Seventh African Development Forum

Acting on Climate Change for Sustainable Development in Africa

Climate Change and Infrastructure Development

Issues Paper #8

ADF VII • 10 - 15 October 2010 • United Nations Conference Centre • Addis Ababa, Ethiopia

African Union

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I. Overview

1. Weak infrastructure is a critical bottleneck in Africa's development after decades of under-investment. Sound infrastructure would contribute significantly to achievement of the Millennium Development Goals. (MDGs). Changes in climate will stress current infrastructure, exacerbating existing weaknesses and forcing major programmes of renewal and replacement, well-supported with finance and technology and implemented by skilled workforces.

2. The three principal drivers are:
   a) Development: New infrastructure is required for present and future generations expecting higher standards of living;
   b) Adaptation: Existing and planned infrastructure need to be reinforced and adapted to cope with higher temperatures, greater and more frequent extreme events, sea-level rise, increased sand movements, and changing hydrology/precipitation regimes; and
   c) Mitigation: Investment in smart infrastructure and human capacities is required to mitigate emissions from, for example, energy, transport, agriculture, and forestry sectors.

3. While investment is important in all sectors, abundant low-carbon energy is absolutely fundamental for mitigation and sustainable development. Similarly, appropriate water infrastructure is critical for adaptation and sustainable development. Widespread access to water and energy provides many development benefits, such as reducing poverty, improving social and human development and opening economic opportunities in both urban and rural areas.

4. Mitigation of emissions requires new technology, planning, capacity and finance for provision of low-carbon energy technologies. Adaptation will be much more difficult without easy access to water and energy.

II. Stakeholders

A. General considerations for climate-proofed infrastructure

5. Decisions made today, for example, in creating new or retrofitting old infrastructure, it should be ensured that such infrastructure is robust enough to cope with future climatic conditions, including changes in precipitation, temperature extremes, and the probability and severity of natural calamities, such as floods and droughts. The following should be considered:
   a) The infrastructure deficit in Africa is vast. Most existing infrastructure has been built with low-energy efficiency and based on historical climate information. The World Bank estimates that $US93 billion is needed to improve Africa's infrastructure; nearly half of it on power supply. This amount will be much greater for new infrastructure that is (i) low carbon, (ii) climate proofed, and (iii) developmentally-sound and sustainable;
   b) Design and construction standards will need to be changed as a matter of priority. New infrastructure must have climate change considerations integrated into their design and planning processes to ensure future sustainability. Guidelines for climate risk assessment and better standards for planning of energy, land, water use and construction need to be developed;

c) The functionality of much of the existing infrastructure is threatened, for example, by floods and sea-level rise. This is true particularly for transport and for urban and industrial sites located in low-lying and coastal areas;
d) For mitigation, energy infrastructure needs replacement. Long-term planning has to address development and emission-reduction goals. This might involve change in practice in such areas as energy efficiency, new infrastructure, and an enabling environment to encourage behavioural change;
e) Much infrastructure needs upgrading to cope with growing human needs within a different climatic regime. For example, energy, dams, urban water supply, sanitation, and transport;
f) New low-carbon energy will be required for economic and social development in line with improvements in wealth and quality of life for larger numbers of people;
g) New technologies will need to be more energy-efficient to minimize emissions during construction and operation. For instance, cement production contributes some five per cent of total global emissions;
h) Agriculture-related infrastructure will need major overhaul in order to produce more food for the growing numbers of people in less propitious climates, while reducing emissions;
i) While improved information and communication technology (ICT) has had a transformational impact on the continent by enabling access to finance, and enhancing the dynamism and efficiency of markets, further developments are needed for distance learning and to reduce travel;
j) A strong and equitable global agreement is vital to 'cap' the impact of future climate changes, reduce uncertainties, and thereby facilitate long-term planning. For instance, known peak sea levels can be accommodated in planning; sustained rise over centuries is a planning nightmare;
k) The functioning of railways, waterways, and mass-transit systems as well as of homes, offices, and factories will have to be re-thought, for creation of much more sustainable cities; and
l) Wise investment in infrastructural renewal will sustain growth and maintain employment.

B. Sectoral considerations in building resiliency into infrastructure systems

6. Since climate change will affect all people and all sectors in Africa, infrastructure - as a support system - will need attention in all sectors. The particular sectors of interest include, (i) energy, (ii) water and sanitation, (iii) transport and ICT, (iv) urban, industrial and coastal, and (v) rural infrastructure (in relation to land use, agriculture and forestry).

