Southern Agricultural Growth Corridor of Tanzania

Appendix VIII:

Environmental Management and Climate Change

Draft

EXECUTIVE SUMMARY

This paper reviews how SAGCOT will approach environmental management and climate change concerns. The report is in three main parts.

Part A reviews conventional environmental concerns. SAGCOT will be guided by the provisions of the 2004 Environmental Management Act and an ecosystem approach. Special areas of concern include land, water, biodiversity and wildlife, forests and hazardous material. There is a range of management options to mitigate or avoid the problems and negative impact. They includes improved land use planning, better land management, respecting protected areas, responsible design of infrastructure, awareness of health hazards, improved catchment and groundwater management, and suitable human settlement planning. Management responses will be guided by both the Precautionary and the Polluter Pays Principles. There will be emphasis on general responsibility of all partners for environmental management, but with distinct accountability for specific actions and their impact.

Part B looks at current climate change and carbon emissions and proposes actions to prepare for the future. Although there is great uncertainty on exactly how future climate change will impact Tanzania, it is clear that (i) Tanzania is currently poorly prepared for existing 'extreme climate events' (floods and droughts); (ii) despite uncertainty, actions can immediately start to improve preparedness, resilience and adaptation capacity; (iii) many of the required preparatory measures are essentially good farming and land management practices; (iv) the threat of climate change underlines the importance of taking immediate and strong action. Tanzania is currently a low carbon emission country. There are opportunities to 'lock in' the agricultural sector into long term systems that will allow profitable agricultural growth and maintain low emissions.

Part C sets out the environmental review process that SAGCOT will follow as it moves from plan to investment and from investment to implementation. This will start with a Strategic Environment Assessment (SEA) to provide an overview of the main issues and indicate the need for specific actions. Subsequently, as planning proceeds, each cluster will require an Environmental Impact Assessment (EIA), conforming to the Environmental Management Act as well as more recent regulations of the National Environmental Management Council (NEMC). The responsibility for limiting environmental damage and for respecting existing regulations lies very clearly with the investors. The SAGCOT Secretariat will be able to provide investors with initial guidance, contacts and advice on the necessary process.

1. INTRODUCTION

This paper is part of the preparation of the Investment Blueprint for the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). After the introduction, there are three main parts. **Part A** reviews environmental concerns and options to mitigate or manage the problems. **Part B** looks at current climate change predictions and preparations for the future. **Part C** describes the environmental review

process that SAGCOT will follow as it moves from the Investment Blueprint to investment and implementation. There is a short conclusion.

1.1 The Background

At the start of the twenty first century, very few people on earth live in a pristine environment. For the past 10,000 years mankind has used and modified the environment and natural resources for development and growth. Tanzania has a rich endowment of natural resources. It also has a rapidly growing population that might reach 110 million by 2050. This population's well being is threatened if the environment is not properly managed. The environmental demands of future development will jeopardize basic ecosystem services and the country will run out of replicable natural resources.

Currently, population pressure is relatively low in many parts of Tanzania. But there are already signs of widespread degradation, shortages of water and fuel, overgrazing and erosion. If this happens with 40 million Tanzanians, much worse will be to come when there are 110 million.

The climate is another natural resource that needs attention. Tanzania has an excellent climate. However, Tanzania and Tanzanians are increasingly affected by extremes of climate, especially drought and floods. For example, the 2005/2006 drought cost Tanzania 1% of total GDP (Dfid, 2010).

Solutions to these complex problems, which include compromises between the different interests, are now required. Some important choices are now needed if Tanzania is to manage the environment and natural resources in a sustainable manner. Implementing the wise choices will not be easy, as it requires strong leadership and firm discipline. SAGCOT can help play a part in this process.

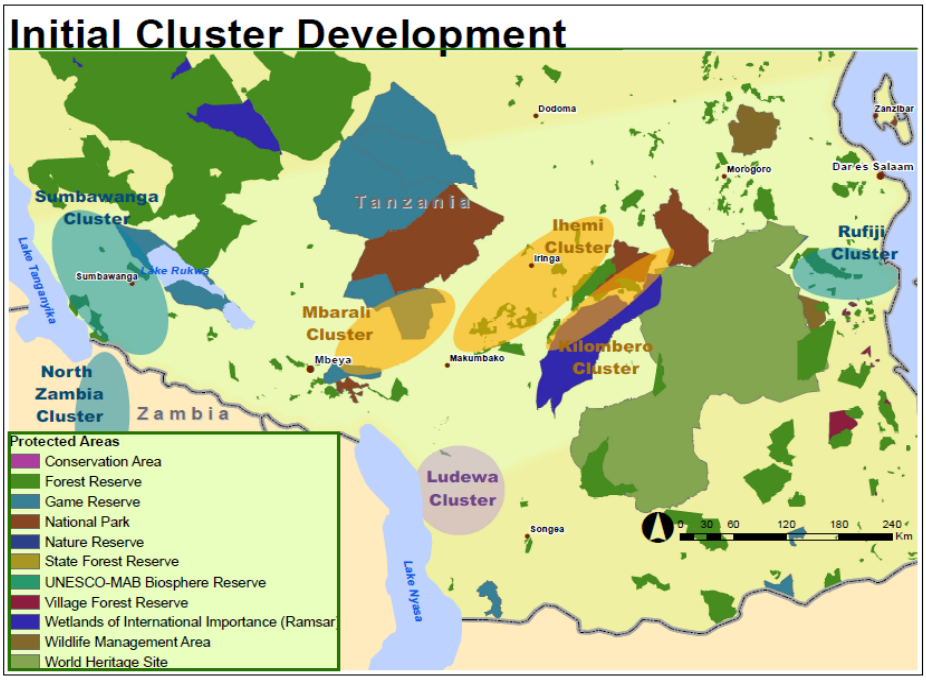
1.2 SAGCOT

SAGCOT's aim is to expand and develop the Southern Corridor as a cohesive, modern commercial agricultural area over the next twenty years. The outcomes will be growth in modern, commercial agriculture and a new force for rural development and poverty reduction.

The Southern Agricultural Growth Corridor of Tanzania will better link the high potential agricultural areas of the Southern Highlands to local and export markets. The corridor is based on the central 'spine' of existing road and rail infrastructure. SAGCOT brings together many different organisations to develop a private sector-led approach to agricultural growth and is recognized as a way of implementing the national *Kilimo Kwanza*[1] initiative.

SAGCOT proposes a set of investment areas, the Clusters, which are identified on the basis of commercial development potential for agriculture. However, rural poverty reduction, food security and environmental management are additional factors that have been considered.

[1] "Farming First" - a proposal for private-sector led agricultural growth coordinated by the Tanzania National Business Council



It is necessray to balance the advantages of new investment in agricultural against the wise, sustainable use of natural resources. The Government has established the legal framework, but it is for the investors and implementers to take the necessary action. The private sector must shoulder the responsibility for managing the environment in a sustainable manner and preparing to respond to climate change.

SAGCOT's investment in the cluster sites will strengthen selected agricultural value chains. This will link inputs (fertiliser and seeds), production, finance, infrastructure, processing and markets. Some modern agriculture is already underway in the initial cluster sites. The clusters will also include many small-scale and emergent farmers[2] who will become important partners in the operations. Figure 1 (need to add Katavi and Mahale NPs) shows the initial general SAGCOT Cluster Areas. SAGCOT activities will take great care to respect the protected areas as well as the associated ecosystems, sensitive habitats and other areas important for biodiversity. The specific details will be determined during the Environmental Impact Assessments of each cluster (see Section 6.2).

[2] This will include Non-Farming Land Owners (NFLO) - a large group on individuals and institutions who are not yet making productive use of titled agricultural land.

