

## FINAL SEA REPORT

STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA) OF THE  
NATIONAL SUGAR ADAPTATION STRATEGY FOR KENYA,  
SEPTEMBER 2012

***EXTRACT BY THE TRAINING COURSE MANAGEMENT***

**EXTENSIVE SUMMARY  
HANDOUT 2**

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# 1 Scope

The Government of Kenya (GOK) and stakeholders in the sugar industry are implementing the National Sugar Adaptation Strategy (NAS) with financial support from the European Union (EU). The period covered by the strategic action is considered to be 2007–2011, although implementation is ongoing. The NAS aims to make Kenya's sugar industry more competitive and to reduce the cost price of sugar in Kenya. 'Environmental and social protection' is one of the 6 strategic-intervention-areas covered by the NAS.

The GOK commissioned this Strategic Environmental Assessment (SEA) of the NAS implementation. The objectives of this *ex-post* SEA<sup>1</sup> are to:

- Describe, identify, and assess the likely significant environmental effects of implementing the NAS;
- Provide information to better integrate environment into decisions, implementation, and monitoring;
- Provide strategic-level recommendations on how to minimize potential negative effects and optimize positive effects.

It is anticipated that the findings of the SEA will also influence policy development in the sugar sector.

The SEA was organized in three phases: a scoping phase (April/May 2012), a more-detailed-study phase (June/July 2012), and a review and report-finalization phase (August/September 2012).

Stakeholders had special roles in all phases of this SEA. During the scoping phase, stakeholders provided input to:

- Identify the main issues and concerns to be further studied during the detailed SEA;
- Identify other key stakeholders;
- Select the SEA objectives (i.e., the evaluation framework);
- Select alternatives to be assessed during the detailed SEA;
- Identify data sources and data gaps, and provide input to the type of methodology to be used during the detailed SEA study.

During the detailed SEA period, stakeholders provided input to the various analyses, mitigation measures, and recommendations. Stakeholders also provided review comments to finalize the SEA.

This *SEA Report* presents the results of the April to September work. It integrates the results of the literature review, fieldwork, interviews, discussions, and workshops. It also integrates the review-period comments.

The report structure reflects the requirements of the TOR, as follows:

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<sup>1</sup> An *ex ante* SEA is conducted during the formulation of a strategic action, and will integrate environment into the strategic action at a very early stage. An *ex post* SEA is conducted after the strategic action has been approved; it will green ongoing activities and will make recommendations on future amendments.

- Chapter 1: Scope**
- Chapter 2: Background** (Chapter 2 describes the pre-NAS situation, the Sector Programme Objectives, the geographical scope, and the sugar-sector issues (2006–2012). It also introduces the 4 alternatives and provides an overview of the institutional, policy, and legal framework.
- Chapter 3: Approach and Methodology and Assumptions, Uncertainties, and Constraints**
- Chapter 4: Baseline study** (introduces the SEA objectives and provides the biological, physical, socio-cultural, and socio-economic baselines and trends, including opportunities and constraints)
- Chapter 5: Impact Identification and Evaluation** (i.e., this chapter summarizes the results of the consistency analysis, compatibility analysis, and qualitative impact analysis)
- Chapter 6: Analysis of Alternatives** (Chapter 6 presents the Qualitative Scenarios developed for the 4 alternatives and the results of the Multi-criteria Analysis of Alternatives)
- Chapter 7: Institutional Capacity Assessment for Environmental Management (in General) and to Implement the SEA**
- Chapter 8: Mitigation or Optimizing Measures and Indicators** (Chapter 8 serves as the Environmental and Social Management and Monitoring Plan)
- Chapter 9: Conclusions and Recommendations**

## 2. Background

### 2.1 The Pre-NAS Situation Assessment and Justification for the NAS

Sugar can be economically derived from sugarcane and sugar beet. About 70% of the world sugar is produced from cane. In 2005, sugar was being produced in 127 countries: the major producers included Brazil, India, and the European Union. Of note, only 30% of the world sugar output is traded internationally, with most sugar produced for local consumption.

Sugarcane is a strategic produce as it has many functions and by-products, ranging from sugar crystals, sugar syrup, molasses, bagasse, and filter scum. Sugarcane can be converted into 50, 1<sup>st</sup> generation derivatives for commercial operations, which can then be used to produce over 100, 2<sup>nd</sup> generation derivatives. Sugar is an important ingredient in beverages, sweets, pharmaceuticals, wine, spirits, power-alcohol, animal feed, chemicals, and fertilizers. By-products from sugar processing are used in animal feed, chemicals, yeast, and fertilizers (CGD Bills Digest 2005).

The sugarcane crop was introduced in Kenya in 1902, and the Miwani Company (1922) was the first sugarcane factory. Other factories followed. But, from around 1990 onwards, Kenya's sugar sector has been in crisis, with strikes, shutdowns, poor stewardship, and (an apparent) lack of political will to address issues. The sugarcane industry in western Kenya had previously achieved relatively high cane yields, but yields per hectare declined over the years, and significantly so after 2000.

The Sugar Act 2001 was meant to address the sectoral problems of the time, which were diagnosed as weak regulation, insufficient outgrower involvement, poor pricing, ineffective licensing and dispute resolution within the industry, and delayed payments. The Sugar Act 2001 and the Sugar (Amendment) Bill 2004 addressed some of those issues, but other issues were persistent. The unresolved issues are manifested in the cost price of sugar. In the period 2000–2005, Kenya's average ex-factory price was 3.1–3.5 times the world market price (€ 535 per tonne in Kenya vs. € 174 per tonne on the global market in 2005) (see p.10 of TORS). The issues viewed as 'persistent' in 2005 when the NAS was being formulated related to outgrowers, cane yields and cane quality, and factory operations, as described below.

#### ***(Pre-NAS) Issues affecting growers, cane yields, and cane quality included:***

The low cane yields and high price of sugar in the period around 2005 were attributed to:

- Poor land preparation;
- Low quality of seed cane (e.g., lack of interest to introduce appropriate cane varieties and poor crop maintenance);
- Institutional disincentives for farmers to grow high-sucrose cane varieties<sup>2</sup> (i.e., new varieties were not significantly penetrating the market; farmers tended to

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<sup>2</sup> This is expected to remain an issue until incentives were provided to grow high-sucrose and early-maturing, but low-yielding cane. The payment system was viewed as inadequate, as is based on weight only; the thinking is that farmers would have an incentive to grow high-sucrose cane varieties if the payment is based on cane weight and sucrose content.

grow low-sucrose and late-maturing cane, such as Co421 which is known for its drought resistance);

- Poor organisation and financing of small-scale growers (i.e., the price paid by farmers for their inputs, e.g., fertilizers and short-term credit interest, was higher than the market price);
- The growing conditions and the cost price for cane in Kenya's sugar industry were also far from ideal for these reasons:
  - The maturity age at harvest was high in both plant cane and ratoons (which is somewhat related to growing cane at high altitudes);
  - The small plot size of farmers' fields restricted the development of mechanisation;
  - The transport distance was long and the road conditions were generally poor;
- Poor cane quality (e.g., due to delays between cutting the cane and transporting it to the factory for crushing);
- Due to the absence of a distinct dry season in between the long and the short rains, some factories in western Kenya felt forced to crush during rainy days, meaning that cane was being harvested and transported, often under wet conditions. This tended to damage cane stubble, cause soil compaction, and damage the roads. Harvesting under wet conditions also meant that the cane yields, especially the ratoon yields, suffered.

