Climate Change and African Development

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This paper examines the broad impact of climate change on the African continent and investigates how strategically best to address the emerging climate challenge. Nick Mabey is Chief Executive of E3G (Third Generation Environmentalism). Jan Ole Kiso works for the UK Cabinet Office. Both were members of the Prime Minister's Strategy Unit project on 'Countries at Risk of Instability'.

People in Africa are already experiencing a significant impact on their livelihoods from climate change. This is tragic in on several levels. Firstly, Africa's historical contribution to the causes of heightened greenhouse gas levels in the atmosphere is negligible. Climate change is not a threat of Africa's making. Secondly, the solution to the problem is mostly outside of Africa's control. It is in the hands of the developed and large industrialising nations. Thirdly, climate change has particularly serious impacts on countries at risk of instability in vulnerable climatic areas. More strenuous climate conditions represent an added cause of instability, and increases already existing stresses. Fragile states do not have the capacity to adapt to changing circumstances as quickly as others and are more likely to further become destabilised. As a continent, Africa possesses by far the largest number of countries at risk of instability with high levels of climate vulnerability.

Past emissions commit the world to at least 1.5C rise in temperature by 2050; even the most aggressive efforts to limit greenhouse gases will only start to slow warming trends from 2040 onwards. In the short and medium term, counties need to invest in adaptation measures to improve their resilience to climate change. At a broad level, the best defence against climate change is a strong economic base and resilient political institutions; however, there is also a need for specific action to address specific vulnerability to changing conditions such as shifting rainfall patterns. Many parts of Africa have made significant strides during the last decade in strengthening both.

Also, if African states are flexible enough economically as well as politically the climate challenge could even pose some growth opportunities. A changing climate generates winners and losers. African states have to be able to adapt, guard themselves against growing climate threats and should take advantage of newly emerging markets for low carbon technologies and services.

This article will outline the broad scientific predictions as to how climate change will impact the continent of Africa over the coming decades. We recognise that the complexity of the issue means there is significant

uncertainty over the scale of many of the impacts, and the precise regional patterns of changes. However, climate change is measurably happening and Africa is one of the most vulnerable continents. The article will then move on to investigate the strategic options that African states face in order to adapt to the new challenge.

Where do we stand on climate change?

Carbon dioxide concentrations in our atmosphere are at their highest for at least 650 000 years[1] and perhaps 20 million years. Over this period, the world has never experienced higher atmospheric carbon concentrations than 300 ppmv. Levels always fluctuated between 160 and 290 ppmv. Today, the carbon concentration is around 385 ppmv. We are in unchartered waters. Every year we leap further into the unknown – at a rate of roughly 2 to 3 ppmv per annum; and this rate has increased over the last 5 years due to a reduction in the rate of natural carbon absorption.

The extraordinary rise in atmospheric carbon levels is clearly due to human influences. We have multiplied our usage of controlled fossil fuel burning mostly for industry, transport and heating; we continue to engage in rampant deforestation and we occupy huge areas for mechanised agricultural businesses. All these activities influence carbon concentrations in our atmosphere. Though we have increased the efficiency with which we use energy remarkably in the last 100 years, this effect has been swamped by rapid economic growth and the tripling of the global population leading to rapidly rising carbon dioxide emissions.

There is strong evidence that carbon levels in the atmosphere are correlated to the earth's weather system - especially temperatures. This article will not be diving into the scientific debate on this issue. However, the overwhelming majority of scientists support this correlation. As predicted by those scientists early on, we begin to experience the first impacts of climate change. Twenty-three of the twenty-four hottest years since records began in 1850 have occurred since 1980. Average global temperatures have risen by over 0.7C since the 1960s. Growing evidence for the validity of this increase in temperatures are not only hotter summers at home, but melting ice sheets at the poles and retreating glaciers; 99% of all glaciers are net retreating. These factors combined, gradually effect world-wide sea-levels. Over the period from 1993 to 2003 average sea-levels have risen by 3.1mm per year. This is nearly twice the historic average rate of increase. Extreme weather events are also on the increase. Incidents of major floods, wildfires, wind speeds and cyclone activities experienced a much stronger frequency over the last two decades than past records.