PART A - ENVIRONMENTAL ISSUES

2. SAGCOT's Approach to the Environment

This section outlines the general environmental concerns and potential hazards that could be expected during planning and implementing SAGCOT Cluster development.

SAGCOT's environmental strategy is based on an ecosystem approach, and the precautionary principle of identifying potential problems before they become real problems. The Polluter Pays Principle will also be applied, acknowledging that investors are financially and legally responsible for the costs of mitigation and rehabilitation.

Local degradation of land, forest, wildlife and water sources is already a problem in many parts of the Southern Highlands. Combined with rural poverty, this constitutes a significant, simultaneous danger to both the environment and future economic growth. Poverty is a key driver of environmental degradation: it also increases a community's vulnerability to climate change. Reducing rural poverty therefore will help improve environmental management, which in turn will stabilise the resource base for poverty alleviation. However, if not properly managed, work on reducing rural poverty can pose threats to the environment through unsustainable use of land, water and forests. There are therefore difficult decisions that need to be made.

Considerable work is underway to improve natural resource and environmental management in the Southern Highlands. This includes national parks and game reserves, forest reserves, RAMSAR sites for wetland management, Participatory Forest Management activities, Conservation Agriculture Projects and River Management Boards, and a wide range of NGOs working on different environmental projects.

Each SAGCOT partner will be expected to be responsible for environmental concerns, and will be required to cooperate with the ongoing environmental management activities in their cluster area. The first priority will be to respect existing environmental laws and regulations. But SAGCOT and its partners will also need to go beyond this and develop a culture of respect for the landscape, the ecosystem and natural resources. In this way 'the environment' will not be just a box to be ticked to satisfy regulations, but a basic way to thinking and acting. It needs to become an integral part of SAGCOT planning and implementation.

The world warmed by about 0.7°C in the 20th century. And despite 20 years of international meetings and negotiations, the planet is still on a "business as usual" emissions trajectory. This will be catastrophic for humans (though not for the planet). While SAGCOT cannot change the overall situation, it can work locally within the corridor to increase awareness of the problems, and act on measures that can be immediately implemented to improve preparation, resilience and adaptation.

To succeed, SAGCOT's environmental and climate change responses must be practical and affordable: neither complex nor highly technical. The options and consequences of the different development

actions need to be clearly assessed and understood by all involved. The benefits, risks and disadvantages must be carefully evaluated. Responses must consider the range of legal, ecological, social and economic aspects and requirements of each situation. There needs to be general responsibility for wise environmental management, but distinct accountability for the decisions and their consequences.

2.1 Land

Land is a basic ingredient of agriculture. It is often assumed that Tanzania is a land-rich country. There are, indeed, large areas of unused and under-used agricultural land. However, not all this land is actually available for commercial development, especially in high potential areas. Understanding the details and complexities of this situation is difficult. Reliable information is scarce and the issue is, understandably, highly sensitive.

Current estimates suggest that there is about 7.5 million ha of potential arable land within the Southern Corridor. Of this, about 2.2 million ha is cultivated. Only a very small portion of this land has been surveyed and registered with a Certificate of Occupancy.

Accessing Land: Due to the difficulty of accessing unused land, the first phase of SAGCOT will focus on land that has already been surveyed and registered for agricultural use. These are areas of land that already have a Certificates of Occupancy of the Land Act No 4 of 1999, or title through the local *Hati ya Kimira* system of the Village Land Act No 5, also of 1999. Associated with these focal points in each cluster will be the many established small scale farmers and neighbouring emergent farmers. They will have the opportunity to participate in SAGCOT. The mixture of large, medium[3] and small-scale farming, all working together towards the same objective, will be a central theme of the SAGCOT approach.

The development, or redevelopment, of these agricultural areas is already an established part of government policy. SAGCOT is therefore both implementing a policy as well as providing a practical response to Pillar 5 of the *Kilimo Kwanza*.

SAGCOT investment will target only agricultural land, not protected areas or pristine environments. Neither, knowingly, will they be unprotected areas of importance for special natural habitats or endangered species.

Inevitably investments will bring environmental changes to the land. SAGCOT's investors must take all the necessary steps to minimise negative impact on ecosystems and local communities. The intentions are (a) to improve and stabilise the agricultural environment, (b) not to damage the natural environment, and (c) to reduce rural poverty. These will be factored into the Environmental Impact Assessments to be undertaken for each cluster (see Section C).

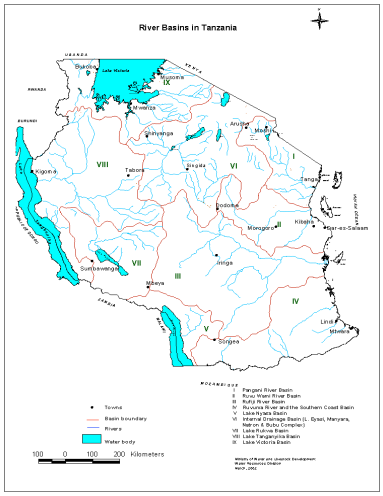
[3] This will include Non-Farming Land Owners. They have land but are not currently using it. They will usually have little experience in farming or land management. They will be in need of considerable technical assistance to ensure they do not damage the environment.

In subsequent phases, SAGCOT will explore opportunities for developing new 'greenfield' sites. However, the extent this can be developed will be dependent to the rate with which the government - the legal owner of all land in Tanzania - can further clarify the current legislation, and establish effective Regional Land Banks[4]. Currently in the five regions involved with SAGCOT the Regional Land Banks have some 112,000 ha on their books, though most of this is relatively small plots of land, which offer limited opportunity for commercial development.

Land Use Planning: Tanzania currently lacks a Land Use Planning (LUP) System that incorporates all land-using sectors and makes the information accessible. This is a basic tool in planning the wise use of land resources that requires considerable further attention. Some village and Districts LUP is underway supported by the Agricultural Sector Development Programme. SAGCOT will work with this initiative in the clusters.

Land Management: Good land husbandry and the maintenance of soil fertility and structure will be essential elements in SAGCOT development. Enough is known about the negative long-term economic effects of poor land management to ensure this is now acknowledged as bad farming and bad business. As SAGCOT will initially work only on existing farms and land with Certificate of Occupancy, there will be little need to clear primary vegetation. However, as some of the farmland will not have been recently cultivated, a certain amount of clearing of secondary bush and regenerating fallows may be required.

Figure 2: Main Rivers and Catchments



Source: Ministry of Irrigation and Water Development

Many of the soils in the Southern Highlands are acidic. They will therefore be particularly sensitive to increased, long-term fertiliser applications. However, the current high costs of liming are expected to be

[4] The Tanzania Investment Centre is no longer operating a Land Bank system. This has been devolved to the Regional Administration.

reduced through the development of a commercial lime deposit near Makombako. Monitoring soil pH will be an important part of environmental monitoring, though it is also an essential agronomic practice.

2.2 Water

The first phase of SAGCOT development will include both dryland and irrigated production systems. The cluster sites will also concentrate water demand for domestic and commercial use, such as processing.

It is frequently assumed that Tanzania has ample supplies of available water. But this is not an unlimited resource and water use must be properly planned and carefully controlled. There are increasing demands on existing supplies, even in rural areas. Uncontrolled use of water cannot continue. Improved planning, water charges and stronger controls on extraction will all be needed to protect the long-term surface and groundwater supply.