***(Pre-NAS) Issues affecting the factories included:***

- Poor or non-existent road network (resulting in high transportation costs and high post-harvest losses because of haulage delays);
- Institutional fragmentation (the role of the many institutions was seen as uncoordinated);
- Overstaffed (usually public) factories;
- Mismatches between the cane supply and mill capacities (sometimes oversupply; sometimes undersupply);
- Low factory time efficiency (e.g., for a number of reasons, factories had a lot of 'downtime', related to either maintenance issues and/or cane supply);
- Inappropriate technologies (e.g., obsolete factory technology; weak extension, and insufficiently funded and narrowly focused research);
- Lack of funds to modernize factories and to diffuse new technology; there was also an issue related to the diversion of funds provided for modernization (e.g., even when sugar mills received money from the Sugar Development Fund (SDF) to rehabilitate or expand their sugar factory, it proved difficult to recover those loans and there was no guarantee that the loans would be used for the intended purpose);
- High taxation (i.e., paying value added tax, Cess, and Sugar Development Levy meant fewer gains for farmers and millers);
- Liberalization and increasing globalization of the economy (market liberalization removed some price controls, allowing for competition from low-cost sugar producers within COMESA);
- Large fluctuations in (global) sugar prices, affecting sugar imports;
- Illegal sugar imports (in 2005, there was said to be poor import-quota control so illegal sugar entered the local market and was repackaged by local sugar factories);

- Under-development and under-capitalization of the sugar factories (most factories were operating below capacity, had significant debts, and needed government bailout to attract the private investor).

## **2.2 Sector Programme**

### **2.2.1 Why the NAS? Sugar Sector Reforms, as Viewed in 2005**

Sugar production in Kenya in 2005 occupied an estimated 200,000<sup>3</sup> smallholders, who supplied more than 80% of the cane milled by the sugar factories. The factories had about 40,000 workers. The 600 jaggeries employed about 6,000 workers. The Kenya Sugar Board (KSB) estimates that up to 6 million people directly or indirectly derive their income from sugar. Sugar consumption was 696,000 tonnes in 2005 (with a domestic production of 489,000 tonnes). Producing domestic sugar was said to save the country about KSh 20 billion in foreign exchange (in 2005). Of note, sugar consumption is projected at 1,287,000 tonnes by 2015.

As one of the 18 Sugar Protocol (SP) countries, Kenya exports some sugar to the EU under the preferential and quota regime established by the EU-ACP Cotonou Agreement. Kenya has an allocation of 10,000 tonnes under the SP and an allocation of 10,000 tonnes under the Agreement on Special Preferential Sugar (SPS).

The basic elements of the EU sugar reform with regard to sugar exports of ACPs are a price cut for standard raw sugar of 36% over 4 years (from € 497 in 2006 to € 335 in 2009), combined with free access from 2009/2010 onwards for sugar exports under the *Everything But Arms (EBA)* regime (which Kenya does not benefit from, as it is not a LDC country). At the time of writing the NAS, the most successful sugar company, Mumias, was producing sugar at € 510 (i.e., more than € 175 above the EU new reference price). (It was thought at the time that Mumias would still be interested in exporting some sugar, but only to earn foreign exchange and to maintain the Sugar Protocol quota). Otherwise the high domestic prices for sugar were generally more attractive than exports to Europe. Of note, the other sugar companies all had higher production costs, and were not at all likely to reach the new EU reference price level.

The SPS quotas were to disappear by 2009/2010. It was planned that the Sugar Protocol would be integrated into the Economic Partnership Agreements (EPA), which was to be negotiated between the EU and the ACP. The EPAs were due to enter into force in 2008. With the relatively low export quotas for SP and SPS to the EU, it was assumed that Kenya would not have a very substantial direct loss if it was unable to export to the EU. But the concern was that the EU reform would affect other African Sugar Protocol countries, which would redirect their exports from the EU market towards the attractive Kenyan market (e.g., at the time Swaziland, Malawi, Mauritius, and Zambia were noted<sup>4</sup>).

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<sup>3</sup> More recent studies indicate that there are about 310,000 small-scale sugarcane farmers, supplying about 90% of all cane delivered to the mills (from EU 2012 Action Fiche).

<sup>4</sup> Of note, the shortfall of sugar production in 2010 was covered by imports (259,000 tonnes), with 53% coming from COMESA countries (of which 85% from Egypt) and the rest from other countries, mainly South Africa and Saudi Arabia (EU 2012 action fiche).

Kenya has been protected from cheap sugar imports from other COMESA partners since 2000. The COMESA Safeguard Clause allowed Kenya an annual duty free quota of 200,000 tonnes to meet the shortfall between the domestic production and consumption. Kenya negotiated extensions to the safeguard clause, which was to end in February 2008, then 2012, and now this safeguard of maximum duty-free imports of 340,000 tonnes was extended to February 2014 (EU 2012 Action Fiche).

The EU 2012 Action Fiche notes that the threat of imports from other COMESA countries is not as serious as previously assumed. Most surrounding countries have sugar deficits and the low-cost producers (e.g., Swaziland and Malawi) have long-term contracts with European customers. The Action Fiche also notes that the long-term sustainability of the Kenyan sugar industry is viewed as positive (e.g., because of capacity building through EC support, new sugar mills, scope for further expansion in western Kenya and at the coast, and environmental management measures).

### **2.2.2 The Proposed Activities of the NAS and the EU Support**

The NAS was formulated to address the most salient issues of the time. The Government of Kenya (GOK) and stakeholders in the sugar industry are implementing the NAS with financial support from the European Union (EU). The NAS covers the period 2007–2011, although implementation is ongoing.

The core development objective of the NAS was to make Kenya's sugar industry more competitive and to reduce the cost price of sugar in Kenya. The cost of the planned activities associated with each of the NAS objectives was KSh 49 billion or € 541 million. The financing was expected to come from: internal cash generation by the sugar factories; the Sugar Development Fund; Government resources; private investors; and international financial institutions.

Six objectives were put forward to achieve the core development objective:

1. Improve sugarcane production and productivity;
2. Privatization and financial restructuring of public mills;
3. Rehabilitate, modernize, and expand sugar factories;
4. Diversify products and add value;
5. Promote trade and marketing;
6. Protect the environmental and social components.

The planned activities associated with each objective are shown below.

#### **1. Improve sugarcane production and productivity**

- Improve infrastructure in the sugarcane producing areas;
- Improve cane yields and cane husbandry practices;
- Introduce a cane-payment system based on sucrose content;
- Build the capacity of Outgrowers' Organisations;
- Strengthen KESREF (Kenya Sugar Research Foundation).

#### **2. Privatization and financial restructuring of public mills**

- Privatization studies for Government divestiture from Chemilil, Muhoroni, Nzoia, and Sony;
- Liquidation of Miwani Sugar Company (no longer relevant);
- Verification and conversion to equity or write-off of debts of public mills.



### **3. Rehabilitate, modernize, and expand sugar factories**

- Create enabling environment for new investors;
- Attract appropriate financing for projects.

### **4. Diversify products and add value**

- Review electricity pricing regulations to enable the industry to sell co-generated power at rates comparable to independent power producers (IPPs);
- Develop a policy for blending petrol with alcohol;
- Attract appropriate financing for projects.