This is a trend which all of us need to adapt to. On top of the already 0.7C increase of global temperatures, the level of greenhouse gases in the

[1] Scientific observations currently do not have measurements beyond 650 000. (GRID - Global Resource Information Database of the United Nations Environment Program in Arendal, Norway)

atmosphere entail that we are committed to another 0.8C increase over the coming decades. This is even if we completely stop to emit greenhouse gases today. As the recent Stern Review explained, the risk of not reacting now is much higher than waking up to the challenge in the midst of the storm. The growing evidence base around climate change is strong enough to drive urgent action to both mitigate emissions and begin adapting to its effects. This fact is nowhere else more pressing than on the African continent.

What are the likely impacts of climate change on the African continent?

Climate change impacts can be categorised in four broad themes: Rising temperatures, changing precipitation patterns, increases of extreme weather events and gradually rising sea-levels. Rising temperatures and changing precipitation patterns will have significant influence on the habitability of many areas that we humans live in. Some areas will become uninhabitable, like deserts, and others will become more accommodating, like the snow-covered lands in Greenland, Canada or Siberia. Extreme weather events will increase risk to humans living in instable areas. Rising sea-levels will obviously also impact habitable spaces – about a third of humanity lives no more than 50 miles from the coast.

The critical measure is an area's vulnerability to climate change. This is a combination of how sensitive the existing climate and ecosystems are to predicted changes. Net impacts will then be determined by the adaptive capacity of the ecosystems and populations affected

Poor people and poor countries will notice climate changes first. The poor are less likely to be able to adjust and to protect themselves effectively. Most regions that are already impacted by climate change are also regions where relative poverty prevails. The dry-lands of central Africa, the delta area of Bangladesh and the mountain areas of central Asia are some prominent examples. Climate change is likely to aggravate the divide between the poor and the rich. Indeed, President Museveni of Uganda was the first head of state to name climate change as an aggressive act by the rich against the poor. The widening divide will increase the risk of internal frictions within states as well as generate unprecedented global immigration flows. Estimates of climate change induced immigration range from 200-400 million additional migrants by 2050. As such, climate change poses a significant political, security, economic and social threat.

The African continent already experienced record levels of temperatures over the last decade. It is expected that this will continue. The most recent report by the Intergovernmental Panel for Climate Change predicts a minimum 2.5C increase in temperatures in Africa by 2030. This entails that most African areas are expected to be impacted much stronger than the global average. Indeed, the UK's Hadley Centre states temperature increases over many areas of Africa will be double the global average of increase

(metoffice.gov.uk; Oxfam 2007). This is mostly due to the large land areas of Africa, which are more prone to temperature fluctuations.

Generally the rise of temperatures in Africa is predicted to make dry-lands dryer and wetlands wetter. Rising temperatures will shift patterns of human habitability through impacts on crop growth, risks of diseases, desertification and related water scarcity. The Fourth Report from the Intergovernmental Panel on Climate Change stated this year that:

> *'agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020.'*

The IPCC predicts that net around 600 000 square kilometres of cultivable land may become unsuitable for agricultural activities. They forecast, for example, that wheat could all but disappear from the African continent by 2080. Soya bean harvest is expected to drop close to 30% by 2050 (IPCC April 2007). Stern predicts that crop yields in the whole of Africa will fall as much as 30% by 2050. All this will be due to the twin impact of higher temperatures and less predictable weather patterns. As up to 70% of the African population currently relies on rain-fed agriculture or pastoralism, this predicted impact on agricultural yields in Africa will obviously have major economic and social impacts[2].

The predictions for the whole of the continent, however, do not look all the same. The IPCC, for example, forecasts that some areas in eastern Africa like the Ethiopian highlands might benefit. This can offset some of the hits on agricultural production in lower-lying areas. Also, some parts in southern Africa are forecasted to become wetter. However, this might include increases of extreme weather events, which do not necessarily facilitate agricultural production.

With temperatures rising, water scarcity will widespread globally. Water management in form of storage, transportation and allocation will emerge as a strong growth industry. Here, again, the poor will feel the impact stronger than the more affluent. As a general rule of thumb, the richer are less impacted by the price of water than the poor. In Tanzania the average percentage of wage income spent on water is over 5%, in the UK it is 0.013% (Clarke & King 2004). The availability of water is closely linked to almost all the poverty indicators, including education and gender issues[3]. Water stressed areas in

[2] A University of Pretoria study estimates that Africa might lose $25 billion in crop failure due to rising temperatures and another $4 billion from less rain (up.ac.za).
[3] See, amongst others, 'Human Development Report' UNDP 2006 or Environment Conflict Cooperation 2007

Africa will increase, especially as the projected strong population growth is already driving water scarcity.