7. ***Energy:*** Energy use is closely linked to development as guided by the MDGs and growth in gross domestic product (GDP). Access to electricity is currently very low in Africa; less than 25 per cent of households have electricity. Although Africa's potential for hydropower is huge, only seven per cent of this is exploited. Furthermore, hydropower has a high share of total energy generation (40-45 per cent), but is affected by the vagaries of climate change. Projections give a 10-20 per cent decline in rainfall by 2070 and a fall in river-water levels of as much as 50 per cent by 2030, in various parts of Africa. Therefore, energy generation, transmission and distribution are some of Africa's main challenges given that demand for more energy will grow rapidly with economic growth and population despite the vulnerability of hydropower. Africa also needs to mitigate emissions from current and future energy use. The ideal is to expand energy availability, while reducing energy-related emissions. This is an essential part of low-carbon development, achievable through a much more expanded use of renewable energy, together with energy-efficiency measures.

8. ***Urban and industrial energy*****:** Electric power grids will need extending and strengthening with greater production capacity from a diversity of sources to reduce dependency on fossil fuels. Smart grids and regional production schemes such as solar power in deserts, hydropower, offshore wind, wave and tidal energy technology, and geothermal technology could provide new and clean sources of energy. Access to modern technology is therefore critical and increased power pooling is inevitable.

9. ***Rural energy*****:** Access to energy in rural areas is currently very low in Africa. In 2007, the continent had about 500,000 solar home systems in use, more than half of these in Kenya and South Africa. Developing off-grid decentralized renewable energy supplies is a cost-effective way of increasing access to energy in rural areas. Off-grid options include solar photovoltaic, micro hydropower, biogas digesters, small wind turbines, and bio-fuels from non-food crop sources. These technologies could also improve adaptive capacity and reduce the risk of natural disasters. Renewable energies also promote gender equality by reducing the burden on women of collecting firewood and water and other needs, for carrying out household chores and generating income. Reducing the use of biomass for cooking and heating will significantly reduce deforestation, reducing the risk of floods. Electricity can be used to improve access to clean water, to cool medical supplies in rural health centres, and for food preservation.

10. For mitigation purposes, the technologies most frequently required in Africa include renewable energy, energy-efficient appliances and buildings, efficient land management, and public transport. The energy sector requires a major transfer of environmentally-sustainable technologies, especially for energy generation. The most commonly identified technology needs for mitigation, relate to solar energy, biomass energy (forest and communal bio-waste), large and small hydropower plants, efficient lighting and water heating, geothermal, water pumping, efficient and low-fuel consuming stoves and ovens, and solar drying of agricultural products. Transport will need to convert from oil to bio-fuels, electricity or hydrogen, depending on circumstances.

11. ***Water and sanitation:*** Projections indicate that 230 million Africans will face water scarcity by 2025 as a result of declining water resources and due to increasing constraints on water resources, especially in hotter climates. Much of the water infrastructure will need upgrading to maintain adequate supplies for meeting future demand. This transformation could be achieved in harmony with the diversity of water uses including for agricultural production, fishing, navigation, industrial production, domestic consumption, and ecosystem sustainability.

12. Construction of new dams and upgrading existing ones will become essential to sustain urban water and hydropower supply under conditions of more frequent river-flow variations and greater competition for water. Watersheds already need improved management (agro-forestry, erosion control and livestock management) to protect water resources. Management of rivers will require trained staff to engage in minimizing flood risks along bridges, culverts, and embankments.

13. Urban and rural water supplies will need to cope with both increasing population and drought in many parts of Africa, while in flood-prone areas, flood-prevention infrastructure such as drainage, strengthened river banks, and provision of clean water are important. Desalination infrastructure may be required for high-value water in coastal areas, depending on the fragility of local coastal ecosystems. Improving urban sanitation is hugely important in many countries, including improved drainage systems to mitigate the increasing risks of urban floods. A process combining the collection of waste and converting it into fuel or electric power provides win-win solutions.

14. ***Transport:*** As earlier stated, there are many threats to existing infrastructure (roads, railways, harbours, waterways, airports) from increased flood risk and sea-level rise. Coastal networks may need complete replacement with upgrades (new bridges, culverts, river management training) required elsewhere. The expected increase in the frequency of extreme events will further increase damage to infrastructure, loss of life, and financial burdens to governments. However, transport equipment also poses threats to climate change. New types of fuel (bio-fuels, hydrogen, electricity, solar energy) will be needed to replace petroleum/oil. Further, the effect of transport infrastructure on the environment, especially forests, land stability, and water courses will have to be minimized. Sustainable transport will have to be fostered at the transport-policy level.

15. ***Information and communication technology (ICT):*** Sustained investment in ICT infrastructure should be a high priority in all countries, to improve communication, to open markets, to provide access to finance, telemedicine and distance learning, especially in rural areas., At the same time, ICT use reduces people's need to travel. In addition, there is need for enhanced protection of ICT infrastructure, for example, from extreme events (floods and storms with high winds and lightning).