### **5. Promote trade and marketing**

- Negotiations with COMESA on extension of the Safeguard Clause;
- Control of legal imports and enforcement of rules of origin;
- Product diversification and exploration of export possibilities.

### **6. Protect the environmental and social components**

- Conduct periodic environmental audits on the existing factories;
- Conduct environmental impact studies for new developments;
- Reduce solid, liquid, and gaseous wastes;
- Improve health and education services in sugar areas.

#### **2.2.3 EU Support**

The EU supports the NAS implementation through Multi-Annual Indicative Programmes (i.e., MIP 1 and 2) and Annual Action Plans. The EU objective is specifically: *to increase competitiveness of the sugar industry by improving efficiencies and reducing production costs (e.g., through better rural roads, cane quality, capacity development, and environmental management)*. Various activities are programmed within Annual Action Plans to support the EU sub-objectives.

The EU sub-objectives mainly relate to the 1<sup>st</sup> objective of the NAS (i.e., *Improvement of sugarcane production and productivity*). The EU focus is:

- Rehabilitate roads (improvement of infrastructure);
- Develop cane (e.g., varieties) and (strengthen) cane husbandry;
- Support to introduce the cane sugar formula/cane payment;
- (Provide) training and capacity building;
- (Support) research (KESREF);
- (Conduct) policy support studies, feasibility studies, and safety studies.

The EU also supports the 2<sup>nd</sup> NAS objective through:

- Support to privatization of the sugar industry.

EU also supports the 6<sup>th</sup> NAS objective, which is related to *environmental and social protection* through:

- (Improve) environmental management;
- Strengthen social services (e.g., voluntary counseling and testing (VCT) services, good governance, and gender equity).

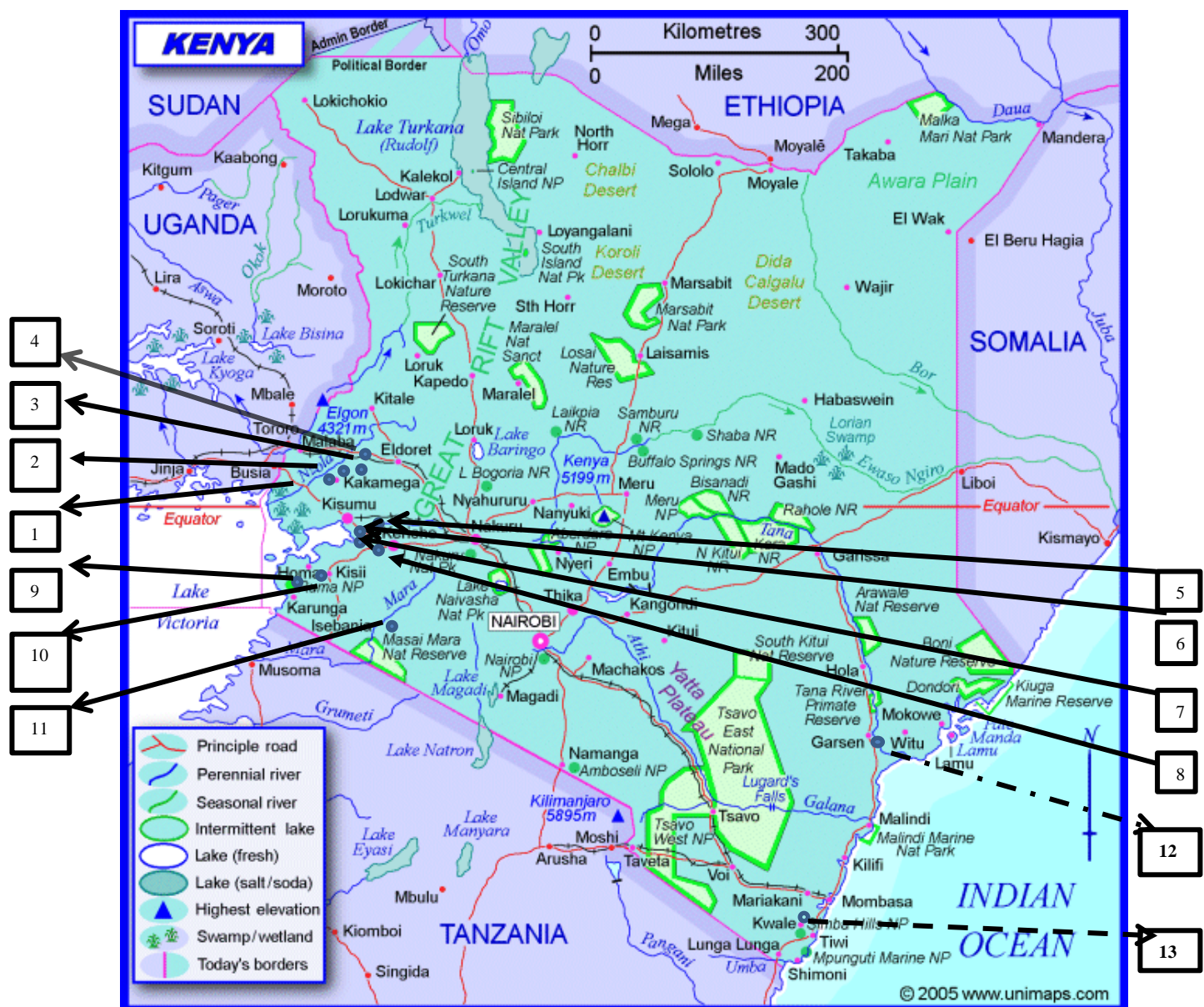
### 2.2.4 Purpose and Rationale of the NAS

The purpose and rationale of the NAS can be summed up as follows:

- To create an industry where the cost price of sugar and sugarcane (both are strongly interrelated) is much lower than at present;
- To bring production back to previous levels, using the same total amount of resources now in use.

## 2.3 General Geographical Scope of the Sugar Industry in Kenya and of This SEA

Kenya's current sugar industry is mainly based in the western part of Kenya, in three zones/belts: Kakamega, Nyando, and South Nyanza Belts. There is some tentative expansion to the Coast.



## **2.4 The Performance of the Various Sugar Mills in 2006** **(as presented in the NAS)**

### **2.4.1 Quantitative Description of the Existing Sugar Mills in 2005/2006**

**Table 3: Sugar production per factory (in tonnes) by calendar year <sup>a)</sup>**

<b>Factory</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>% in 2005</b>
<b>Kakamega Belt</b>							
Mumias	219,806	226,687	258,869	244,801	265,437	260,224	53
West Kenya	7,917	13,889	18,914	19,897	22,336	27,071	5
Nzoia	41,924	39,922	56,972	55,086	69,551	62,587	13
<b>Nyando Belt</b>							
Muhoroni	12,640	1,001	36,580	38,665	28,660	28,369	6
Chemelil	64,324	43,906	59,884	38,085	54,266	38,189	8
Miwani	8,970	352	0	0	0	0	0
<b>South Nyanza Belt</b>							
South Nyanza	46,403	51,681	63,030	51,955	76,553	72,557	15
<b>Total</b>	<b>401,984</b>	<b>377,438</b>	<b>494,249</b>	<b>448,489</b>	<b>516,803</b>	<b>488,997</b>	<b>100</b>
<i>a) Figures refer to the amount of sugar 'bagged'; there is a slight difference with 'sugar made'.</i>							
<i>Source: KSB Year Book of Sugar Statistic 2005</i>							