Sea-level rises are notoriously difficult to predict. However, recent data indicates a steady increase of annual rises. It is estimated that until the end of the century this will result in an increase of at least half a meter and most probably more. Sea level rises impact salt conditions, sea-defences and water-systems. Obviously, low-lying coastal areas with large populations are the most vulnerable. It is estimated, that the cost of adaptation could amount to at lease 5-10% of GDP especially in the delta areas of Egypt or Nigeria (Stern 2006). There is still some time to adapt. However, planning for sewage systems, dams, water-ways, etc. tend to encompass a time-span of several decades. Thus, it is best to take these factors into account, today.

An early consequence of sea level rises and temperature increases is that mangroves and coral reefs are projected to be severely degraded. This will have grave consequences on the fishing and tourism industries o which many Africans depend. Already patterns of commercial fish stocks are changing off the West African coast due to unexpected changes in ocean circulation and nutrient availability.

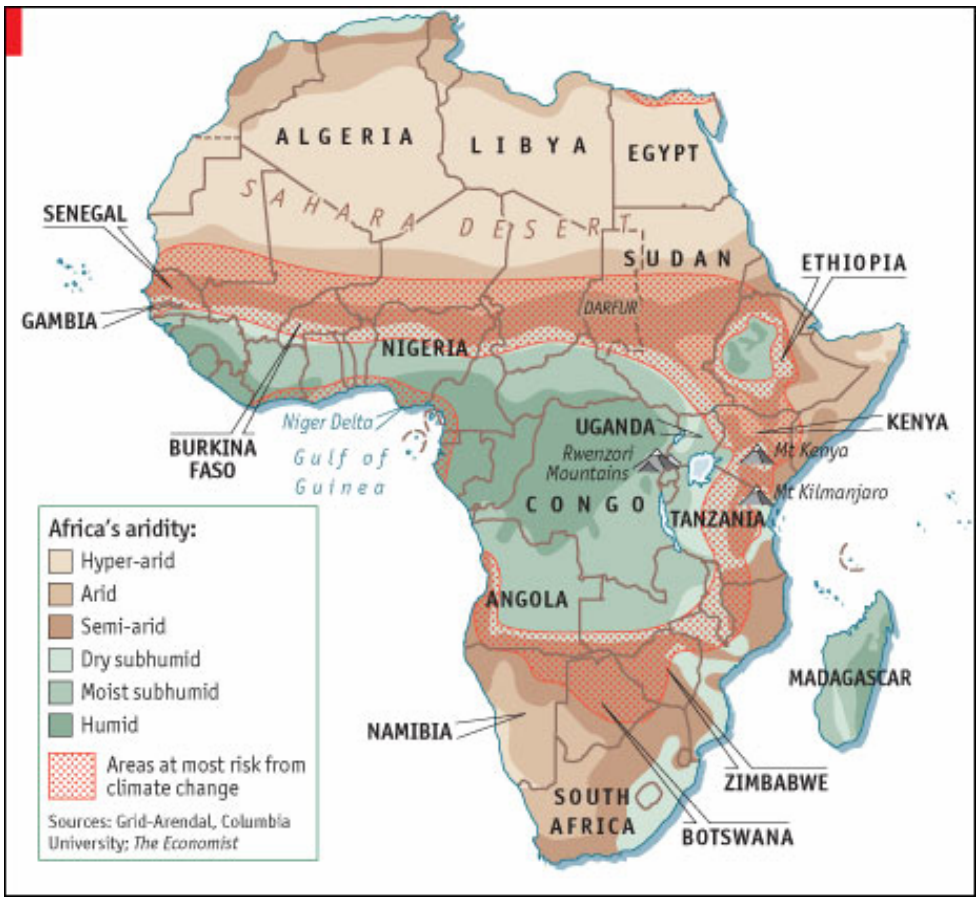
Predicting what climate change could entail for the level of human conflict in Africa is difficult to forecast due to the dependence on other human factors, such as internal political resilience or international engagement at the time. However, climate security has been taken for granted over the last centuries. Climate events, when they occurred, were seen to be out of humanity's control and thereby a *fait a` compli*. This will change. Climate security will be seen as a critical factor. Climate changes will become part of analysing political and economic events - as much as religious movements or monetary conditions are seen as factors in regional analysis. Margaret Beckett, Foreign Secretary of the UK, stated on the topic of climate security in May 2007:

> *'There are, of course, many ways in which we can and must analyse the security situation in the Middle East – national, religious, economic. But my argument is that to deliberately choose to ignore a process of the magnitude of climate change – a process that threatens to raise tensions between states, that has the potential to cause widespread political instability, that might swell further the ranks of the dislocated and disaffected – would be wilfully to restrict our understanding of the challenges we face and to hamper our ability to meet those challenges in good time' (RUSI 10 May 2007).*

This is as much true for Africa as for the Middle East. Origins of conflict are complex and varied. However, economic well-being - and with it the management of scarce resources - is a major factor in triggering human conflict (Meier & Bond 2005). Climate change will affect the demographic and economic balance of whole regions, especially by creating greater food and water scarcity. Darfur is one example where extreme weather conditions further aggravated human conflict. The causes for the Darfur crisis are multi-

facetted, but it is wrong to ignore the climate trend of the region (Sachs 2006). Rising temperatures increase desertification - as it happened in Darfur over the last decades - this in turn creates greater competition over already scarce resources. Migration out of these effected areas will further spread conflicts regionally beyond state borders and into cities. Urban poverty will increase as people migrate and search for opportunities. The Ivory Coast, Darfur, Nigeria, Senegal/Mauritius are just some areas where we should keep climate conditions on close watch in order to fully understand the political picture.

The attached map from Grid-Arendal/The Economist pictures the most recent scientific predictions of the vulnerable African regions from a climate change perspective. As one can see, some areas are expected to be much stronger effected than others. The sub-tropical regions of Congo, for example, are currently predicted to only experience minor threats by climate change. Also, the most northern and southern regions appear less effected. In order to illustrate more the varying impacts of climate change on African regions we like to finalise this section by providing three short case-studies.



Ghana and the Sahel region are expected to encounter more and more desertification (Reich 2002). Throughout the whole of West Africa the continent's climate extremes are at their closest proximity. These contrasts will become more accentuated as the savannas and deserts of the Sahel region will further move south towards the coastal areas. From the highs of the 1950s to the lows of the 1980s, rainfall declined by 40 per cent in the

Sahel region and continues to experience steady decreases. The 1980s and early 1990's had been 'the most substantial sustained change for any region of the world within the period of instrumental measurements' (Kelly and Hulme 1993). This drying trend continue until today (Oxfam 2007 p.8). Obviously, it has impacts on living conditions in the area. Indeed, during April 2007 the UN Security Council debated the issue of climate security. The Ghanaian representative, L K Christian, pointed out that nomadic Fulani cattle herdsmen were moving south and beginning to arm themselves. This is a reaction to confront local farming communities who where threatening their cattle herds. Christian saw the cause for this in the encroaching desert from the north. Naturally, other factors exist. Luckily, Ghana is an increasingly resilient country, which can hopefully defuse potential conflict situations via political institutions and economic strength. However, similar events in adjacent weaker countries could become highly destabilising. The risk of an encroaching desert will occupy the whole region for some time to come.

The **Rift Valley** is generally predicted to experience more wet and volatile conditions while temperatures continue to rise. The maximum temperature in Kericho, a highland area in the Rift Valley province where most of Kenya's tea exports are grown, has already increased by over 3C during the past 20 years. In Lamu, on Kenya's north east coast near Somalia, the maximum temperature has increased by more than 3C since the 1940s (Christian Aid 2006). Rainfall in the area is predicted to increase. However, it will be less seasonal as it is today. Also, the rainfall periods are seen to become more intense. Both these factors are likely to make agricultural activities more demanding, as seeding patterns will be less predictable and crops more frequently destroyed by heavy rainfall.

The long-term fate of snow-cap mountains in the Rift Valley, like Mt Kilmanjara, are well documented. But apart from the area loosing one of its iconic tourism landmarks, climate change in Rift Valley is predicted to have a major impact on river flows and, thus, for example on the hydro-electrics industry. Drought in the late 1990s already severely impacted this major source of energy supply in the area and has had a significant knock-on effect on GDP growth of Kenya; with a 20% GDP reduction over several years. Irregular rain patterns could make supply patterns more unpredictable in the future.

Additionally, the region is already experiencing changing patterns to disease prevalence. Malaria is moving into areas that were previously too cold for it to spread, such as in the highlands of Kenya, Tanzania and Rwanda. Also, Rift Valley fever ravages livestock in areas where it previously has not been recognised as a problem.