16. ***Rural infrastructure land use: agriculture and forestry infrastructure:*** Projections indicating declining water availability will lead to serious food deficits in parts of Africa. Many African countries will be able to benefit from global carbon trading through major reductions in emissions by changing land-use practices. This will require significantly strengthened agricultural and forestry infrastructure, much of it in relatively remote regions. The establishment of agro-forestry systems could help to cope with increased risk from changing climatic conditions. Agro-forestry benefits of carbon trading complement those obtained from the use of renewable sources of energy, such as solar, wind and biogas and increased energy efficiency.

17. ***Urban, industrial and coastal infrastructure:*** Improved planning, building regulations, flood-resistant design, water supply, sanitation and drainage are essential short-term solutions. Improved disaster risk planning, preparedness and response will also help to minimize the impacts of extreme weather events. Land issues compel the poorest urban residents to live in high-risk areas such as flood plains, and their needs should also be resolved.

18. The tendency to 'temporarily' protect lowland areas from sea-level rise by means of dykes and sea walls must be reconsidered in the light of (a) possible long-term sea-level rise of several metres combined with, and (b) storm surges such as Hurricane Katrina's impact on New Orleans. Much coastal infrastructure in Africa will need to be relocated sooner or later if sea -level rises are not addressed. Countries particularly vulnerable include Egypt, the Gambia, Nigeria, Côte d'Ivoire and Mozambique. Shoreline defence structures could help protect vulnerable coastlines - for a while only - especially where they enhance coastal ecosystems as well as protect infrastructural assets. Cities located on river deltas are particularly vulnerable due to land subsidence.

19. ***Cement for concrete*** is in great demand for safe urban and industrial construction, but cement production is a major source of emissions both during production and use. Are alternatives a possibility in Africa? It is possible to partly switch to biomass-based fuel to replace heavy fuel oil and coal in cement factories, thus becoming eligible for CDM projects? Low-carbon cements are still at the research stage though several CDM projects have attempted improvements. Poorly designed buildings constructed with inadequate materials can consume up to 30 per cent more energy for lighting and cooling. Design and construction materials will have to be adapted to future climate.

III. Conclusion

20. Investment in new and existing infrastructure in Africa must be well resourced, well planned and well managed along a low-carbon and climate-resilient path. Current investment of $US45 billion per year needs to be doubled according to the African Development Bank (AfDB). The needs are much larger than this, and their solution is very important for Africa's future adaptation, mitigation, and development.

21. Infrastructural planning will have to incorporate the concerns over the new weather and climate risks. Capacity-building and much improved climate information will be required, along with greater exchange of best practices throughout Africa, as advocated in the Climate for Development in Africa (ClimDevAfrica)programme.

Priority actions:

22. These should include:

a) Reform of planning processes to include climate change information, with enforceable land- and water-use policies and practices, in harmony with regional circumstances;
b) Reform of building regulations to support energy and resource efficiency in national processes, while maintaining regional coherence;
c) Access to quality climate information and climate risk-management processes;
d) Updating the Africa Infrastructure plan to accommodate climate change considerations;
e) Support for regional hydropower and other clean energy sources;
f) Integrating climate change considerations into contracts on infrastructure; and
g) Learning more about the impact of climate change on infrastructure given the uncertainty as well as the broad range of expected changes in rainfalls and temperature.

IV. Key questions

23. These include:

a) How can the opportunity for continental infrastructural development and renewal be realized? Can regional harmonization help drive the process forward? Raise standards? Encourage cooperation? Assist national processes?
b) Is there sufficient information on expected climate changes to enable adaptation of infrastructure design? What is the information gap relative to best design and construction practices in Africa? What levels of long-term rise in sea level should be accommodated in new coastal infrastructure? Can existing ports and harbours be upgraded to cope with sea-level rise or will changing and eroding coastlines make them unusable? What should be done to improve information sharing in Africa on such matters?
c) Is there an alternative to Integrated Water Resource Management (IWRM) as best practice for managing change in resource availability under conditions of increasing demand? Many urban and rural water supplies are extracted from groundwater. How can such supplies be made sustainable in areas of predicted decline in groundwater recharge?

d) In the context of planning infrastructure development within ever-changing climate conditions:
   i) Can African countries absorb all the major investment in infrastructure that is required? What other sources of finance are available, and what financial governance architecture is required to maximize such sources? How can existing planning and construction regulations be reformed, implemented and enforced effectively?
   ii) How can the low-carbon path be integrated into existing and future plans?
   iii) How can infrastructural investment be programmed to sustain growth and employment?

e) Water harnessing and productivity are very low in Africa. How can these be improved, especially in areas of projected water stress?

f) To what extent should current programmes, such as the African Union's Programme for Infrastructure Development in Africa (PIDA) be improved to take account of climate change?