## **2.5 General Summary of the Overall Situation at the Sugar Mills in 2012**

In the 2005 to 2012 period, the sugar industry developed in its own way. Some noteworthy developments are listed below:

### ***1. Improve sugarcane production and productivity***

#### **Cane yields and husbandry**

- With the exception of Nzoia Sugar Company, where better agricultural practices had a positive effect, sugarcane production per ha for the 4 public and the 1 private (older) mills did not significantly improve in the 2005 to 2012 period;
- The sugar industry often does not receive the required fertilizer in a timely way;
- Until now, the sugar companies have not been able to address the most significant problems related to the low yields (i.e., unmotivated farmers, partly due to contract conditions, and sub-optimal agricultural practices);
- Cane is grown in western Kenya at altitudes varying from 1,100 to 1,400 meters above sea level. At these higher altitudes, cane grows slower than at the coast because of the climatic conditions. One advantage of growing cane at the high altitudes is that when it is harvested during the dry season (when there is a significant difference between the day and night temperature), the absorbed energy is stored as sugar, and not put into vegetative growth.

#### **Outgrowers**

- The need for qualified and well trained extension workers is significant;
- The private mill, *West Kenya*, which has been operating since 1980 is well established and seems to have less problems with cane growers than the other 5 big mills (4 public and 1 private);
- Sugarcane farmers feel that millers have charged them too high a price for fertilizers and other services; farmers now seem interested in choosing which mill to sell their sugarcane to and in buying their own inputs at the true market price;

- Outgrowers on the other hand should realize that transporting cane to the factory requires a high-level of organisational capacity, which is not available at the farm level or at the level of farmers' companies and associations;
- In conclusion, it looks like the outgrowers and the millers need to develop new and more equitable arrangements for growing and supplying cane to the mills.

#### **Cane payment system**

- Studies have been completed on a cane payment system based on sucrose content, but this system is not yet implemented;

#### **Research and KESREF**

- Research from KESREF has confirmed that the current “old” varieties and the newly introduced varieties (e.g., D8484 and KEN83-737) are early maturing varieties, but still require 18 months to mature in western Kenya;
- It is promising that KESREF is called to provide advice on agronomy issues in the Coastal Province, as required;
- There is still a need to better focus research on the most field relevant needs of the millers and sugarcane farmers;
- Mumias Sugar Company has its own agronomy department doing applied research, but in general, the private companies do not have research sections;
- The relationship between KESREF researchers and the cane growers could be improved by having test and demonstration fields spread over a wider area.

#### **2. *Privatization and financial restructuring of public mills***

- Due diligence reports have been completed on the public mills, but the 4 public mills have not yet been privatized (Nzoia, Sony, Muhoroni, and Chemelil);
- KSB has been approached by private parties, but it is unclear when this privatisation process will actually happen.

#### **3. *Rehabilitate, modernize, and expand sugar factories***

- As of 2012, little has been achieved in terms rehabilitating and modernizing existing operations; and little has been achieved with respect to the ambitious expansion programs proposed in the NAS and the Company-specific Strategic Plans. Muhoroni Sugar Company came under receivership, and the other 3 public mills are just surviving.
- West Kenya considered expansion in 2005, but instead the company split into two (now West Kenya and Butali Sugar Company);
- In the 2006-2012 period, there has been however an increase in the number of sugar factories:
  - Four (4) new mills came into production, all in western Kenya (Butali, Kibos Allied, Sukari, and Trans Mara);
  - Private companies are interested in starting new mills in two locations in western Kenya — Busia and Southern Nyanza;
  - There is a move to establish new sugar mills in the coastal area. One mill is under construction (in the same location as the old Ramisi Sugar Factory, which operated from 1927–1988). A second mill was proposed in the Lower Tana (feasibility study completed in 2007);
- There is interest (on behalf of KSB, Mumias, Kwale, the National Irrigation Board (NIB), KESREF, and Kenya Agricultural Research Institute (KARI) to develop the cane industry under irrigation in places where dams can be built on rivers, but

some stakeholders (e.g., sugarcane farmers) do not associate sugarcane with irrigation. The latter would require a lot of extension work to overcome.

**4. *Diversify products and add value***

- The cane industry is diversifying, moving into cogeneration, alcohol production, and other activities (e.g., bagasse board for house construction and bottling water);
- In general, the cane industry is keen to make use of by-products and to sell surplus energy.

**5. *Promote trade and marketing***

- The COMESA safeguards have been extended to 2014;
- There has been little discussion on producing other sugar-based export products; the focus has been entirely on 2 kg bags of sugar, which for the local market requires producing this product at the lowest possible price. An export-oriented market could focus on higher priced specialty products.

**6. *Protect the environmental and social components***

- This SEA contributes to this NAS objective, as do project-specific EIAs;
- One general conclusion is that a good number of the sugar-sector environmental issues have a strong ‘institutional’ component, and the institutional issues have to be more fully understood and managed to improve environmental management and achieve a modern, competitive, low-cost, efficient, sugar industry.

## **2.6 Alternatives to the NAS**

Based on the scoping results in April/May 2012, four relevant alternatives were identified for more detailed study during the June-July detailed-study period. The alternatives are:

**Alternative 1:** Expand the sugar industry in a *horizontal* manner (using a larger area, but with the existing cane production per ha). This is equivalent to the zero- or business-as-usual alternative.

**Alternative 2:** Fully implement the NAS. This alternative evaluates the impacts of the NAS and all its elements.

**Alternative 3:** Cane production under irrigation in the 3 agro-ecological zones in western Kenya. Smallholders are integrated into the set up:

*Alternative 3a:* Kakamega belt

*Alternative 3b:* Nyando belt

*Alternative 3c:* South Nyanza belt

**Alternative 4:** Large-scale, irrigated, nucleus estate for sugar production. The location for such a complex could be in an area where flood-control measures are planned, e.g., near a dam site.

Based on an analysis of the NAS and the performance of the sugar sector (2005 to 2012) (**Chapter 2**) and an analysis of the trends in the environmental baseline (**Chapter 4**), a scenario was developed to evaluate each alternative in **Chapter 6**.

## 2.7 Overview of the Institutional, Policy, and Legal Framework

Section 2.7.1 below covers in general the *Institutional, Policy, and Legal Framework of the Sugar Sector*. Section 2.7.2, in contrast, focuses on the *Policy and Legal Framework for SEA*.

During the scoping period, the policy, legal, and institutional framework review helped identify the stakeholders, the key issues, and the SEA objectives (the evaluation framework). For the detailed SEA study, the review enabled or facilitated the policy impact identification and assessment (*Chapter 5*), the analysis of alternatives (*Chapter 6*), the development of multi-sectoral strategies for tackling the challenges in the sugar sector (mitigation or optimizing measures, and indicators in *Chapter 7*), and conclusions and recommendations (*Chapter 8*).

### 2.7.1 The Institutional, Policy, and Legal Framework for the Sugar Sector

Significant changes to the policy, legal, and institutional framework can be expected in the next few years, as the provisions of the new Constitution are implemented. The SEA integrates the changes that are manifest at the time of writing (July/August 2012). **Table 8** below shows the core ministries and institutions and a number of other ministries that have a role in coordinating and implementing policies that directly or indirectly affect the agricultural sector, the sugar sector, and the NAS in particular. The table also shows the relevant *existing* policy, institutional, and legal framework.