The main catchment in the SAGCOT area is the Ruaha/Rufiji, though some of the Ruvu/Wami catchment in the north east and Lake Nyasa and Lake Tanganyika catchments drain the western end of the corridor (see Figure 2). The office responsible for regulating quantity and quality of water resource use is the Rufiji Basin Water Office (RBWO), based in Iringa. Under the Ministry of Water Resources and Irrigation, the RBWO covers the whole of the Rufiji basin, from the headwaters to the sea. Water rights specify water quantities that may be abstracted and water use fees payable. Applications for water rights for a project should be based on technical studies of available resources, hydrological impact and downstream and instream users needs to ensure that water resources are equitably shared. Self-monitoring and reporting of abstractions and return flows will be an important part of the regulatory process. However, although the capacity of many Water Offices has increased, there is still a considerable number of illegal large-scale and small-scale water users which will jeopardize future flows.

There are also three important wetlands and flood plains in the SAGCOT area, the Kilombero Floodplain in the Kilombero Cluster, Usangu Flats in the Mbarali Cluster and the Rufiji Delta in the Rufiji Cluster.

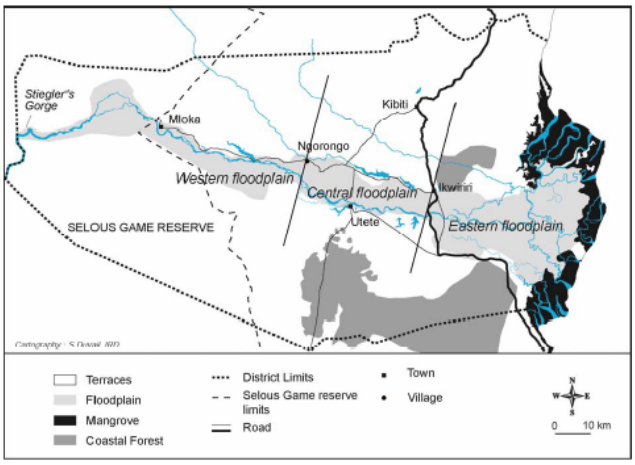
An illustration of current water management problems is provided by the Great Ruaha River. The detailed implications of this are clearly shown by the situation in the Usangu Plains.

Farmers in the Usangu Plains grow 200,000 tons of rice each year, which is about 20% of Tanzania's total production. Crop production is mainly through supplementary irrigation during the wet season. Up to 42,000 ha of rice is grown, though area depends on each year's river flow.

The 20,800 km^2 catchment of Usangu forms the headwaters for the Great Ruaha River (see Figure 3, Source, SMUWC, 2009). The area's rich alluvial fans provide ideal soils for agriculture and the adjacent swamps are important wildlife habitat and dry season grazing for livestock. Downstream, the Great Ruaha feeds the Mtera and Kidatu dams, which provide over 50% of Tanzania's hydro-electricity.

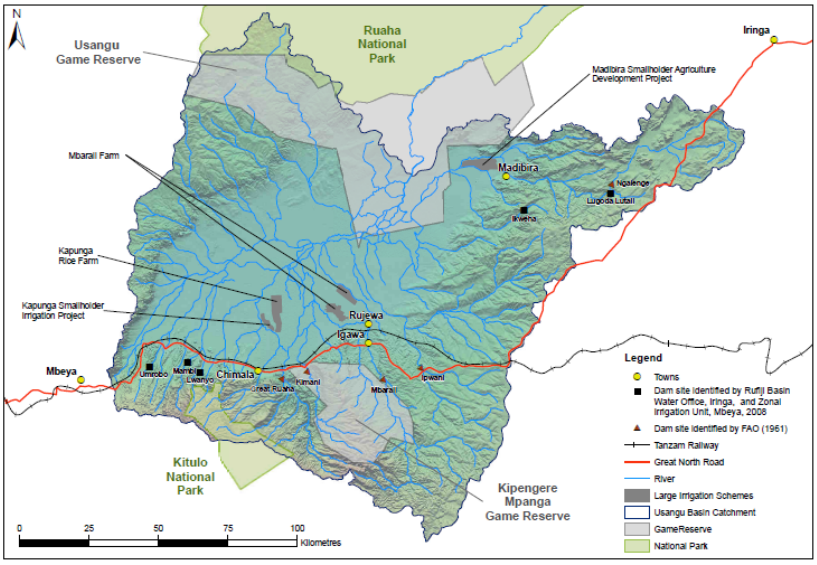
The hydrology of the plains has been studied in detail (SMUWC, 2002). Wet season flows into Mtera decreased by 5% between 1980 and 2000. Traditionally a perennial river, the Great Ruaha temporarily

stopped flowing in the dry season in 1993. This has been repeated almost every year since, which poses a threat for downstream wildlife populations and tourist economy of the Ruaha National Park.



The underlying problem is open-access use of land and water, coupled with inadequate incentives for systematic management. Local resistance to change is strong. Consequently, short-term personal interests prevail over long-term requirements. When the SMUWC team presented their analysis there were accusations of 'voodoo science', as the proposals were contrary to local short-term interests. The problem is further exacerbated, in the eyes of the local population, by the annexation of significant area of land gazette as a game reserve. This increases the pressure on the remaining available land.

If these problems could be overcome, with improved management there is the theoretical potential to increase the irrigated area by up to 10,000 ha, especially during the dry season. This would require improved irrigation efficiencies, shorter-season rice varieties, improved timing of planting and disciplined water management. However, the process for land allocation is far from clear and this would also result in further reduction of the flows into the Mtera reservoir as well as additional reduction in wildlife habitat and dry season grazing.

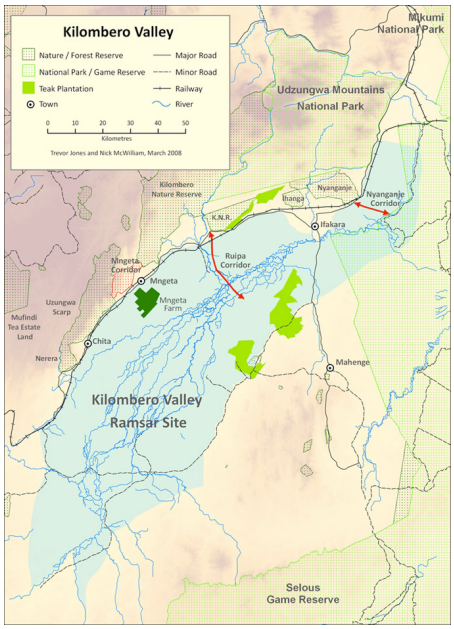


The Rufiji Delta (see Figure 4: Source Hammerlynk *et al*, 2009) - downstream from the Ruaha, is another area where realising the apparent potential may not be as easy as initially appears. The Rufiji is one of Africa's largest rivers with an annual mean flow of 800 m^3/sec. The delta holds one of the largest stands of mangroves in East Africa. The area has been viewed with potential for development for nearly 100 years. In reality, mainly due to hydrological and soil characteristics, the potential for large scale irrigation schemes is not as great as it superficially appears. A recent review of large scale irrigation potential in the Rufiji has clearly set out the limitations (Hamerlynck *et al,* 2009*).* SAGCOT should therefore proceed with considerable caution in this area.

These two examples show that when assessing access to areas for irrigation, SAGCOT investors will need to work with a wide range of organisations: local villages, regional government, Water Boards, River Basin Development Authorities and the National Environmental Management Council (NEMC).

Priorities must be established and difficult choices must be made.

2.3 Biodiversity and Wildlife



Tanzania has a worldwide reputation for its wealth of wildlife. Approximately 25% of the country is already set aside for the protection of nature. Within the southern corridor, wildlife provide significant local and national revenue, particularly through tourist visits to the Selous Game Reserve (a World Heritage Site), and the Mikumi and Ruaha National Parks. There are also many game reserves and forest reserves, and a number of wetlands protected under the RAMSAR Treaty. In addition, there are Wildlife Management Areas (WMA) which aim to involve local communities in the management and revenue sharing from wildlife management (see, for example, Paulo, 2010).

