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## **SECOND NATIONAL COMUNICATION TO UNFCCC**

### **CLIMATE CHANGE MITIGATION MEASURES AND OPTIONS**

#### **Land Use, Land Use Change and Forestry**

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## 1. INTRODUCTION

### 1.1 Land use in Kenya

Land tenure in Kenya has a direct impact on the use and management of the natural resources. When tenure rights are certain, they provide incentives to use land in a sustainable manner or invest in resource conservation whether for the individual or group of individuals (Ogolla, Mugabe 1996). Kenya having an agricultural based economy has majority of her people deriving their livelihood from various forms of agriculture. Different communities practice various forms of land used based on their social-economic needs and cultural practices and determined mainly by weather patterns, soil fertility, ecology and level of social development.

Wetland areas play an important role as water filters, fish nurseries and endemic bird's habitats. Forest fragments; grasslands and wetlands are critical natural habitats for endemic and threatened species. Whereas grasslands are scrublands are easy targets for conversions to farmlands; the pressure to settle landless had lately targeted forested areas due to its productivity.

In the high-populated areas i.e. Central Kenya, Nyanza and Western Kenya, agroforestry systems contribute to satisfying the demands for fuel wood, leading to low encroachment into forests and woodlands. In these systems IPCC estimates CO<sub>2</sub> accumulations rates range from 2 to 9 MT/ha/year. In other areas however poor land management and high population density contributed to land degradation. This was particularly evident in the river estuaries (Yala, Nyando and Nzoia) in the lake region. The increase in population has also resulted in massive land sub divisions in the high and medium potential areas. The units of such subdivisions have been uneconomical (0.25 ha) contributing to impoverishment of the land users.

Intensification of land use in urban areas for informal settlements has led to a number of environmental problems such as outbreak of diseases, and dumping of both liquid and solid wastes. Likewise increase of horticultural farming near water sources have led to pollution of water sources by fertilizers and agricultural chemicals. This is evident along Lake Naivasha where for decades the lucrative flower farms have consistently affected the entire lake ecosystem through high intensive production for largely export market.

### 1.2 Land Use, Land Use Change and Forestry under the context of the UNFCCC and its implications for Kenya

Under the Kyoto Protocol, certain human-induced activities in the land-use, land-use change and forestry (LULUCF) sector that remove greenhouse gases from the atmosphere afforestation, reforestation and tackling deforestation, may be used by developed countries (Annex I Parties) to offset their emission targets. A number of issues, however, remained unresolved in the Kyoto Protocol and have been the subject of continuing negotiations since its adoption. These outstanding issues include the elaboration of agreed definitions for afforestation, reforestation and deforestation.

Earlier agreement by Parties had limited LULUCF activities under CDM to afforestation and reforestation (16/CMP.1, 5/CMP.1). However, Kenya and other African countries together with Coalition of Rainforest Nations have since broadened the mandates to include forest conservation and degradation. In the meantime, issues regarding methodologies and policies to guide parties in long-term co-operation remain unresolved. Recent discussions on the possibility of including LULUCF in the Carbon market are still not finalized but opportunities and potential exist under the revised IPCC (2006) guidelines.

The Fourth Assessment Report (4AR) of the IPCC suggests that even small local temperature and associated decrease in soil water may reduce both agricultural and forest productivity. Ecosystem change will translate into significant biodiversity loss, reduction in incomes derived from agricultural and forest products and fundamental increase in livelihoods risks among rural populations. In our context we see an opportunity in undertaking several mitigation measures to improve the resilience of ecosystems where changes have been made without these considerations in mind. Recent practices related to land use changes such as forest destruction produced rapid response by the Government by undertaking mitigation measures despite limited resources.

## **2. Contribution to National development**

Most land use changes and conversion of forested areas to alternative uses, which has taken place under Government programmes, has been planned and aimed towards boosting sectorial developments. However other unplanned changes including illegal activities and pressure on natural resources have largely contributed to environmental degradation, loss of biodiversity and reduction of carbon sinks. The Government has nevertheless taken decisive steps to avert these activities through increasing awareness, enforcing existing regulations and by enacting appropriate policies.