**Table 8: Institutional, Policy, and Legal Framework for the NAS**

Ministry	Parastatals/Institutions	Policy and Legal Framework
<b>GoK</b>		<ul style="list-style-type: none"> <li>2010 Constitution</li> </ul>
<b>Ministry of Agriculture</b> Formulates, implements, and monitors crop, agriculture and land development policy and programs; MoA provides some agricultural extension.	<ul style="list-style-type: none"> <li>Kenya Sugar Board (manages the <i>Sugar Development Fund</i>)</li> <li>Other boards and authorities (e.g., Tea, Coffee, Cotton)</li> </ul>	<ul style="list-style-type: none"> <li>Sugar Act 2001</li> <li>Agricultural Act (Cap 318)<sup>5</sup></li> <li>Agriculture Sector Development Strategy 2009-2020</li> <li>Ministry of Agriculture Gender Mainstreaming Strategy</li> <li>Other Acts (e.g., Tea, Coffee)</li> </ul>
<b>Agricultural Sector Coordinating Unit</b>		
<b>Tribunals for the Agricultural Sector</b>	<ul style="list-style-type: none"> <li>Sugar Arbitration Tribunal</li> <li>Other Tribunals</li> </ul>	
<b>Agricultural Research</b>	<p><b>Public (existing)</b></p> <ul style="list-style-type: none"> <li>Kenya Sugar Research Foundation</li> <li>Kenya Agricultural Research Institute</li> <li>Kenya Marine and Fisheries Research Institute</li> <li>Coffee Research Foundation</li> <li>Tea Research Foundation</li> </ul> <p><b>In the future:</b></p> <ul style="list-style-type: none"> <li>Autonomous body corporate to coordinate agricultural research (or a 'forum' or <i>Kenya Agricultural Sector Research Organisation</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Companies Act,</li> <li>Science and Technology Act</li> <li>National Agricultural Research Systems Policy (2010)</li> </ul>
<b>Agricultural Training</b>	<ul style="list-style-type: none"> <li>Ministry of Agriculture Training</li> </ul>	

<sup>5</sup>Cap 318 allows MoA to make Rules and Land Development Orders on agricultural land use. The new Constitution transfers this power to the National Land Commission.

Ministry	Parastatals/Institutions	Policy and Legal Framework
<b>Institutes</b>	<ul style="list-style-type: none"> <li>Institutes</li> <li>▪ Livestock Industry Training Institute</li> <li>▪ Farmers' Training Centres</li> <li>▪ Bukura Agricultural College</li> </ul>	<ul style="list-style-type: none"> <li>▪ Bukura Agricultural College Act 1999</li> </ul>
<b>Agricultural Extension Services</b>		<ul style="list-style-type: none"> <li>▪ National Agricultural Sector Extension Policy 2009</li> </ul>
<b>Agricultural Finance Corporation</b>	<ul style="list-style-type: none"> <li>▪ Public institution that provides finance to farmers</li> </ul>	
<b>Ministry of Cooperative Development and Marketing</b>		<ul style="list-style-type: none"> <li>▪ Cooperative Societies Act No 12, 1997</li> <li>▪ SACCO Societies Act No 14, 2008</li> </ul>
<b>Public and Private mills</b>	<ul style="list-style-type: none"> <li>▪ Public and Private mills</li> </ul>	
<b>Ministry of Fisheries Development</b>		<ul style="list-style-type: none"> <li>▪ Fisheries Act Cap 378 of 1991</li> <li>▪ Draft Fisheries Bill 2012 (<i>in parliament</i>)</li> </ul>
<b>Ministry of Water and Irrigation</b>	<ul style="list-style-type: none"> <li>▪ Kenya Water Institute</li> <li>▪ National Irrigation Board</li> <li>▪ Water Services Regulatory Board</li> <li>▪ Water Resources Management Authority</li> <li>▪ Water Services Board</li> <li>▪ Water Services Trust Fund</li> </ul>	<ul style="list-style-type: none"> <li>▪ Water Act 2002</li> <li>▪ National Water Policy 2012</li> <li>▪ Draft Water Bill 2012<sup>6</sup></li> <li>▪ Irrigation Act 2002</li> <li>▪ National Irrigation Policy 2011</li> <li>▪ National Land Reclamation Policy 2011</li> </ul>
<b>Ministry of Environment and Mineral Resources</b>	<ul style="list-style-type: none"> <li>▪ National Environment Management Authority</li> <li>▪ National Environmental Tribunal (or Council)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Environment Management and Coordination Act (EMCA) No 8 1999</li> <li>▪ Environmental (Impact Assessment and Audit) Regulations, 2003</li> <li>▪ EMCA (Water Quality) Regulations, 2006</li> <li>▪ EMCA (Waste Management) Regulations, 2006</li> <li>▪ EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009</li> <li><b>(Relevant) Signed International Conventions:</b> <ul style="list-style-type: none"> <li>▪ Convention on International Trade in Endangered Species of Wild Fauna and Flora</li> <li>▪ Convention on the Elimination of All Forms of Discrimination Against Women, 1979</li> <li>▪ Convention on the Conservation of Migratory Species of Wild Animals, 1979</li> <li>▪ Convention for the Protection, Management and Development of the Marine and Coastal Environment of the East African Region, 1985.</li> <li>▪ Vienna Convention for the Protection of Ozone Layer, 1985</li> <li>▪ United Nations Framework Convention on Climate Change, 1992</li> <li>▪ Convention on Biological Diversity</li> <li>▪ Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000</li> <li>▪ Agreement on Conservation of African Eurasian Migratory Water Birds, 1995</li> <li>▪ Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade</li> <li>▪ Stockholm Convention on Persistent Organic Pollutants</li> <li>▪ African Convention on the Conservation of Nature and Natural Resources, 1968</li> </ul> </li> </ul>
<b>Ministry of Lands and</b>		<ul style="list-style-type: none"> <li>▪ National Land Policy 2009 (re: tenure and</li> </ul>

<sup>6</sup> N.B. The Draft Water Bill 2012 establishes new institutions: The *Water Resource Management Authority* becomes the *Water Resource Regulatory Authority* (WRRA) and the *Basin Water Resources Boards*. The *National Water Conservation and Pipeline Corporation* becomes the *National Water Storage Authority*. The *Water Services Regulatory Board* becomes *Water Services Regulatory Commission*. *Water Services Trust Fund* becomes the *Water Sector Trust Fund*; *Water Services Boards* become *Water Works Development Boards*. The *Water Appeals Board* becomes the *Water Tribunal*.

