among stakeholders in the way they view nature. To reach this desired end, reform of the region's institutions, both traditional and modern, becomes an imperative. Building capacity of the region's scientists and policy makers becomes another imperative. The following recommendations outline some actions needed to reach

these goals.

1. Develop an Africa Ecosystem Research Network with core functions of monitoring, research, demonstration, policy support, and capacity building. This will help enhance the capacity of scientists and policy makers in Africa for sustainable management of their ecosystems and livelihoods. The development of this network should build upon existing infrastructure for ecosystem monitoring and research and draw its lessons from existing continent-wide research networks.

2. Review existing laws, policies, and regulations. While existing laws may contain fragments of ecosystem management concepts, there are still significant barriers to be confronted. For instance, national laws dealing with natural resource management and environmental quality tend to delineate ecosystems with convenient administrative boundaries that bear no relationship to ecological structures. Also, most laws and institutions separate natural resource management and economic management into different categories.

3. Address overlapping jurisdictions, fragmentation of authority, and conflicting objectives that stand in the way of efforts to adopt an ecosystems approach to development through legislative reforms. An economic valuation of the costs and benefits of an integrated ecosystems management approach to development should be undertaken: the economic dimensions of ecosystems management must be better addressed. While recognizing that it is not always easy to place economic values on ecosystem functions, the costs of both adopting and not adopting an ecosystems approach need to be defined. Further, an analysis of the role that economic institutions, specifically the market, play in promoting the adoption of ecosystems management on both public and private domains is needed.

4. Develop an institutional mechanism for managing ecosystems across jurisdictions in the region. It is rare to find an ecosystem wholly contained on a single “owner’s domain.” The multiple scales of ecosystems management require cooperation among a broad range of interests as well as improved interorganizational coordination. What is required is the design of institutions and cooperative approaches to management that cut across these jurisdictional boundaries. Efforts to manage ecosystems divorced from ownership realities are equally ineffectual; therefore, to implement integrated ecosystems management, the inclusion of private landowners is necessary.

5. Gain greater commitment from member states to propose, designate, protect, and effectively manage ecosystems. An initiative equal in scale and magnitude to the Maputo declaration, but focused on ecosystem commitments, is recommended.

6. And finally, maximize existing policies at the national level that are aimed at sustainable management of ecosystems. Through resource allocation, both budgetary and manpower, a collaborative approach is fostered in implementing policies that address ecosystems and encourage private sector involvement in ecosystems management through formal public-private partnerships, using incentives such as tax rebates and clear policy guidelines.