### **2.1. Agriculture under the LULUCF**

Agriculture contributes to rural employment, foreign exchange earnings and rural incomes. The conversion of large tracts of forest and woodlands to large scale commercial crop production aims at boosting food production to offset domestic shortfall and enhance food security. According to the medium term expenditure framework report for the agriculture and rural development (ARD) sector 2007, agriculture is the dominant sector of the economy contributing 26% of the GDP directly and a further 27% indirectly through linkages with manufactures, distribution and other service related sectors. It is estimated that about 80% of Kenyan population derive their livelihood from the agricultural activities. The recent promotion of large scale production of commercial crops e.g. wheat (Narok District) Sugar cane (Coast, Nyanza, Western provinces and recently Tana River District) aims to increase production to offset National shortfalls and reduce import of these commodities. Besides enhancing production and self sufficiency, commercial farming also provides employment opportunities and reduces migration to urban areas hence boosting the economies of respective regions. The continued expansion of agricultural activities in areas hitherto designated to game reserves as is the case of Narok District Masai Mara might reduce earnings from the tourism sector. Balances between the two sectors need to be critically analyzed taking into consideration issues of deforestation and its possible negative impacts

### **2.1.1 Mitigation options**

The Kenya Agricultural Research Institute (KARI); the country's premier institution for agricultural research and technology development through its breeding programme successfully released their first mutant wheat variety (Njoro-BW1) that tolerates drought and use limited rainfall efficiently. The key side benefits of the variety include a moderate resistance to wheat rust; high yields, with grains valued for flour production of good baking quality. The new variety is cultivated on more than 10,000 hectares. The need to undertake strategic breeding for other food crops such as potatoes, maize and other indigenous food plant will contribute significantly to sustenance of food security and mitigation efforts towards the negative effects of climate change

### **2.2 Forests and Forestry sector**

Kenyan Forests provide economic, environmental, social and cultural benefits and values. The forests are also source of utility products such as timber, transmission poles, fuel wood and pulpwood and a wide variety of non-wood products. Forests support the five water towers in Kenya that include Mt. Kenya, Aberdare's, Mau complex, Mt. Elgon and the Cherangani hills. They are the sources of the major rivers in the country, which provide water for hydroelectric power generation, irrigation schemes that are important for agricultural sector development and water for both domestic and industrial use. They are important in conservation of biological diversity, carbon dioxide sequestration and are a major habitat for wildlife, which promotes tourism from which Kenya earns a substantial amount of its revenue. For example, the market value of goods and services generated annually in the tea, tourism and energy sectors alone to which the forest of the Mau Complex have contributed, is in excess of Kshs 20 billion.

However, sustainable management of forests continues to be hampered by a number of factors, including inadequate resources and pressure on the country's forest resources due to the increasing population and poverty. These problems have undermined the Government's efforts in undertaking sustainable forest management. Continuous loss of forestland has likewise resulted in loss of biodiversity, destruction of water catchments, affecting the quantity and quality of water, destruction of wildlife habitats and decline in production of wood and non-wood forest products.

With the enactment of the Forests Act, 2005 and its operationalisation in 2007, the necessary reforms to revitalise the sector are in place. These reforms provide for participation of other stakeholders including the private sector and communities through the Community Forests Associations (CFA) in the management and conservation of forests. With the new policies these forests are put under efficient and sustainable multipurpose management, which combines biodiversity conservation and water-catchment functions together with production of tangible benefits for forest adjacent communities. In doing so, forest principles are employed to ensure application of science in forest management. Revenues accrued through commercial forest activities support the management and conservation of indigenous forests. In addition, in relation to climate change, the new environmental policy puts great emphasis on the forestry sector as follows:

- (a) Promotion of sustainable management of forests for climate amelioration, soil, and water and biodiversity conservation. Activities to rehabilitated degraded and over-exploited forest areas will also be promoted.