Ministry	Parastatals/Institutions	Policy and Legal Framework
<b>Settlement</b>		promotion of sustainable use of land)
<b>Ministry of Regional Development Authorities</b>	<ul style="list-style-type: none"> <li>▪ Lake Basin Development Authority</li> <li>▪ Coast Development Authority</li> <li>▪ Tana and Athi River Development Authority</li> <li>▪ Others</li> </ul>	<ul style="list-style-type: none"> <li>▪ The 2010 Nile Cooperative Framework Agreement (Kenya, Uganda, Tanzania, Rwanda, Burundi, and Ethiopia)</li> <li>▪ Lake Victoria Tripartite Agreement (Kenya, Uganda, and Tanzania)</li> <li>▪ Lake Basin Development Authority Act</li> <li>▪ Coast Development Authority Act</li> <li>▪ Tana and Athi River Development Authority Act</li> </ul>
<b>Ministry of Energy, Renewable Energy Department</b>	<ul style="list-style-type: none"> <li>▪ KenGen</li> <li>▪ Kenya Power</li> <li>▪ Rural Electrification Authority</li> <li>▪ Electrical Department and Renewable Energy Department</li> </ul>	<ul style="list-style-type: none"> <li>▪ Biofuels strategy paper</li> </ul>
<b>Ministry of Forestry and Wildlife</b>	<ul style="list-style-type: none"> <li>▪ Kenya Forestry Services</li> <li>▪ Kenya Forestry Research Institute</li> <li>▪ Kenya Wildlife Service</li> </ul>	<ul style="list-style-type: none"> <li>▪ The Forestry Act, 2005</li> <li>▪ The Wildlife (Conservation and Management) Act</li> <li>▪ Biosafety Act (2008)</li> </ul>
<b>Ministry of Planning and National Development</b>	<ul style="list-style-type: none"> <li>▪ Inter-Ministerial Coordinating Committee on Food and Nutrition</li> </ul>	<ul style="list-style-type: none"> <li>▪ National Food Security and Nutrition Policy 2011</li> <li>▪ Vision 2030 (2007)</li> </ul>
<b>Ministry of Transport and Communications</b>		<ul style="list-style-type: none"> <li>▪ Integrated National Transport Policy 2004?</li> </ul>
<b>Ministry of Health</b>		<ul style="list-style-type: none"> <li>▪ Public Health Act (Cap 242)</li> </ul>
<b>Ministry of Tourism</b>		

The EU's development framework is also important, including the:

- Regional Strategy Paper and Regional Indicative Programme for the Period 2008–2013;
- Country Strategy Paper and Indicative Programme for the Period 2008–2013.

**N.B. Chapter 5, *Impact Identification and Evaluation*, presents the policy impact assessment (i.e., the internal consistency analysis of the NAS objectives and the compatibility assessment of the policy framework objectives against the NAS objectives).**

## 3. Approach and Methodology

### 3.1 General Approach

The overall approach to this SEA was participatory. This was very necessary because the environmental management issues related to the NAS cannot be addressed unless the institutional issues are addressed. Many of the sugar-sector issues have been around for many years. Trying to solve the issues with only a technical or data analysis approach will not yield the desired future. Only the stakeholders (together) can tackle the institutional issues. Stakeholder involvement 'drove' the methodology of this SEA, and a great effort was made to involve stakeholders throughout the SEA process. So, in addition to field visits to collect primary data (e.g., field observations) and the review of secondary data, the SEA relied heavily on interviews, focus group discussions, one-on-one discussions with stakeholders, workshops, and stakeholder review comments.

As mentioned in **Chapter 1**, the SEA was organized in three phases: a scoping phase (April/May 2012), a more detailed study phase (June/July 2012), and a review phase



(August/September 2012). The specific approach, methodology, and results associated with each of the three phases are discussed below.

### **3.2 Scoping-Period Approach, Methodology, and Results**

The main activities and results of the scoping period included:

- The NAS was described (in general);
- An information handout outlining the SEA exercise and information needs was prepared to leave with the stakeholders consulted during the scoping phase (this handout was revised on a daily basis);
- 33 national level and sugar-belt stakeholders were consulted and interviewed;
- A small number of field visits were conducted (e.g., Mumias Sugar Company and Sony);
- More than 93 key stakeholders were identified through stakeholders interviews and literature review; the importance and influence of the 93 stakeholders was analyzed;
- Ten key issues/objectives (and 31 sub-objectives) were identified for use in the detailed SEA;
- Four alternatives were identified to analyze during detailed study (based on a preliminary assessment of the primary and secondary data);
- The institutional, policy, and legal framework was outlined;
- The data needs and the methodologies for the detailed study were outlined, as was the workplan for the detailed study;
- The Draft Scoping Report was prepared and a draft scoping workshop was conducted May 8, 2012;
- The Draft Scoping Report was subjected to stakeholder comments for a 3-week review period;
- The SEA Scoping Report was finalized and submitted on May 31, 2012.

*See the full Scoping Report, Annex 1.1, for a more complete description of the scoping phase methodology and for the ‘proof of consultation’ sheets for the 33 stakeholders.*

### **3.3 Detailed SEA Study Approach, Methodology, and Results**

*Note: Text deleted by the training course management*

### **3.5 Assumptions, Uncertainties, and Constraints**

*Note: Text deleted by the training course management*

## **3 Baseline Study**

An SEA is based on a good understanding of the strategic action and a good understanding of the potentially affected biophysical and social systems. The baseline is the current state of the environment, plus its likely future status in the absence of the strategic action. It serves as the starting point to measure impacts and performance and is an important reference for evaluation. In sum, establishing the baseline helps:

- Identify existing problems that the strategic action should try to solve;
- Set a context for impact prediction and evaluation;

- Provide a basis against which the strategic action's impacts can be monitored;
- Highlight the resilience, vulnerability, and significance to human wellbeing of the important ecological systems and services;
- Outline and review existing environmental protection measures and objectives;
- Assess the compliance of the strategic action to relevant international and national treaties, conventions, legislation, guidelines, and objectives.

The baseline data should reflect the objectives (and indicators) identified during the scoping period and should cover various aspects of the biological, physical, and social environment. *N.B. An SEA cannot describe the baseline environment in as much detail as an EIA, as it is NOT an EIA.* The baseline should identify:

- Environmental and sustainability opportunities and constraints (e.g., issues related to carrying capacity and standards);
- Existing or potential conflicts with stakeholders;
- Public concerns;
- Trends;
- Other supportive or constraining strategic actions.

This SEA used typical SEA data sources, such as:

- State of the environment reports;
- Current sectoral or regional plans;
- GIS data;
- Maps, both current and historical;
- Discussions with sector-relevant officers, experts, and stakeholders;
- Field observations.

The above data was compiled and organized based on the 10 key issues identified during the scoping period. The baseline description in this SEA is presented using text, tables, and maps (maps are generally found in **Annex 1.1**). **Table 9** below shows the *SEA Objectives/Evaluation Framework for the detailed SEA*. The 31 evaluation criteria were generated by giving due attention to the above-mentioned ten key stakeholder issues, the desk review (i.e., policy and legal framework review and other documents), the agricultural sector objectives, and objectives of the NAS.