The initial phase of SAGCOT will work only on titled farmland. It is therefore very unlikely there will be any direct threat to biodiversity, wildlife or natural ecosystems. However, as the saga of the Kihansi Spray Toad has shown, this should not automatically be assumed. A site-specific review of bio-diversity resources and possible threats, to both habitats and species, would be included in each cluster's EIA (see Section C).

With an interest in developing irrigation, SAGCOT is inevitably drawn towards wetland areas. Of course SAGCOT is not the first to look in this direction. In all wetland areas (as already shown by the Usangu example in the previous section) there is already strong competition for resources. The current situation in another wetland zone included in SAGCOT - the Kilombero Floodplain provides an important example of the competition and the conflict between agriculture and nature (see Figure 5, Source: RAMSAR).

Currently, the valley is being farmed by small and large scale farmers, and investors are looking at opportunities in the area. There are also many small local reserves along the floodplain and a RAMSAR site[5]. Most of the west side of the valley is either cultivated or under some form of legal protection. While there is some control on the expansion of large investments through EIA requirements, small-

[5] In August 2000 Tanzania ratified the Ramsar Convention of Wetlands and in April 2002 the Kilombero Valley Flood Plain Ramsar site was established. The Government of Belgium is working with Kilombero and Ulanga Districts to develop an Integrated Management Plan for the area.

scale farmers have no such constraint. Consequently there is a proliferation of unregulated small-scale plots and illegal offtake structures. This results in significant local increase in production. But it is also an uncontrolled and unsustainable resource use system. Many of the new small-scale farmers - especially between the Udzungwa mountains and the permanently flooded area of the valley - are strangers coming in from outside.

The lack of a comprehensive Land Use Plan to provide the basis for rational resource allocation and conflict resolution is complicating the situation. With support from the Belgium Government, there are plans to establish an Integrated Land Use Plan for the Kilombero floodplain. This should include not only protected areas and existing farmland, but also areas that have not yet been developed or officially protected. Investor Guidelines and tighter local regulation of land and water use will also be needed. The Kilombero Plantations and Kilombero Valley Teak Company have provided example of responsible, large scale commercial operations that are established in the area and can contribute to this process.

2.5 Forests

Forests and woodlands are an important local resource providing household energy, building materials, medicine and cash income. However, recent growth in Tanzanian agricultural production has mainly been achieved by increasing total cropped area through deforestation rather than increasing yields. This serious threat to forests can best be resolved by improved modern farming techniques and increasing on-farm yields. SAGCOT will contribute in this process. A stabilised modern agriculture, with reduced need for itinerant slash and burn, will reduce the threat to forest and woodlands.

Different organisations manage protected forests. National and Catchments Forest Reserves are managed by central or local government. Local communities manage village forest reserves through the Participatory Forest Management system.

As with the major wildlife areas, SAGCOT investments will not include or impact on protected forests. It is, however, possible that areas under community-controlled Participatory Forest Management (PFM) may be near cluster sites. This could prove beneficial as SAGCOT will recognise the importance of these areas and could provide support to neighbouring local communities. This would be seen as part of the overall land management and ecosystem approach to be used when looking at the clusters.

2.6 Hazardous Material

Modern commercial agriculture involves increased use of agricultural chemicals. This brings very specific risks to those handling the chemicals, to the waterways and to the general environment. For the most part, due to ignorance of the danger or lack of supervision, agricultural chemicals in Tanzania are not handled in the appropriate manner. The agro-chemical industry is aware of this risk and some organisations, such as CropLife, provide training in handling techniques and safety. These types of initiatives will need to be extended through SAGCOT.

2.7 The TAP Strategic Environmental Assessment

In 2009 the Tanzania Agricultural Partnership (TAP) commissioned a Strategic Environmental Assessment (SEA). The purpose was to integrate environmental issues into strategic decision making, assess risks and opportunities and to validate intended strategies regarding their environmental and social consequences, and sustainability. The SEA was guided by the National Environmental Policy, and conducted in accordance of the provisions of the Environmental Management Act No 20 of 2004, Sections 7 and 104 (2) and Sections 3 (a - e).

The SEA found that TAP operations are in line with all major Government policies related to economic growth agricultural development, poverty reduction. Furthermore, using an analysis of the 'no-project alternative' the SEA found that without TAP intervention '*farmers will continue to experience hardship in terms of limited access to inputs, credit facilities…. poor crop production and lack of access to fair markets. The situation would not relieve the rural population from poverty neither will it enable Tanzania to realise the economic benefits of its considerable agricultural resources. Some of the environmental problems and pressures on natural resources may continue, albeit at a slower pace and on a smaller scale. Indeed, there is a strong argument that without any improvements….the low-input, low-output slash and burn agriculture of many parts of Tanzania will continue to spread and environmental degradation will continue to accelerate. This will lead to further rapid forest depletion, increased soil erosion, decreased aquifer recharge and sustainable poverty*' (WEMA, 2010).

This is a compelling environmental case for well-planned agricultural development. It is also recognised that the implementation of TAP involves environmental and social impact. This includes:

Environmental factors	**Socio-economic factors**
○ Eutrophication of water bodies ○ Human health hazards ○ Biodiversity loss ○ Land degradation ○ Chemical contamination of food-chains ○ Ammonia volatization ○ Infrastructure expansion >> deforestation	○ Improved access to affordable inputs ○ Increased crop yields ○ Improved local food security ○ Increased household incomes ○ Improved rural infrastructure

The SEA established the basis for future district-level Environmental Impact Assessments (EIA) which will be followed up at the District level. Further details of the SEA and EIA process for SAGCOT are presented in Chapter 8 in Part C of this report.

3. MANAGING THE ENVIRONMENT

This section outlines some of the practical measures to minimize negative environmental impact. Under the Environmental Management Act of 2004 the responsibility for implementing such actions clearly lie with those who will be financing and implementing the field activities.

Because 'the environment' is often perceived as a common good belonging to all, it often gets abused and misused, because no one takes the lead tackling the problems. Improved knowledge, traditional

culture and intrinsic goodwill can all help overcome the difficulties. But there needs to be both a sense of general responsibility as well as some very clear, distinct accountability for taking action. All too often, short-term economic interests override the weaker incentives for wise long-term resource use. Education, awareness and innovation all help overcome this constraint, but rules, control and discipline are also essential.

3.1 Mitigating Environmental Hazards

Mitigation actions will be based on (i) existing legislation and regulations, (ii) good understanding and knowledge of the risks, (iii) good understanding of the measures to be taken and their benefits and, (iv) heightened personal, community and corporate responsibility and accountability. The plans and the actions must also be simple. If they are complicated or costly little will be achieved[6].

(i) Land Use Planning[7]: The Agricultural Sector Development Programme (ASDP) is working with Local Government Authorities and the Ministry of Land, Housing and Human Settlement prepare District Land Use Framework Plans (DLUFP) and Village Land Use Plans (VLUP). These are limited to agriculture, forestry and human settlement. In addition, as discussed in more detail in Section 5.2 the World Economic Forum is considering a Financing Sustainable Land Use Project in Tanzania that will focus particularly on lowering carbon emissions.

The general lack of reliable land use planning creates a significant weakness in planning wise-use of natural resources, in identifying areas for future agricultural potential, and in protecting biodiversity. Improved land use planning systems would provide a transparent framework for development planning as well as helping to reduce the risk of damage to important natural habitats and fragile ecosystems. It will need to link the different sectoral aspects of land use - including water and catchment planning, protected areas, forestry, dryland and irrigated agricultural development, urban settlement.