- (b) *Ex-situ* conservation activities to safeguard species loss resulting from climate change and over-exploitation are intensified. Such measures include seed storage and botanical gardens in all agro-ecological zones.
- (c) Deliberate efforts are made to exploit the Global Carbon markets through the forestry sector under the guidance of the National Clean Development Mechanism (CDM) clearing house. These may include large afforestation and reforestation (A/R) programmes and efficient conversion of wastes e.g. sawdust to useful products.

## **2.3 Bio fuels and their role in sustainable land use, forestry and the carbon market**

The prospects of a growing Bio fuel industry and the anticipated local and international markets for seed and oil have led to increased interest in planting of Jatropha. The Government is promoting the use of Jatropha oil as a bio-fuel additive to mitigate against high International oil prices. Large areas of the arid lands in Eastern Kenya have been planted with this shrub and plans to plant excess of 100,000 hectares are underway in the coastal region through two Japanese Investors in collaboration with a local Non Governmental Organization; Green Africa Foundation. From forestry point of view, this land use change will contribute to a significant increase in the National tree cover besides being a substantial carbon sink. With an estimate Ksh. 3,000 / Ha annual income from the carbon market, the initiative is expected to generate about Ksh.3 billion (\$46.2m) annually. Incomes from oils estimated at 5.25 tonnes / hectare will provide additional and more substantive cost benefit to the investors. In addition this venture will contribute to meeting rural energy needs, protecting of arid land, soil erosion and stabilization of extreme weather related impacts. An improved dryland ecosystem management will contribute to improved tree cover and stabilization of other biophysical element of the dryland environment thus mitigating impacts of possible climate related changes such as droughts. Further research and pilot testing of performance of these plants in different region based on the seed sources and site matching must be prioritised. This will avoid cases of production failures due to physiological stress of the exotic species and provenances thus negating the expected benefits as a carbon source and the potential for carbon trading.

## **2.4 Land clearing for road construction**

Roads and road transport are crucial to land transport and thus social economic development in Kenya. However expansion and construction of roads directly results in deforestation in cases where such activities are carried out in forested areas. The expansion of Mombasa – Nairobi highway and the Naivasha – Nakuru – Kisumu highway has contributed to significant loss of vegetation cover. Most of the mitigation measures suggested in the Impact assessment studies on these projects are tree planting. Since infrastructural development is the key to economic development, these activities must be underpinned with verifiable and mitigation measures. However the Environment Impact Assessment (EIA) reports fall short of quantifying the areas to be planted to compensate for the actual potential forest cover loss. Given the fact that deforestation contributes to climate change, the change of forested areas to roads contributes to these changes.

### **2.4.1 Mitigation Options**

### **Case study 1. Mau forest**

The Mau Complex forms the largest closed-canopy forest ecosystem of Kenya. Through the ecological services provided by its forests, the Mau Complex is a natural asset of national importance that supports key economic sectors including energy, tourism, agriculture and water supply. The complex is particularly important for two of the three largest foreign currency earners: tea and tourism. This is in addition to the provisional services such as water supply to urban areas and support to rural livelihoods, in particular in the Lake Victoria basin outside the tea growing areas. The estimated potential hydropower generation within its catchments is approx. 535 megawatts, representing 57% of the current total electricity generation capacity in Kenya. The forests therefore contribute to underlying requirements to achieve Vision 2030.

Despite its critical importance for sustaining current and future economic development, the Mau Complex has been impacted by degazettement of forest reserves (excisions) and continuous widespread encroachments led to the destruction of some 104,000 hectares representing over 24% of the total forest cover.

Taking into consideration that a 200km stretch of road i.e. 10,000,000msq assuming a width of 5m would be equivalent to 1,000ha, the contractors should be compelled to plant a similar area to compensate for tree cover loss as a result of the road construction. This can be undertaken in the degraded areas occasioned by the construction or at a nearby site. Furthermore the restoration planting should be carried out using local seeds and seedlings sourced from local plants.