**Table 9: SEA Objectives (Evaluation Framework and Data Collection Strategy)**

	5 themes	10 key issues/objectives	31 sub-objectives	
<b>1</b>	<b>BIOLOGICAL</b>	<b>1. Protect Habitat</b>	Protect habitats, incl. wetlands and fish habitat	<b>1</b>
			Conserve forests and trees	<b>2</b>
			Payment for environmental services	<b>3</b>
			Promote adaptation to climate variability and climate change for habitat resilience	<b>4</b>
<b>2</b>	<b>PHYSICAL</b>	<b>2. Protect Soils/Avoid Land Degradation</b>	Protect soil (from water/erosion)	<b>5</b>
			Protect soil (from excess chemicals)	<b>6</b>
			Optimize land use	<b>7</b>
		<b>3. Optimize Land Use</b>	Avoid land use change	<b>8</b>
			Protect/rehabilitate water catchment	<b>9</b>
			Enhance water supply/availability	<b>10</b>
		<b>4. Protect Watersheds</b>	Reduce flood risk	<b>11</b>
			Improve water quality	<b>12</b>
<b>3</b>	<b>SOCIO-CULTURAL</b>	<b>5. Adapt to climate change and variability</b>	Adapt to climate variability and climate change	<b>13</b>
			Improve air quality	<b>14</b>
		<b>6. Protect Health</b>	Enhance governance and equity	<b>15</b>
			Enhance gender equity and protect children	<b>16</b>
		<b>7. Enhance Livelihoods (food security, poverty and income)</b>	Protect health (AIDs, malaria, cholera)	<b>17</b>
			Promote food security and diversified nutrition	<b>18</b>
<b>4</b>	<b>SOCIO-ECONOMIC</b>	<b>8. Improve Productivity</b>	Reduce poverty	<b>19</b>
			Improve income and improve livelihoods	<b>20</b>
			Improve sugarcane productivity (better husbandry and road infrastructure)	<b>21</b>
		<b>9. Support Economic Development</b>	Improve value addition in an environmentally-sound manner	<b>22</b>
			Enhance competitiveness, commercialization, and resource efficiency (sugar sector)	<b>22</b>
			Promote <i>agricultural</i> economic development (e.g., through irrigation)	<b>23</b>
<b>5</b>	<b>INSTITUTIONAL</b>	<b>10. Strengthen Capacity (including enforcement and monitoring)</b>	Promote <i>economic</i> development (of other sectors, including tourism)	<b>25</b>
			Strengthen planning and coordination	<b>26</b>
			Expand and disseminate research	<b>27</b>
			Strengthen extension services	<b>28</b>
			Strengthen Outgrowers' Organisations	<b>29</b>
			Execute the legal requirement and gazette the rules (includes MEA and agricultural sector rules)	<b>30</b>
			Strengthen monitoring and evaluation	<b>31</b>

## **4.1 BIOLOGICAL BASELINE, TRENDS, OPPORTUNITIES, AND CONSTRAINTS**

The biological baseline covers a number of relevant topics, including: international conventions, major ecosystem types; protected areas; forests; wetlands; natural disasters: *floods and droughts*, and biodiversity (mammals, birds, threatened species, and invasive species).

### **4.1.1 International Conventions**

Kenya has signed a number of important international conventions to safeguard its environment. The most noteworthy and relevant to this SEA include<sup>7</sup>:

- UN Convention on Biological Diversity (UNCBD), 1992;
- Ramsar Convention, 1971;
- Protocol for Sustainable Development of the Lake Victoria Basin, 2004;
- UN Framework Convention on Climate Change (UNFCCC), 1992.

### **4.1.2 Kenya's Major Ecosystem Types**

Savanna and grasslands (rangelands) cover 39% and bushland and woodlands cover 36% of Kenya. Agro-ecosystems/croplands extend over 19% and closed forests cover 1.7% of the land area. Urban ecosystems only account for about 0.2% of the country. Lakes, rivers, and other aquatic environments are also important ecosystems.

**Trend/constraint:** For most parts, the land that was originally covered by montane or coastal dry forests was converted to cropland, representing a significant loss in biodiversity. Remaining forests need to be preserved. **Map 3 (in Annex 1.1)** shows the major ecosystems, highlighting that the NAS' geographical focus is predominantly in the *cropland ecosystem*.

### **4.1.3 Protected areas in Kenya**

Kenya's biodiversity conservation system includes terrestrial and aquatic national parks and reserves, conservancies, Ramsar sites, biosphere reserves, and world heritage sites. The protected areas increased from 12.1% in 1990 to 12.7% in 2007. Private conservancies complement this system of national parks and reserves. The protected areas within this SEA's geographical coverage are in bold in **Table 10**.

**Trend/constraint:** Sugarcane farms are not to encroach on protected areas.

### **4.1.4 Kenya's Forests**

Kenya has felled over 90% of its natural forests. Forests are under pressure from increased population, charcoal production, and illegal logging, excisions for human settlements, cultivation, and livestock grazing. Forests continue to disappear at about 5,000 ha/year. The decrease in forest cover and the degradation of forests and catchment areas contribute to a decline in important ecosystem/forest functions, such as soil conservation<sup>8</sup>, water yield and hydrological balance (leading to increased intensity and frequency of droughts and floods), wildlife habitat, and biodiversity.

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<sup>7</sup> Other important conventions include: UN Convention to Combat Desertification (UNCCD), 1994; Stockholm Convention on Persistent Organic Pollutants (POPs); Basel Convention on Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989; Montreal Protocol on Substances that Deplete the Ozone Layer, 1987; and Convention on International Trade in Endangered Species, 1973.

<sup>8</sup> The 5 rivers that flow into **Lake Victoria** are part of the Nile Basin. The increased sediment influx from the 5 rivers (and the Kagera River in Uganda) is estimated to cost farmers more than US\$ 40 million annually in **lost soil**. This high sediment or nutrient load going into Lake Victoria contributes to the water hyacinth problem.

Having less forest cover also causes sedimentation problems in the lower reaches of rivers, dams, and ports (and associated impacts, e.g., damaging parts of the aquatic food chain or reducing the capacity of dams and hydropower). Kenya has 5 forest types:

1. Indigenous forests (i.e., water towers; montane forests);
2. Tropical rainforest (Kakamega);
3. 4. and 5. Plantation forests; marine forests (e.g., mangrove forests); woodlands (shrub forests) in the rangeland areas.

Gazetted forests (*#1 indigenous forests* above) cover about 2% of the land surface. As of 1995, only 1.7% of Kenya's land area was classified as *closed forest*, mainly consisting of 1 million ha around the 5 'water towers': 1. Mount Kenya, 2. Aberdare Range, 3. Mau Escarpment, 4. Mount Elgon, and 5. Cherangani Hills. Kenya's 5 water towers are the largest forests in Kenya, forming the upper catchments of most of the main rivers. The surrounding areas are generally densely populated because there is water for intensive agriculture, industry, hydropower, and urban settlement and a supply of timber and non-timber products for adjacent communities [State of the Environment Report (SOE) 2010, JICA 2002; EU 2006].

**Trend/constraint:** The continued degradation of the *water towers* through ill-planned, illegal settlement, and illegal exploitation activities is a national concern.

A number of water towers and associated ecosystems are targeted for conservation<sup>9</sup>, including: **Mount Elgon, Mau Forest Complex, and Shimba Hills**. The most relevant forest complex to this SEA<sup>10</sup> is the **Mau Forest Complex**, the largest tower with 403,775 ha of forested cover. It supports critical economic activities: hydropower generation, tourism, and agriculture. The rivers flowing from the Mau Forest Complex drain into five lakes, three being international water bodies: e.g., Lake Victoria. Notwithstanding its national importance, the **Mau Forest Complex** is under threat. Over 100,000 ha (about 25%) of the Mau Complex were destroyed since 2000 through excision of forest reserves and encroachment. As of 2005 and 2007, there were some signs of improvement in the state of the Mau Complex, but it is unclear whether the improvements will be sustained (*Source: EU 2006*).

Mount Kenya and the Aberdare Range are source water for coastal rivers, and hence coastal forests. Coastal forests are a unique forest type, providing habitat for rare species (e.g., red colobus monkeys). The area under coastal forests decreased due to extensive damming of the Tana River, mainly for hydropower. This has modified the flooding regime, which is an integral part of the ecological system, threatening both the forests and the forest species.