Without these plans, development proceeds in a haphazard manner; driven more by personal and political preferences than by a coherent and disciplined vision of future growth. This is well beyond SACGOT's mandate. However, at every opportunity SAGCOT should endeavour to cooperate with those working towards this goal.

(ii) Eutrophication of water sources by fertiliser run-off: Guidelines on transporting, handling and using fertiliser will need to be developed and training programmes expanded to ensure that everybody involved understand the hazards and the necessary precautions to keep damage to a minimum.

Improved soil and water conservation systems - including minimum tillage, agro-forestry and conservation agriculture - will all help reduce eutrophication risks from fertiliser run-off, as well as maintain soil fertility and soil quality. Particular attention will be required in irrigated areas. Loosing fertiliser into the waterways, rather than retaining it in the soil where it is available for plant growth, is not only bad for the environment, but careless farming and uneconomic.

[6] For example, the case of Farm Dam EIAs mentioned in Chapter 6.2.
[7] For more information see the SAGCOT Land Development Issues Paper.

(iii) Biodiversity Loss: There are substantial areas of National Parks, Game Reserves and Forest Reserves within or near to the general cluster areas. Expanding agriculture poses a constant threat to these areas. By encouraging modern farming systems, SAGCOT increases the chance of stabilising shifting cultivation, and reducing the threat from agriculture to protected areas.

The Puku, a small swamp-living antelope (*Kobus vardoni)* provides an example of the speed with which environmental conditions - especially the spread of agriculture - can change the status of a species. In 1982 there were so many Puku in Tanzania that cropping schemes were proposed (Kingdon, 1982). Thirty years later, although Puku are still found in the Kilombero Valley, it now has a 'Near Threatened' status on the IUCN Red Data list.

Outside the protected areas in and around the Clusters the EIA will assess the biodiversity resources in the ecosystem and assess likely impact of proposed SAGCOT investments. Appropriate mitigation measures would then be designed and implemented. A simple monitoring process would also be established to track future changes and challenges.

(iv) Infrastructure: Before any major infrastructure investments are undertaken an EIA will be required. It is important that the level of detail and cost is appropriate for the scale of investment. For example, there are recent cases where cost proposals for EIAs for farm dams have been greater than the cost of dam construction. It is important that the level of detail and cost is appropriate for the scale of investment. The investment should be reviewed form both the site-specific and ecosystem perspective. Any necessary mitigation measures will need to be incorporated into the engineering design and construction process.

(v) Health: The specific health hazards from transporting and handling agro-chemicals are important to the local population as well as to those directly involved in application. Guidelines need to be established and monitored for SAGCOT investments. Other aspects of environmental health - especially transmissible and water-borne disease - will need to be reviewed and monitored and site-specific mitigation measures adopted. The health aspects of increased settlement are discussed Section (vii) of this chapter.

(vi) Catchments, surface and groundwater:[8] Three important areas need to be considered for the possible environmental impact of water and water use: (a) soil moisture balance for rainfed crops, (b) river flow availability and (c) groundwater availability.

Changes in land use such as proposed by SAGCOT can significantly change water balances and water use patterns. Any environmental and social impact assessment should investigate the effect of abstraction on downstream water availability in relation to downstream users needs. Users include the instream ecological environment and users of environmental services provided by a water body. Long term

[8] Technical information provided by Peter Baur, Schlumberger Water Services (Shrewsbury, UK)

groundwater abstraction can lower the groundwater table locally or regionally, perhaps causing existing wells to dry up and reducing the flow of groundwater into water courses, reducing dry season flow.

(vii) Human Settlement: SAGCOT investment will encourage formal and informal settlement around the cluster sites. To as great an extent possible, settlement needs to be planned and implemented in a way to minimize environmental hazards and ensure a good quality of life for residents. In new settlements household water supplies and sewage must be properly designed and managed. In major settlements, appropriate school and health facilities will need to be established to service the new population. These facilities will inevitably attract additional informal settlement, so SAGCOT must develop clear and effective policies relating to this problem. While it is essential to maintain good relations with the local communities, improved social facilities should not be allowed to become an excessive burden to productive investments. This will require settlement plans that are developed and agreed with local community leaders and the relevant public sector authorities.

PART B - CLIMATE CHANGE

4. CLIMATE CHANGE PREDICTIONS

This chapter reviews current understanding of possible future climate change and carbon emissions.

4.1 Review of Climate Change Models

The threat of climate change is a complex technical issue that is turning into an equally complex political issue. There is uncertainty as to how this will impact on southern Tanzania. Under such uncertainty, the best approach will be a precautionary response-based on the best available information.

The Copenhagen accord was a non-binding document trying to keep the world less than 2°C warmer than in pre-industrial times. We wait to see if the Cancun meeting can make some real progress. But lack of international consensus among the world's leaders does not hold back a world-wide set of local initiatives to tackle the problems. SAGCOT can therefore have a role to help prepare for and respond to climate change.There are many different models predicting climate change in Tanzania, and they do not agree. However, a recent and thorough review has been undertaken by a group sponsored by the British Government (Dfid 2010). Among their main conclusions was that *'the projections show increases in temperature, but more variation for future rainfall, with possible increases or decreases in many areas. While this highlights the uncertainty in current knowledge, this is not a reason for inaction'.* Additional important points are:

- Tanzania has a complex climate with wide variations across country, but is very sensitive to El Nino (floods) and La Nina (droughts)
- The 2005/6 drought cost Tanzania about 1% of total GDP
- Net economic costs could be as high as 2% of annual GDP by 2030
- There has been an intensification of extreme events (droughts and floods) over recent decades and these may reflect a changing climate already.
- Tanzania it is not adequately adapted to deal with existing climate risks
- Vulnerability is likely to increase due to changing land–use patterns, rising population pressure and increased demands on land and water
- Tanzania should prepare a national adaptation strategy, get ready, and act now.

There is some agreement between the different models on temperature. It is possible there may be an average increase from 1^{o} to 3^{o} C by 2050. This would be greater in the north and north east parts of the country. Mean temperatures could rise by up to 5.2 ^{o}C by end of century.

Although all models show rainfall will change, there is no agreement on how it will change.

The study also notes "…. *the climate is changing already and the most striking conclusions is that the climate of 2030 (and beyond) is very unlikely to be the same as at present. It is essential to recognise this uncertainty, not to ignore it."*

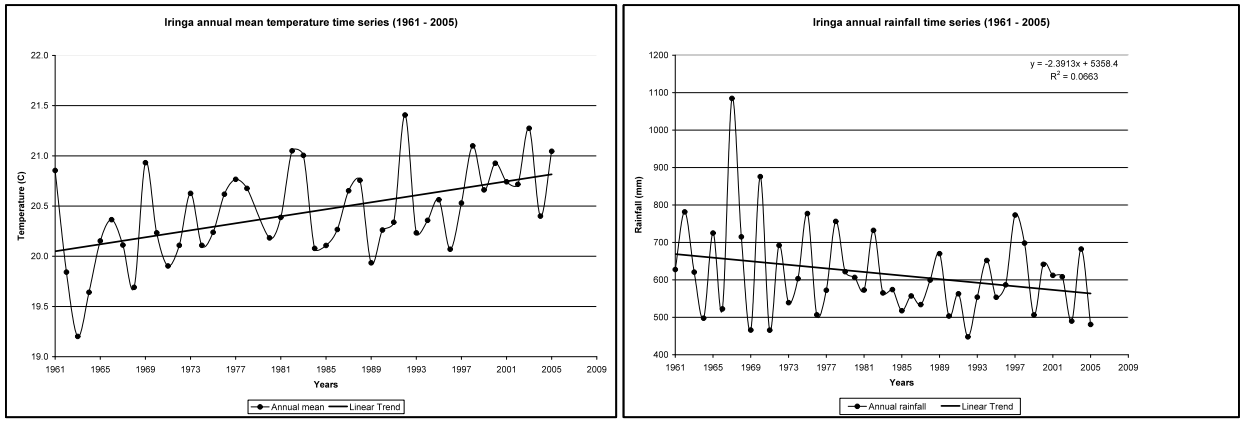
This uncertainty is very difficult to manage. The East African Commission Food Security Plan (EAC, 2010) notes that, whatever the predictions, key factors are: (i) inadequate food exchange and trade between times and places of abundant harvest and those with deficits; and (ii) high variability in production caused by high variability of weather which is becoming worse due to climate change.