### **2.5 Acquisition of land for settlement:**

Large areas of forest land have been deforested to give way to settlements in many parts of Kenya. The most noticeable being the Mau forest complex where in 1998, 46,273 hectares of forest was hived off to settle the landless. Since then this action has been the subject of many debates which took political dimension. From a humanitarian point of view the move was seen as an opportunity to provide land for poor rural communities from which they could derive their livelihood by improving food production from the fertile soils. However, the long term environmental implications of these settlement was not taken into account. The ecological and economic effect that has since emerged from the settlement is currently under consideration with aim of reaching an

appropriate solution. In many other areas settlement schemes have contributed positively in solving landlessness among many communities. Parallel to settling people, such programmes have boosted food production as the settlers have managed to fend for themselves by cultivating sufficient food to cater for their requirements and for the market hence contributing to national food security. With the advent of social and farm forestry, tree planting in newly settled area have had significant contribution to increase in total tree cover (carbon stock) and provision of tree based products and services while at the same time increasing opportunities for forestry related enterprises.

### **3.1 Present situation and trends in relation to Green House Gas Emissions**

#### **3.1 Key drivers of deforestation in Kenya**

The total area under woodland in Kenya is estimated at 48.6 million hectares. Of these, 1.3 million are under natural forests, 0.17 million are forest plantations, 9.5 million are farmlands

and settlements and 37.6 million are woodlands, bushlands and wooded grasslands. Deforestation is driven by many forces. In some cases, extreme poverty forces forest adjacent communities to open up forested areas for subsistence agriculture. Planned deforestation for development needs forms a major part of forest loss. Incidentally this activity has not kept tandem with the reforestation rate thus resulting into large parts of planting backlogs: Transmigration programme of communities and settlement due to increasing population has contributed to substantial loss of forest cover in the last decade. Unsustainable forest practices, illegal logging and forest fires have similarly played significant roles if forest loss.

Charcoal burning in many areas has continued unabated despite Government ban on forest destruction. Conflicting policies on the production and use of charcoal has encouraged this state of affairs. Whereas some of the illegal acquisition of forest land has been reversed by the Government, some of the severely affected areas will take a long time to restore.

Woody vegetation in the arid and semi-arid areas provides useful cover to the fragile soils. These habitats also provide shelter for people and livestock and wildlife. Climate changes in these areas have severely been felt by the pastoral communities who mainly depend on wild plant resources and livestock for their livelihood. Several indigenous fruits and food plants are on the decline as a result of declining rainfall. Most plants are therefore threatened with extinctions in these regions. In Eastern province of Kitui; a pilot rehabilitation project undertaken by JICA /KEFRI Social Forestry Project with a local species; *Melia volkensii* has shown promising progress and should be expanded to cover wider areas. A financial facility to upscale this initiative is required.

The increasing environmental deterioration of the ASALs makes it difficult for the communities in those areas make ends meet through pastoralism. These communities are constantly searching for other options to support their families, and some are compatible with wildlife (tourism) while others are leasing land to investors for farming and high density settlement.

#### **4. Mitigating options**

Sustainable Forest Management will increase people's ability to cope with and recover from climate stresses. Forestry activities can be used to buffer against biophysical changes induced by climate change e.g. floods, droughts and temperature increase. Planting trees in markets, social places and homes as piloted by the JICA /KEFRI collaboration in Kitui District also offers cooler environments particularly in hot regions and therefore offers an easy option of mitigating temperature increases, winds and other extreme weather that may be associated with climate change. Fruit trees such as mangoes are good candidates as they offer environmental, nutritional and economic benefits. Local experiences with the high value trees are promising and require upscaling.

Social organization is one of the keys to tapping the potential of carbon markets for sustainable development. In 2006, Kenya's Greenbelt Movement successfully marketed a programme to reforest two mountain areas in Kenya as part of an emissions reduction agreement. Through these initiatives women groups will plant thousands of trees, with revenues coming from a carbon trade for the reduction of 350,000 tonnes of CO<sub>2</sub>. The aim is to generate wide-ranging social and environmental benefit including the restoration of eroded soils.