Egypt is positioned in another region of Africa, which is very likely to be severely impacted by climate change. Egypt's population is projected to rise from 67.9 million to around 125 million in the year 2050 (United Nations Population Division 2004). 97% percent of the water consumed in Egypt today originates from outside the country. The Nile's water is being used so extensively to irrigate crop fields that at times the flow into the Mediterranean

is reduced to nothing (Clark & King 2004). The IPCC predicts that under current water management, the Nile flow will decrease by up to 80% by the end of this century - mostly because it will lose much of its capacity while flowing through much dryer areas in both Sudan and Ethiopia. This will have significant knock-on effects on crop yields and human water consumption further down the river. For example, today normal irrigation practices cease when annual flow is reduced by more than 20% (Stern 2006). Climate change will bring Egypt's strong dependency on Nile river flows to the forefront. The fear is that Nile water will increasingly become a trigger for regional tensions.

As regards the Mediterranean Egyptian coastline, rising sea levels will incrementally threaten the low-lying ground on the banks of the Nile delta. Egypt's delta is one of the most densely populated areas in the world and is extremely vulnerable to sea level rises. Some of Egypt's most fertile land is going to be flooded by saltwater. One study suggests that even a half a meter rise of sea levels (well within predictions for this century) will cause the migration of some 2 million people (El Raev 1999). Thus, both from the north and the south Egypt will find itself in a precarious position by climate change events.

Overall, the balance of climate change projections – even over the next 50 years – seem to point to a range of increased stresses and impacts on Africa. Though there are always uncertainties over the details – which could mean they are being under or over estimated - we are best advised to begin to take the challenge and impacts of climate change seriously. As the former US Chief of Staff General Sullivan stated in his report on security considerations of climate change: 'If you wait until you have 100% certainty on the battlefield, something bad is going to happen' (Sullivan and Zinni 2006). The remainder of this article focuses on some possibilities on how African states can adapt and prevent – as well as possibly even contribute to overcome the climate change challenge.

An emerging strategy for response to climate change in Africa

The longer we wait to take on the challenge of climate change, the more difficult it will become to find practical solutions. The old principle of 'prevention is better than cure' has seldom been more important to follow. Essentially we are dealing with a global market failure. Over the past century we have had the perception that carbon emissions do not bear a cost, whereas for years the cost was actually hidden in the invisible atmosphere; leaving later generations to foot the bill.

Similar to other areas of the world, future African economic advancement needs to take the climate change issue into account of its political, economic and demographic planning. It would be dangerous to do otherwise, especially if climate change impacts lie in the upper range of estimates and we fail to effectively control global emissions. This does not entail disputing the right of African countries to develop and to bring to their populations the benefits of

modernisation, including access to energy. But it entails that Africa's development faces a different factor than did the industrialised countries during their earlier period of development. African countries need to have a clear and frank assessment of the forthcoming risks and should participate in their solution. This development should take place with the aim of achieving long-term sustainable growth. Since Africa is in a special position, its strategic response needs to include both a reaction to the already given impacts of climate change as well as a sustainable outlook in the long-run. More specifically for Africa, the strategic response could be divided into four broad issue areas:

- Understanding its climate change vulnerabilities
- Preparing for climate change impacts
- Gaining from new market opportunities
- Combating the continent's own greenhouse gas emissions

Understanding Africa's climate change vulnerabilities is not an exact science. Weather forecasting is notoriously difficult. The more regional as well as time-specific it tries to becomes, the more unreliable it appears. Some of the most advanced computer modelling in the world currently occupies itself with this challenge. We have to work with the information we can generate. Due to its increasing importance, this information should be better communicated to the local/regional level. A better system for climate observation and for feeding climate information into policy-making procedures should be developed. Local, national and regional institutions should be aware of the latest long- to medium-term predictions for their areas. On this basis, they will then have the chance to take climate changes into account for future planning.

Most of the advanced technology on weather modelling and observation is based in the developed world. This needs to be better shared. Many useful initiatives already exist. The British Government through DFID, for example, is supporting the GCOS[4] Action Plan for Africa which, amongst others, develops regional action plans for improving observation systems and addresses initial resource mobilisation issues. Also the Met Office Hadley Centre, again with DFID support, has developed software that assists PC modelling of climate scenarios at the regional level. This software can be made available to national authorities in Africa and elsewhere. Feeding this increasingly sophisticated information into the political decision-making processes of African countries is at an early stage. African states with the assistance of existing technology will have to become more mature in handling and reacting to climate change information.