Tanzania's National Adaptation Programme of Action (URT, 2007) predicts changes in the agro-ecological zone distribution. Changes in crop yields would also be expected, with some models predicting reduced maize yields by 33% nationally. Overall crop models applied to Tanzania, as part of an East African analysis reveal mixed patterns in the region and strong differences between areas within the country, with some areas showing higher yields or potential for new crop varieties, whilst other showing negative effects .

A recent study by IIED (2009) also reports on the effects of climate change on agriculture in Tanzania. They assess the climate data, finding rainfall patterns are expected to become highly variable across the country, with an increase in the north of 5 to 45 % and decreases of 5 to 15 % elsewhere: and that wetter regions are at risk of more frequent and severe flooding. Data was generated from a series of stakeholder engagements, and analysed via macroeconomic computer modelling. The social accounting matrix developed by the International Food Policy Research Institute for 2000 was used as a baseline. IIED suggested that the overall impact of climate change on Tanzania could be expected to be extreme, after shrinking GDP by 0.6-1.0 % by 2030. They advise that "f*armers will need to adapt to climate impacts over the next 20 years to avoid catastrophic future costs, but will need policy backing*."

Finally, the two graphs in Figure 6 shows temperature and rainfall changes in Iringa since 1961. These graphs illustrate great variability, but also an underlying pattern of change with increased average temperature and decreased average annual rainfall. This pattern might not continue, but the change should not be ignored.

Figure 6: Temperature and Rainfall Changes in Iringa since 1961



Temperature ***Rainfall***

Source: Tanzania Meteorological Agency

4.2 Carbon Emissions

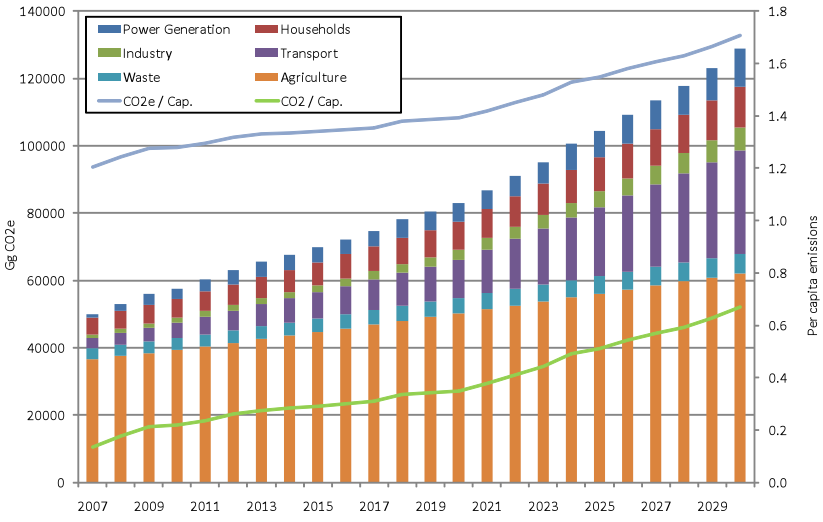
Tanzania currently has relatively low emissions of greenhouse gas emissions (both in total emissions and *per capita*). This is partly due to a high proportion of hydropower. The largest emitting sector is agriculture, primarily from emissions from livestock[9], followed by consumption of oil products in transport and industry.

As the population grows, and urban expansion and development accelerates, emissions are rapidly increasing. Using a simple projections approach, the Dfid Study estimated that GHG emissions would double between 2005 and 2030 (see Figure 7).

Most national and sectoral development plans for Tanzania do not take these concerns into consideration. The current planning process across the economy would 'lock-in' Tanzania into a higher emission pathway. The Dfid study notes *"the increases from the transport, agricultural and electricity sectors, and the associated increase in national emissions, would occur at exactly the time when there are likely to be greater economic opportunities for international carbon credits, particularly if national level GHG mechanisms emerge. Following these higher carbon pathways will therefore lead to an opportunity loss. They could also lead to other economic, social and environmental costs: an example would be the congestion, higher fuel costs, greater fuel imports and higher air pollution that would occur unless private car transport is tackled."*

These assessments appear to ignore increasing recent evidence that intensification of agriculture can in fact offer a practical, low cost method of reducing emissions. (see, for example, Burney *et al,* 2010 and the discussion in Section 5.2). This is still the subject of considerable debate, and opinion seems to carry as much weight as scientific evidence. However, no matter what the eventual outcome, preparedness and adaption will be essential.

5. RESPONDING TO CLIMATE CHANGE



This section outlines possible responses to future climate change. As the details of the changes are not known, the details of the responses cannot be conceived. However, one of the few areas where there is agreement and certainty is that some basic preparation is essential and possible. There is also a short section on carbon emissions and possible future activity.

[9] Approximately 20 million cattle, 14 million goats and 4 million sheep

5.1 Preparations for Climate Change

The current low-input, low-output, low-technology, low-risk traditional farming systems used by about 90% of Tanzania's farmers leaves them highly vulnerable to climate change. They are not well organised or well-informed. They make little use of irrigation, improved seeds or basic mechanisation. Soil and water conservation techniques are not often applied and their market options are limited. Frequently choice of crops are grown is as influenced by dietary preferences as the suitability of the crop for agro-ecological conditions.

It is clear that, no matter what changes will happen, Tanzanian farmers and their husbands must be ready for the unknown, and able to provide their own responses. There are two elements to the response. The first increased awareness and improved information systems. The second is better resilience to changing conditions and preparation for adaptation.

According to the Dfid Study, Tanzania is *"not adequately adapted to deal with existing climate risks"* As increased difficulties from climate change can be expected, it is critically important to improve preparedness.

While SAGCOT cannot be expected to change the national preparedness, investors and implementers must make plans and be ready to work with others to contribute to improved readiness. In this context, the Dfid study has identified four categories of adaptation. They are:

- Accelerating development to cope with existing impacts - such as integrated water management, electricity sector diversity, natural resources and environmental management.
- Increasing social protection, such as cash transfers to the most vulnerable following disasters, safety nets for the most vulnerable.
- Building adaptive capacity and institutional strengthening, such as developing meteorological forecasting capability, information provision and education.
- Enhancing climate resilience, such as infrastructure design, flood protection measures.

In practical terms, agricultural adaptation, can take place by (a) physical responses - such as dams, irrigation, zero tillage, drought adapted crops and livestock, water harvesting, irrigation, conservation agriculture, and by (b) behavioural changes - such as getting better organised, better informed, and better prepared for change. It should be noted that these are virtually all improvements that would be required for improved farming, with or without climate change.

These proposed adaptations are not new ideas. They are old ideas that now receive more attention due to changing circumstances. But to move these ideas into action requires new political commitment and strong leadership.