In areas where extensive deforestation have given way to expansion of agricultural opportunities, as part of Government policy for enhancing food security, the intervention measures by planting trees along farm boundaries and rehabilitating adjoining lands is recommended. The activities should be undertaken as parallel programmes to counter the emission level and to achieve carbon neutrality. Indigenous trees and shrubs would be the best candidates for such initiatives.

Recent extreme weather patterns in dryland regions particularly in North Eastern province resulted in droughts and floods both of which brought about serious impacts on the livelihoods of these communities. Whereas droughts affect livestock production by limiting the availability of forage and water, floods limits access to forage and increases vulnerability of waterborne diseases such as cholera. In addition, competition for grazing land and water resulted into conflicts and extreme insecurity causing displacements, loss of life and property

Given that most of the degraded land is a direct result of overstocking, a best bet mitigation option would be to review policies that may lead to reduction of animal populations. This can be achieved by increasing marketing opportunities. At the same time, the provision of other livelihood options such as trade and promoting the planting of drought tolerant commercial trees and shrubs and domestication of wild fruits accompanied by appropriate processing industries would decelerate loss of vegetation. The Dryland Research Program in Kenya Forestry Research Institute contributes to the harnessing and development of dryland

### **Case study 2. Pastoralisms and a changing landscape; the case of the Masai**

Traditionally the Masai community residents of the greater Laikipia, Narok and Trans Mara District maintain large stocks cattle, sheep and goats, which survive on dry season vegetation of trees and shrubs and grass. The diminishing trends of these plants in recent times have been attributed to several factors. Although pastoral life is an indigenous response to the marginal environment, events in recent years has witnessed the loss of much grazing land through changing land ownership policies and conversions of large tracts to agricultural activities.

Pastoralists' livelihoods are becoming untenable owing to new pressures occasioned by loss of plants and fodder that sustain both the pastoralists and their livestock. In the traditional rangelands management systems, the locals used migration timings and their Indigenous knowledge to shift to areas of adequate fodder during drought allowing the degraded portions to recover over time. It is this traditional way of ecosystem management that has enabled the pastoral Maasai community to survive over many generations since they consider the genetic resources as an integral part of their community heritage. However, with the conversion of large tracts of these group ranches for agricultural use and the increased aridity and land degradation. These communities livelihood is already under threat.

resources by generating technologies to improve woodlands management and conservation, thereby contributing to poverty alleviation at local and national levels. In addition, the programme also generates information that support woodlands management and conservation; developing technologies for rehabilitation of areas cleared for charcoal burning and naturally degraded areas. More recently efforts have been intensified in developing technologies for domestication of drought tolerant indigenous tree and shrubs. These efforts will go a long way mitigating negative effects of climate change. This initiative could be linked to external markets so that local communities could get direct benefits from these resources and also enhance their economic status and reduce overreliance on livestock.

Communities in West Pokot have been collecting and selling substantial amounts of Tamarinds fruits to middlemen for urban markets. The value of this trade is not known but upscaling and expanding the market will invigorate interest of local communities to conserve and plant more as a commercial enterprise. Evaluating the amount of these trees in terms of carbon stocking can be determined and be used to maintain National inventories. The Ministry of trade, Agriculture and Kenya Forest Service should be involved in collaborative initiatives for these programs. In addition KEFRI has developed and promoted the use of non-timber forests products such as Acacia gum which may enhance the conservation and result in planting more Acacia trees as a source of livelihood.