[4] The Global Climate Observing System and Sustainable Development

Some countries' administrations are beginning to implement structural changes in order to fully institutionalise climate change considerations into their decision-making procedures. **The UK system has been one of the most innovative**. The Foreign Commonwealth Office established an ambassadorial post for the Special Representative for Climate Change, John Ashton, in 2006. This year the FCO also nominated George Edgar to become the Envoy for Climate Security in Africa. These are innovative approaches in order to catapult climate change issues into the UK's foreign policy making. The Ministry of Defence, also, incorporates climate change predictions into some of their future scenario modelling. As regards domestic politics, HMG is setting up an interdepartmental Office of Climate Change. This will focus on the UK's legally binding carbon reduction commitments of 26% to 32% by 2025 and 60% by 2050. Attaining this goal necessitates to include climate change cosiderations for all new proposed legislation – irrespective of policy area. Each legislation will receive an Impact Assessment which will ensure climate issue are routinely addressed.

Once understanding of the most significant climate change vulnerabilities is existent, then **preparing for the impacts** becomes pivotal. First and foremost, climate change will trigger migration on an unprecedented scale. Desertification, droughts, water floods and other extreme weather events will force people to move. People living in pastrolist, agricultural and/or conflict areas will migrate even more into the urban areas where chances of survival will be higher. This will become a great additional burden for African countries to bear and a significant destabilising threat. African states will need to show flexibility and foresight in order to accommodate migration. Isolating immigrants within state or local boundaries does not represent a sustainable option. Regional solutions will have to be found through extensive cooperation and burden-sharing. If managed properly, migration does not necessarily need to pose a threat. In this regard, international aid will most probably also play a prominent role in form of immediate humanitarian support for the most critically effected.

In many areas farmers will need to adjust to more frequent extreme weather events. Increased carbon concentration in the air has to be understood as, basically, more energy in the atmosphere. This will turn droughts hotter and rainfall stronger. More extreme and faster weather patterns will force people to invest in greater storage and weather defence capabilities. Marginal cost of the business will increase. Critically, traditional knowledge on how to manage crops etc will account for less, as their past experiences will no longer be the best indicator to understand the present. This represents a major challenge to traditional societies to adapt, and will drive internal social stresses.

The topic of sea defences has already been mentioned as well as the necessity to include climate change threats into the long-term planning circle. Another predictable long-term effect is the gradual spread of diseases,

especially malaria, to mostly higher regions of the continent. Preparing for this migration of diseases will be a challenge for the health systems of African states. Here international support is quite strong as diseases are targeted by specific public and private initiatives. Disease prevention should clearly calculate climate change factors into its future risk analysis and react accordingly.

Water management necessitates another obvious adaptation. Cross regional cooperation will become vital. The African's Ministers' Council on Water (AMCOW) has already been set up for continent-wide cooperation. The Council is putting trans-boundary water management challenges on the political agenda. It receives external support for this purpose. The international donor community has also played an important part in the establishment of almost all river and lake basin organisations in Africa. This assistance includes direct financial support and technical assistance such as regular surveying. Regional initiatives – mostly along existing waterways – represent an important step forward. The Nile Basin Initiative, involving 10 African states, is probably the most advanced. These initiatives have to find ways on how to better utilise the scarce resource water. Agricultural practices, sewage systems as well as drinking water springs all need to be reinvestigated concerning their efficiency and adaptability to climate changes.

Gaining from new market opportunities should be a central pillar of the African countries' reaction to climate change. The business interest in so-called 'green' investments has catapulted over the recent years. Green investment funds have had their investment capital expand dramatically[5]. Providing carbon with a price is not only being realised throughout the European Union's Emissions Trading System, but it is being tested in various other regions of the world – California being one of the most politically critical examples. Once carbon has a price, a new commodity market will have emerged. All this is welcomed news as it spurns on technological development and generates income for those who dare to venture into sustainable growth investments. African countries can and should take advantage of this development.