IIED (2009) has suggested there is a need for *'climate-proofing'* measures for Tanzanian agriculture. These would include policies to help farmers adapt over the next 20 years and steps to make farming systems more resilient. In addition, new supply chains for inputs, new marketing relationships, improved access to credit and better technology would be needed. However, IIED stresses that this requires a political will to match the vision.

In addition to providing a cost-effective response to carbon emissions (see Section 5.3), Tanzanian agriculture could also use climate change to its advantage by planning to respond to regional and global changes in market opportunities. It is not only in Tanzania where the climate is changing. Therefore some countries will lose capacity to produce certain crops which might in the future be better suited to Tanzanian conditions. This is a medium-term opportunity that needs to be studied and explored.

A key feature of all response measures is the need to build in flexibility. This requires adaptive management that based on learning by doing.

The Climate Change Adaptation in Africa (CCAA) research and capacity development program is undertaking work in Tanzania. Project activities include crop modelling to assess future climate impacts, and capacity building through extension and training efforts to reduce the vulnerability maize-based smallholder systems in selected local communities (CCAA, 2009). In addition, the Tanzania National Adaptation Programmes of Action (NAPA) has identified a number of projects related to agriculture, as shown in the box below:

The Tanzania National Adaptation Programmes of Action - NAPA

Initially, the NAPA proposed 72 project activities. Using criteria that best suits Tanzania conditions and local environment, these were later narrowed down into 14 priority project activities. These were further ranked in accordance with their importance regarding impacts, poverty reduction and health, reliability, replicability of the technique and sustainability. Of the 14 selected projects activities of interest to SAGCOT include:

1) Water efficiency in crop production irrigation to boost production and conserve water in all areas
2) Alternative farming systems and water harvesting
3) Develop alternative water storage programs and technology for communities
4) Community based catchments conservation and management programs

As SAGCOT is using an ecosystem approach to environmental management, an understanding of the Ecosystem-based Adaptation (EbA) approach might help respond to climate change issues. EbA aims to enhance ecological processes and services that are essential for resilience to multiple pressures, including climate change. This is a newly developed concept, proposed in the Dfid report, and more investigation will be required to see how it relates to possible use by SAGCOT.

In addition to the awaited outcome of the Cancun Meeting (current draft of this paper at 3rd December, 2010), there are other new initiatives which might be able to improve the detail of Tanzania's response. First, the World Climate Research Programme's CORDEX (Coordinating Regional Climate Downscaling Experiment) is establishing a system that claims to be able to improve predictions more accurately - reducing from 200km to 25 km resolution. Second, there is a new Global Framework for Climate Services (GFCS) being established which is intended to be a new "tool for climate action". Third, a recent assessment of the legal and institutional framework for agriculture (USAID, 2001) identified five areas where action could be taken:

- Help the Government if Tanzania rewrite National Adaptation Plan of Action
- Consider direct assistance to mitigation efforts (i.e., reforestation)
- Conduct a Water Property Rights Assessment & Irrigation Scheme Impact Assessment

- Conduct a Carbon Mapping Assessment
- Develop improve and spread information about climate change

Also, there is a new US$200 million fund being channeled through the Consultative Group on International Agricultural Research (CGIAR) that will focus on early warning systems to help farmers prepare for drought and better link to climate and agricultural research.

Only time will tell how effectively these different initiatives, as well as Cancun outcomes, will be in providing timely practical assistance in the field to Tanzanian farmers. However, it is not necessary to wait for these new operations to become effective, as there are many low-cost activities can take place right away under the existing programmes supporting improved agriculture and empowering local communities to take the lead in the management of their natural resources.

5.2 Reducing Carbon Emissions in agriculture

Following the failure of the climate change conference in Copenhagen, there is growing interest in the role of sustainable land use to reduce carbon emissions. The results from the Cancun meeting are currently awaited, but expectations are generally modest, especially as it appears agriculture will receive less attention than Kyoto renegotiations and forestry.

Nonetheless, it is increasingly recognised that agriculture has a significant role to play in climate change mitigation, and offers cost-effective opportunities that compete effectively with other mechanisms (see, for example, Smith, 2009). Recent analysis shows investment in agricultural yield improvements compares favourably with other commonly proposed mitigation strategies (Burney *et al,* 2010). It therefore follows that the type of modern agricultural development proposed by SAGCOT offers significant opportunities to contribute to reductions in carbon emissions. This is an important additional potential benefit that requires further investigation.

Some relevant work is already planned for Tanzania, with which SAGCOT might cooperate. For example, the World Economic Forum is considering targeting Tanzania through the "Financing Sustainable Land Use Project (FSLUP)". This project aims to catalyse wider private sector engagement in REDD+[10] and sustainable land use. The intention is to take specific steps to reduce carbon emissions. This may be one of the least expensive abatement options available, and one that has considerable widespread political support. It also has very clear direct links to SAGCOT. The Financing Sustainable Land Use Project aims to develop new models enabling policies and investments to be developed. The project will bring together businesses with government, civil society and scientific experts to take actions to attract private sector capital and engagement for sustainable land use objectives. Tanzania will be one of the initial focus countries for FSLUP, and it will be important that close links are developed between FSLUP and SAGCOT.

In addition, Yara is developing a Climate-Compatible Agricultural Growth Partnership for Africa which includes Tanzania. The intention is to scale up what already works through partnership and

[10] Reduced Emissions from Deforestation and Avoided Degradation.

dissemination of information. Proposals for the CC-AG programme will be presented to the WEF Meeting in Davos in January 2011.

There are therefore a number of opportunities to start to lock into low carbon emissions in Tanzania straight away. There are some 'no regrets' options, which would lead to future access to international carbon credits. These actions would be very much in the interest of Tanzania, from the economic, social and environmental perspectives.

PART C - THE ENVIRONMENTAL ASSESSMENT PROCESS FOR SAGCOT

6. THE ENVIRONMENTAL ASSESMENT PROCESS

Each cluster will undertake a site-specific Environmental Impact Assessment (EIA). This will cover the cluster area and associated ecosystems. Each EIA will be guided by the findings of an SAGCOT Strategic environmental Assessment (SEA). These are legal requirements provided for by the 2004 Environmental Management Act.

An important factor that Tanzania needs to address very quickly is that although, quite correctly, large investments in land and water development require EAIs the thousands of small scale developments - clearing forests for new fields and extracting water for small scale irrigation do not. Such is the pace of population growth that the combined impact of the vast numbers of the small-scale developments is having a massive, but uncontrolled and unmonitored, impact on the environment. There is little point in controlling a few large scale operations if the huge number of small ones, which are having a much greater overall impact, pass unnoticed.

6.1 The Strategic Environmental Assessment (SEA)

Strategic Environmental Assessment is a systematic process for objectively evaluating the environmental consequences of a proposed policy, plan or programme initiatives. This is needed to ensure adequate responses are fully included and appropriately addressed at the earliest appropriate stage of decision making. SEA process is important because it: (i) offers a cross-cutting perspective; (ii) promotes a strategic and integrated approach; (iii) discusses alternatives while options are still open; (iv) supports strategic decision making; and incorporates environmental issues and principles of sustainability in policy-making and planning process.

The SEA process for SAGCOT would start once the final Investment Blueprint has been approved. This will lead, in turn, to site-specific Environmental Impact Assessments for each cluster.

The Steps in the SEA Process

Impact Evaluation: The impact evaluation based on assumed existing conditions and absence of any mitigation measure. The evaluation considers the major groups and individuals affected, likely significant effects on the environment (short-, medium-, and long-term effects), and the nature of impact (positive and negative).

Cumulative Effects Assessment: Discussions of significant environmental impacts include predicted environmental impacts (direct, indirect, and cumulative) that may occur from the implementation of alternatives. The cumulative effects assessment considers interaction between SAGCOT plans and other programmes both under public, private and public-private initiatives.