To achieve these measures, new policy interventions need to be enacted to ensure full participation and creation of appropriate and relevant institutions. The policies should be entrenched into the existing development plan. The present plans targeting the ASALs inadequately address a comprehensive revegetation and use economic exploitation of ASAL plant genetic resources. Thus a ASALs Plant Rehabilitation and Development Programme. (APRDP) if formed would deal specifically with protecting, increasing and using plant resources sustainably with an emphasis of economic, social and environmental benefits. Adequate funding (both local and external) should therefore be issues towards implementing such an initiative. Other mitigation measures that may contribute to reduction of deforestation and loss of Carbon loss include:

- (a) Sustainable commercial production of charcoal and use of efficient wood energy technologies and alternative forms of energy will be promoted. This will involve the development of rules and regulations for charcoal production and trade.
- (b) Upscaling existing technologies of efficiency energy use e.g. production and use of charcoal waste as practiced by Kibera Project and use other waste wood and agricultural biomass. These local technologies will promote local entrepreneurship, create jobs and increase incomes. At the same time they will reduce pressure on the reduction of standing carbon stock for energy use and hence contribute to lowering Carbon emissions.
- (c) *Ex-situ* conservation activities to safeguard plant species loss resulting from climate change and over-exploitation will be intensified. Such measures will include seed storage and botanical gardens in all agro ecological zones.

## **5. Farm forestry, carbon stocking and CDM**

Within the Kyoto Protocol, CDM only recognized afforestation and reforestation activities as eligible sources of carbon emissions reductions. In Kenya, an increasing proportion of tree cover is owned and managed by local communities. Recent studies reported by Kenya

Forestry Research Scientists (2007) indicate that eucalyptus trees in the western Kenya region are expected to increase from 14.5 billion to 31.6 billion by 2020 as more farmers venture into farm forestry. Trees are an essential part of diversified farm production, providing both subsistence products and incomes while contributing to soil and water conservation, and soil fertility. Indeed the general thinking in the country is that the future of trees is on farms. As more and more people take up tree planting as an enterprise, it will therefore be reasonable that incentives to support these people will be required to promote their contribution to the National increase in CO<sub>2</sub> sequestration while at the same time decreasing the National rate of deforestation which currently lies at negative 0.3%. Carbon forestry projects therefore provide mitigation option of reducing deforestation but also as a new source of income through carbon revenues; and help strengthen local capacities in forest management. Market barriers provide one explanation for the limited participation of local communities with small land holdings to participate in the CDM market. Current rules for the flexibility mechanisms in the Kyoto Protocol restrict the scope of carbon. However recent influx of investors in the Carbon market are positive indications that technical flexibility in methodologies will be determined and applied to facilitate the involvement small-holder land owners to participate in the market.

International Centre for Research in Agroforestry (ICRAF) and researchers from Michigan State University developed a method for calculating changes in the amount of carbon stored in soil and trees. By combining satellite pictures with infrared spectrum analysis using cheap ground-based instruments, they developed a method that could analyze changes in carbon storage across millions of square kilometers of farmland. The study was conducted in a pilot project in western Kenya and could be upscaled in other parts of the country.

## **6. Quarrying and Sand –Harvesting**

Quarrying for dimension stones, aggregates, ballast and other soft minerals like limestone, dolomite and kaolin pays little respect to environment. Disused quarries and mines are often left un-rehabilitated and thus are unsafe to inhabitants and animals living around. They are breeding grounds for water disease vectors. In some areas, disused quarries are used as dumping sites for domestic and industrial waste that affects both surface and underground water resources. Quarrying result in loss of flora, fauna and habitats, increased soil erosion, scarring of landscape, noise and dust pollution. Sand and gravel harvesting along rivers degrades the environment by lowering the riverbed, steeping and destabilizing river banks thereby causing erosion and river channel widening. In the past these areas have too close to human habits e.g. Dandora, Donholm and Mukuru all in Nairobi.