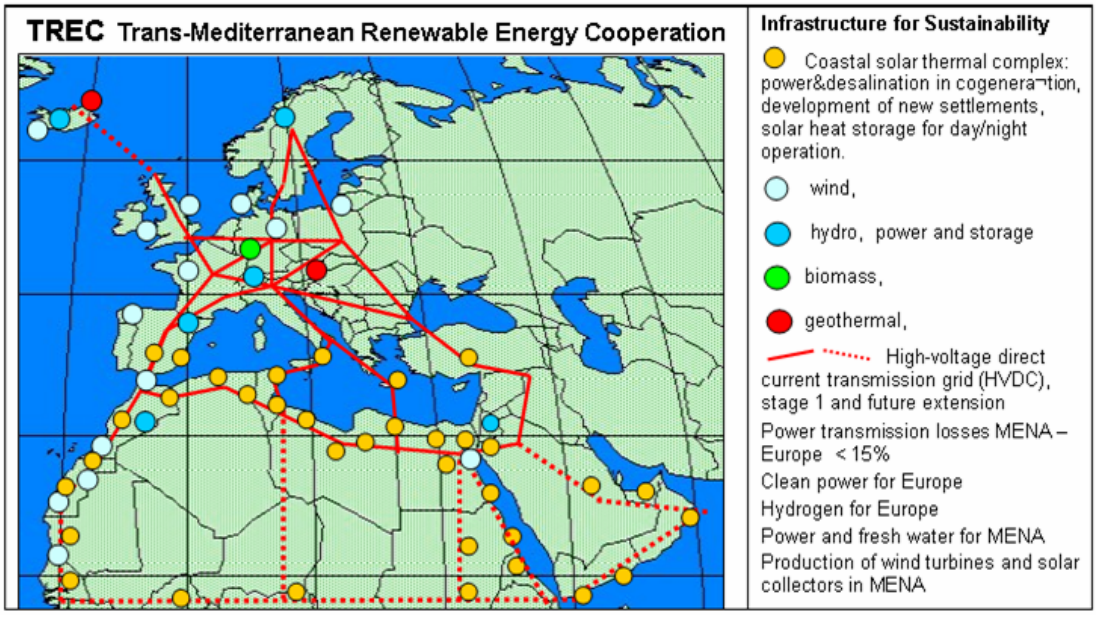
The Clean Development Mechanism (CDM) of the UN Framework Convention on Climate Change is the central mechanism which allows private sector funding of greenhouse gas reductions in developing countries to count against their own emissions. The standard trading unit is a Certified Emission Reduction (CER), which equals 1 tonne of Carbon Dioxide. Together with the EU Emissions Trading System both markets had a turn-over of estimated $30.4 billion in 2006[6]. This has more than doubled from 2005 ($12.7 billion). These figures represent additional low carbon investments, which did not exist just a few years ago. CER from developing countries accounted for around $5 billion of last year's trades. Many areas in South America and Asia, especially

[5] Alone carbon funds are estimated to have raised $11.8 billion of capital so far (New Carbon Finance).
[6] Point Carbon

China, are profiting from this. Unfortunately, CDM has had a difficult start in Africa. Out of 645 registered CDM projects as of early May 2007, only 16 are in Africa, of which 7 in South Africa and 7 north of the Sahara. This needs to change via African states winning a greater market share and realising this new market potential.

Another emerging market is carbon-neutral energy generation. Upfront investment especially for solar but also for wind remains comparatively high. However, costs decreased dramatically over the last years as technology progressed and demand increased; solar power is already economic compared to most off-grid alternatives in Africa.

African countries have very large resources for carbon neutral energy, especially as the sun-radiation and the wind potential is so huge throughout the continent. Increased demand for clean energy might also come from Europe. This could lead to more business opportunities, especially for north African countries, for example through the Mediterranean EU cooperation of MENA. The trade winds of southern Morocco may be harnessed to generate additional supplies of electricity. This 'clean' electricity could be transmitted via High Voltage Direct Current (HVDC) transmission lines throughout the EU. Additionally, some studies predict that up to 10-25% of Europe's electricity may be clean power that is imported from the African desert in the future. Countries such as Egypt, Algeria and Morocco have already shown strong interest in the Trans-Mediterranean Renewable Energy Cooperation (TREC) and its flagship project DESERTEC (Knies 2007; see also chart below). Some of these projects sound futuristic, but much of the technology exists today. Finally, the hydroelectric power potential in Africa is huge. Especially around the tropical regions of the Congo this represents an untapped resource. Africa's wind, water and sun-light are renewable resources which could greatly contribute to a more global sustainable energy generation.