Mitigation Framework: After identifying the likely important environmental issues; their direct, indirect, and cumulative impacts; and their underlying causes and sources, the possible mitigation measures, including policy and regulatory needs, institutional capacity requirements and needs, planning, and new or enhanced programs are proposed. The framework highlights potential trade-offs associated with proposed actions and describes principles, guidelines, management objectives, and targets for balancing social, economic, and environmental factors, with reference to limits on partner's activities for SAGCOT.

6.2 Environmental Impact Assessments

Guided by the SAGCOT Strategic Environmental Assessment, the provisions of the 2004 Environmental Management Act a full EIA will be undertaken in each cluster. The EIAs will also conform to the regulations and procedures established by the Division of Environment (DoE) in the Vice President's Office, as well as the review and approval system of the National Environmental Management Council (NEMC). The process also requires relevant sectoral ministries comment on the EIA process and output.

District Environmental Management Committees will be closely involved in the process, as will Ward and Village Environmental Committees. This will ensure local participation and consultation in the EIA process, and provide important capacity building experience to district personnel. In addition, some SAGCOT investors will have environmental requirements of their own. Where needed, these will be incorporated into the EIA process.

Each EIA will cover each of the main environmental issues, as well as any site-specific concerns raised during the SEA. The detailed Terms of Reference for the EIAs will be established in the SEA. For farms that are already established, and where no major change of land use is proposed, the less detailed process of an Environmental Audit may be required. However, the guidance of NEMC would be obtained on this issue.

Where there will be irrigation, an Environmental Flow Assessment (EFA) should be carried out as part of the overall environmental assessment process. This would determine the river's minimum flow regime required in order to maintain environmental services. Ideally, an EFA should be carried out as a stand-alone study of a target river before any overall cluster Environmental Impact Assessment is started, so that it can inform the EIA.

Given the scope of proposed SAGCOT investments, each EIA team will need to include specialists from a range of disciplines, especially socio-economics, hydrology and biodiversity. However, it will also be essential that the scope and costs of each EIA is appropriate to the scope and budget of the investment (see EIA Costs, below). This means that careful strategic decisions need to be made in the design of EIAs.

It should be remembered that the EIA's objective is to minimize overall environmental risks and negative impact. A totally 'clean' development process will almost never be possible. It is also important to remember that the proposed mitigation measures must be simple, realistic and affordable. They also must be able to provide some long-term benefits to the investor, or they will not be implemented and maintained.

EIA Costs: This is a subject of considerable concern to investors. There are cases where the EIA cost quoted by consultants officially registered with the National Environmental Management Council (the only ones allowed to undertake EIAs) for small farm dams have been the equivalent of the cost of building the dam itself. This defeats the object of both the development and the assessment.

Realistically, for small projects, like a farm dam EIA costs should be about 1% of the total project costs. However, as the project cost increases, so the EIA percentage cost would decrease. For example, EIA costs for projects with a US$10 Million budget should be about O.1%. Of course, there is no fixed rate as the complexity of EIAs vary with site and situation.

6.3 Roles and Responsibilities

The responsibility for limiting environmental damage lies with the investors. This is an essential part of the 'polluter pays' principle underpinning Tanzania's environmental legislation. Undertaking a professional SEA and cluster EIAs is therefore an undeniable obligation for SAGCOT and its partners. However, in overall environmental management and planning responses to climate change there is also significant role for the public sector.

Public sector responsibility lies primarily in establishing policies, legislation, regulations and public institution capacity to support and encourage responsible environmental management. The second critical role for the public sector is maintaining a reliable knowledge base for future growth and development of Tanzania's natural resources. As indicated throughout this report this requirement includes establishing effective national and local land use planning systems.

6.4 Including preparation to climate change and low carbon technology

There are opportunities in designing each cluster investment to include low carbon emission operations. These should be linked with ongoing initiatives such as those started by the WEF and Yara.

6.5 Social Issues

It is important to look at environmental and climate change in the context of the human population. It is expected that by 2050 will be 110 million Tanzanians with 54% of them living in towns. Dar es Salaam alone will have to house 13 million people. This population factor will be a massive driver in all social, economic and environmental factors and cannot be ignored.

Rural communities in Tanzania are dependent on the environment and natural resources. Consequently, their livelihoods are particularly vulnerable to environmental degradation and to the possible impact of climate change[11]. This vulnerability is a concern for SAGCOT. The large-scale commercial operations in SAGCOT should be better prepared and equipped to limit environmental damage and respond to climate change, than resource-poor small-scale farmers. This is a factor that needs to be included in the SAGCOT investment. SAGCOT will need to be particularly aware of the dangers faced by their weaker partners.

According to Climate Vulnerability Monitor (DARA, 2010) Tanzania is likely to have the second highest total climate-related health impact in the world. All Tanzanians, but especially poor rural Tanzanians, are highly vulnerable to the predicted impact of climate change in the country. They are characteristically lacking in resources and options, with low levels of income and few livelihood alternatives to agriculture. They also often have undeveloped technology and poor access to credit. Most of the rural population has limited 'social capital': trust is limited, there are few effective and empowered local institutions, and most have no formal security of tenure or entitlement. This puts them in a highly vulnerable situation when faced with environmental stress. Rural populations are characteristically risk-averse. This is a factor that might serve them well in stable times, but only adds to their vulnerability when change and adoption of new practices might be required. This is an element of *mila na desturi*[12] that will hinder widespread response to climate change.

Forecast of a generally warmer climate is expected to bring an increase the incidence of insect-borne diseases such as malaria and trypanasomiasis. Increased flooding, on the other hand, would increase the risk of waterborne diseases such as typhoid and cholera. In addition, local food shortages might be expected to increase the risk of morbidity and mortality due to lowered nutritional status. The limited rural infrastructure - especially roads and bridges - would be at heightened risk due to floods resulting from climate change. Rural water supplies would also be in greater danger of damage. Due to extended dry seasons, there would be heightened risk of bush fires. These are issues that will be of concern for all involved with SAGCOT, but again, the needs of the more vulnerable partners will require special attention.

An added complication is that in most rural areas the impact of climate change is not evident to rural communities. Farmers worldwide complain about the weather, but this has not been translated into an

[11] In the current state of uncertainty, it cannot be assumed that all the impacts of climate change will be negative. Depending on the local situation, some might turn out to be beneficial.
[12] Culture and tradition

understanding of trends or future changes. As shown in Figures 4 and 5, the overall trend can be hidden by large annual fluctuations. Subjective analysis of these changes by farmers might not reveal the underlying change that is underway. Consequently a particularly good year, or a bad year, is likely to skew perception of the overall process and its impact.

7. CONCLUSION

Albert Einstein defined the environment as "everything that is not me". This concept - easier to grasp than $e=mc^2$ - can guide the mix of wise investment and sound ecosystem management. By doing this, SAGCOT can simultaneously be commercially effective, environmentally sound and respond to long-term changes in the climate. It is in interest of everyone - the government, investors and farmers - that this works. If it does not, growth will not be sustained and environmental degradation and rural poverty will return.

Many actions used for avoiding negative environmental impact and preparing for climate change will also promote good agronomic practices and the wise use of natural resources. So, with or without the threats, many 'mitigation' actions should be encouraged anyway. The danger of negative environmental impact or the threat of climate change simply add an additional sense of purpose and urgency. By bringing together public and private sectors, and combining large scale and small scale operators within shared objectives - SAGCOT offers a unique opportunity to achieve this result.

This will not be easy. It will not be achieved without effort, organisation, coordination and finance.

This is what SAGCOT is aiming to bring.

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