### Mitigation options

- Legislation to ensure such activities are not undertaken close to human habitats
- Enforcement of Environmental impact assessments to and regulations that promote sustainable extraction of the resources taking into consideration harmful emissions and loss of carbon stock
- Investors into such operations should be compelled to undertake parallel activities that compensated for the negative impacts associated with their activities.
- In the next 10–15 years this will mean a continuation of current trends including successive poor rains, an increase in drought-related shocks, and more unpredictable and sometimes heavy rainfall events. Beyond this period the Intergovernmental Panel

on Climate Change's climate models for East Africa show an increase in temperature of up to 2–4°C by the 2080s, with more intense rain predicted to fall in the short rains<sup>2</sup> (October–December) over much of Kenya, Uganda, and northern Tanzania as soon as the 2020s, and becoming more pronounced in the following decades. Pastoralists could benefit: more rainfall could result in more dry-season pasture and longer access to wet-season pasture. It could also result in less frequent drought, which may mean more time for people to rebuild their assets between lean times. However, there are also significant negative consequences including loss of livestock through heat stress, loss of land to agricultural encroachment as the rise in rainfall raises the productive potential of arid areas, an increase in frequency of flooding, and the spread of human and livestock diseases that thrive during the wet season.

- *2 Survival*

## **7. The role of the private sector and Social organization.**

### **7.1 Green Belt Movement**

One of the best options today in tapping the potential carbon markets for sustainable development is through the positive involvement of the private sector. In 2006, Kenya's Greenbelt Movement successfully marketed a programme to reforest two mountain areas in Kenya as part of an emissions reduction agreement. Women's groups will plant thousands of trees, with revenues coming from a carbon trade for the reduction of 350,000 tonnes of CO<sub>2</sub>. The aim is to generate wide-ranging social and environmental benefit including the restoration of eroded soils.

### **7.2 Kenya Tea Development Authority Ltd**

The largest tea producing company in Kenya with a combined annual processing capacity of 750 million Kgs. The company undertakes Commercial tree growing is a multi-billion shilling business in western Kenya. The company provides ready market for wood fuel for farmers a move which has seen farmers turn to tree farming as a viable enterprise. In the past the company has concentrated into the planting of the fast growing eucalyptus species, however there is now need to undertake and promote the planting of indigenous species which they will not use directly but which will be vital maintenance of ecosystem resilience. Annual audits of these activities should ensure that the areas they put under these species exceeds those that they extract for own use. In addition the company should shift to other sources of energy and adopt other technologies that will reduce wood use as fuel.

### **7.3 Green Africa Foundation**

This organization has promotion the planting of Jatropha in Kenya and is the pioneer Non-Governmental organizations which have practically done so in large scale. The firm has further solicited collaboration with Local Research and Forestry Institutions to spearheaded policy and technical approaches into adoption of Biodiesel, particularly Jatropha in the Kenya's energy sector. The result of this initiative might witness large hectarages of land been put under Jatropha. This could be a positive approach in mitigating negative effects of climate change through the increase of forested areas (Carbon stock), decelerating forested degradation and providing alternative renewable energy sources.

#### **7.4 Mumias Sugar Company**

Mumias sugar Company grows sugar cane on its own estates provide up to seven percent of its annual output, but its primary source is over 50,000 registered "out growers" with a total of more than 400 square kilometres under cultivation. The company is on course to produce at least 30 megawatts of electricity using sugar processing by-product known as bagasse. To account for the extensive expansion of land for cane production, the company has undertaken an ambitious tree planting campaign as part of their co-operate responsibility. In addition, the company intends to convert 2,000 square kilometres of the pristine Tana delta into irrigated sugarcane plantations. According to experts, the projected income of the project will be US\$2.45 million over 20 years. Besides creating 20,000 direct and indirect jobs, it will reduce the import bill and put biofuel-powered cars on Kenyan roads. However, the project would transform the riverine vegetation of the delta -- grass, forests and mango trees -- into vast fields of sugar cane.

In view of these considerations, the appropriate mitigation options for this company and others are as follows:

- Planting trees within the sugar estates either as farm boundaries or as amenities within its operation zones. These can be achieved by operating an official seedling nursery and facilitating community and school nurseries and organizing annual tree planting days within their respective regions. Annual Environmental Audits should be an affective monitoring tool to ensure that these activities are undertaken.
- Integration power cogeneration by all sugar firms as pioneered by Mumias Sugar Company. This could provide additional benefit for energy generation and spurring rural and national development through provision of the much needed electric energy.

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