One of the biggest missed opportunities of African countries – and indeed many fully developed nations – has been the ethanol market for transportation. Triggered by the elevated oil prices of the 1970's, Brazil ventured into an ethanol program based on sugar cane in order to diminish its dependency on oil imports. The country achieved this. Brazil saw their gasoline consumption decrease since the 1970's. Ethanol provides around 40 % of Brazil's non-diesel fuel. The whole world's use of alternative fuels for transport is a mere 1% in comparison.

Brazil's sugar cane production benefits from the country's favourable conditions, which include strong rainfalls, large areas of cultivatable land and cheap labour. These are clearly all conditions which could favour ethanol production in many African countries – South Africa, Malawi, Mozambique, Tanzania and Zambia. Like many others, these countries also saw their costs for oil imports dramatically increase over the last years. Ethanol would have made clear economic sense. However, there are some problems with ethanol, also. Most of them are structural. Protectionism of food products in the developed world limits ethanol's export potential. These market barriers distort the price. Also, fears exist that a rush for ethanol would cause disruptions to food production in African countries. Lastly, large upfront infrastructure investment is needed in order to proceed with the introduction of ethanol. Despite of all these challenges, ethanol is a real economic-sensible bio-fuel alternative.

Around 10% of global forest land is in Africa. This is despite the fact that over the last decades the African continent experienced rampant deforestation mostly through logging and expansion of cultivatable land. The logging process has been so ferocious because a standing forest has had little commercial value. This needs to change and forest areas must begin to reflect the true value that they possess. Trading forest land through carbon credits is one way forward. However, accreditation and surveillance of this system involves costs which make it at current prices less attractive. At least in the short-term there is the necessity for government intervention through regulation. Several state initiatives on deforestation exists regionally and internationally. 'The coalition of rainforest nations' is beginning to form itself into an international player. Various aid packages for rainforest conservation exist, also. A recent announcement by the UK Government of an £800 million allocation for environmental transformation includes a £50 million package, which is earmarked to support avoided deforestation in the Congo basis. These should be seen as intermediate steps, before forests can fully reflect their true value for the global eco-balance through market mechanisms.

Combating the continent's own greenhouse gas emissions is the last of the four points, because on a global scale Africa's total as well as per head emissions are still negligible. Also Africa's historical contribution to the problem is minimal. Nevertheless, the issue will need to be addressed in the future.

Just like global carbon emissions, Africa's emissions have ten folded over the last century. Today, Africa's carbon emissions are around 800 million tonnes per annum. This roughly equates to those of Germany. Not surprisingly, the greatest carbon emitters are located in the most developed countries of the continent as well as those who extensively engage in the oil exploration business. South Africa and Nigeria account for about half of Africa's emissions, with South Africa having by far the greatest share.

South Africa's power company Eskom will be key. Eskom generates nearly two-thirds of the whole of Africa's electricity and is extending its customer base north into the sub-Saharan neighbours. 90% of this energy comes from coal burning. Coal burning represents one of the most carbon-intense forms of energy generation. Several coal-burning emitters in Europe, the US and China are beginning to test carbon-capture and storage technology. In order to make coal-burning long-term sustainable, this technology will have to be mainstreamed – also in Africa. Gas flaring in the oil-rich west and north regions of Africa account for another large proportion of the continent's emissions. Nigeria alone is responsible for almost 20% of global gas flaring emissions. Here, also, carbon-reducing technologies do exist. It is a question of how to make these competitive through state incentives or carbon-trading mechanisms.

Conclusion

Ideally, future African development should embrace the green challenge and not repeat the environmental mistakes of the developed world. This aim must not come in the way of the African countries' rights to develop. Growth is the best means to reduce vulnerabilities to climate change impacts. However, it should be economic growth, which is sustainable and not one, which only piles additional cost onto future generations. International aid can play an important role in this transition via alleviating the costs of some of the immediate climate change impacts as well as via long-term information and technology transfer. Aid will increasingly have the additional aspect of being 'climate proofed'.

But Africa's real potential is in its own capacity to adapt and take advantage of new global opportunities. Many of the climate changes will occur over the coming years and decades. Prudent planning can alleviate the worst. The continent could even gain from positively embracing the 'brave new world' of climate change. Its potential to better use its green energy opportunities is huge. This needs to be tapped as a new resource in the quest for sustainable growth. As Desmond Tutu stated (Tutu 2007), the worst that we can do is to fall into a state of 'fatal complacency' on the issue of climate change. The faster we recognise this, the better.

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