The unique **Kakamega tropical forest** is found within the geographical focus of this SEA. It is the only Kenyan remnant of the Guineo-Congolian rainforest. It harbours central African flora; between 10–20% of the total animal species are **endemic**. The

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<sup>9</sup> Other water towers targeted for conservation include: Mount Kenya; Aberdare; Cherangany Forests; Chyulu Hills; Taita Hills, Mount Marsabit, Matthews Range, Mua Hills, Loita Hills, and Ndundori Hills.

<sup>10</sup> Of note, Mount Elgon and the Cherangani Hills are also part of the Lake Basin Drainage system.

forest reserves at **Kakamega** (and Ol Donyo Sabuk National Park<sup>11</sup>) are important water catchments.

The population near Kakamega forest depends on the forest for their livelihood, harvesting an assortment of food, medicines, woodfuel, and building materials. Parts of the forest were converted to agricultural activities and settlements, especially within the past three decades. A 1991 survey compared standing timber volumes against a survey done in 1965, showing that 50% of the Kakamega forest volume had been lost in that short period. This trend continues, as shown by the 1973 and 2010 Landsat images (see **Annex 1.1, Map 4**).

**Trend/constraint:** Sugarcane farms are not to encroach on forested areas.

#### **4.1.5 Wetlands**

Marine and inland wetlands are important ecosystems, providing important ecological services. They host a range of floral and faunal species, filter water, provide food (through fishing and hunting), and are used for cultivation, grazing, and sources of water and building materials. Marine and inland fisheries are highly dependent on the integrity of supporting wetlands. Kenya has more than 467 lakes and wetlands, including five5 large lakes (e.g., Lake Victoria), many small lakes, six6 dams, many marshes and swamps, and the riverbanks of the five5 main river systems. Seasonal and permanent wetlands are mostly located outside protected areas (EU 2006).

Wetlands use to cover about 3–4% of Kenya, but the current size may be below 2.5%. According to the State of the Environment Report (SOE) (2010) and some stakeholders interviewed during this SEA, wetlands (or lands that are wet) are being converted into agricultural land (including sugarcane cropland) at an alarming rate. Wetlands are also subject to unsustainable levels of harvesting for construction materials. Wetlands are also under increased threat from pollution and diminishing size due to encroachment, increased water abstraction, destruction of catchments, and climate change and variability (decreased rainfall levels). All these factors have contributed to the decline in fish production and decline in species composition in the wetlands.

Kenya ratified the Ramsar Convention in 1990 and has five Ramsar wetlands<sup>12</sup>. **Tana River Delta** and perhaps **Yala Swamp** are being considered as Ramsar sites. The Tana River Delta, the Yala Swamp, and Lake Victoria are wetlands of interest to the geographical focus of this SEA, and are discussed in more detail below.

**Trends/constraints:** Sugarcane farms are not to pollute wetlands or to encroach on wetlands, especially Ramsar sites.

##### **4.1.5.1 Tana River Delta**

The people living in the Lower Tana River depend on the river's flooding regime for their livelihoods (farmers, fishers, fishmongers, and nomadic pastoralists) and to meet other socio-cultural needs (SOE 2010). The Tana River was dammed to supply the country's growing water and hydropower needs. The impoundment has affected ecosystem diversity and has reduced water flows. A large number of livestock and

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<sup>11</sup> Other important water catchments include the forest reserves at Kibwezi, Ngong, Karura, and Bonjoge.

<sup>12</sup> Ramsar sites include: Lakes Nakuru, Naivasha, Bogoria, Baringo, and Elmenteita (together 101,849 ha).

biodiversity rely on the Tana River's floodplain grasslands and water bodies for dry season pasture and water. Population increase and irrigated agriculture is likely to increase pressure on the Lower Tana River, potentially adversely affecting biodiversity, as the birds and wildlife depend on the annual flood cycle of the Tana for habitat and forage.

**Trend/constraint:** Any additional development within the Tana Delta will need to strictly apply environmental safeguards.

#### **4.1.5.2 The Yala Swamp**

The Yala Swamp is a wetland region of 200 km<sup>2</sup> located in the north-eastern shore of Lake Victoria in Siaya and Busia counties (West Kenya). The swamp filters the water of 2 rivers flowing into Lake Victoria.

**Trends/constraints:** The swamp is home to 2 endangered fish species (*Oreochromis esculentus* and *Oreochromis variabilis*) that have disappeared from Lake Victoria. The critically endangered Sitatunga antelope (*Tragecephalus spekii*) is also found in the papyrus habitat. BirdLife International classifies the Yala Swamp as one of Kenya's 61 important bird areas (IBAs)<sup>13</sup>. There are already some water use conflicts at Yala swamp. Of note, the rice grower Dominion Farms has been accused of tapping too much of the Yala Swamp water, potentially damaging this important habitat. (Source: [http://en.wikipedia.org/wiki/Yala\\_Swamp](http://en.wikipedia.org/wiki/Yala_Swamp)).

#### **4.1.5.3 Lake Victoria**

The Lake Victoria basin is one of the **most densely populated rural areas in the world**, surrounded by many cities<sup>14</sup>, including Kisumu, Kisii, and Homa Bay in Kenya. (See **Annex 1.1, Map 5** for a graphic showing the population increase around Lake Victoria from 1960 to 2025). N.B. For a discussion on Lake Victoria's water resources see Chapter 4.2.7 (*Water Basins and Water Resources*) and 4.2.8 (*Water Quality and Water Pollution*).

Even though Lake Victoria has issues with invasive alien species (Chapter 4.1.6.3) the lake currently supports Africa's largest inland fishery. The environmental problems in Lake Victoria (i.e., loss of biodiversity and invasive species (also decreasing water levels and water pollution) concern all the bordering countries: Uganda, Tanzania, Kenya, Burundi and Rwanda. In 2004, the East African Community Council approved the *Protocol for Sustainable Development of Lake Victoria* (EU 2006).

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<sup>13</sup> Some of the birds said to be present in Yala Swamp include: the Blue Breasted Bee Eater, the Papyrus Gonolek, the Swamp flycatcher, the Papyrus canary, the White Winged Warbler, the Great snapper, and the Baillor's Crane.

<sup>14</sup> Other important Victoria Basin cities include Kampala, Jinja, and Entebbe in Uganda; and Bukoba, Mwanza, and Msoma in Tanzania.

#### 4.1.6 Biodiversity

Kenya's biodiversity<sup>15</sup> is concentrated in the existing protected network (i.e., national parks, reserves, and sanctuaries), but about 70% of the biodiversity occurs outside protected areas. Kenya is home to about 5 hotspots of globally important biodiversity (i.e., ecosystems have high levels of species diversity, including some with endemic, rare, critically endangered, threatened, or vulnerable species) (SOE 2010). The unique regions within our geographical focus<sup>16</sup> include:

- ***Coastal forests of Shimba Hills, Lower Tana Delta, and Arabuko-Sokoke (largest existing fragment of tropical rain forest);***
- ***Kakamega's Guineo-Congolian equatorial forest.***

**Trends/constraints:** High-intensity agriculture contributes to the loss of genetic and biological diversity by replacing the diverse traditional agricultural systems in the high potential areas with input-intensive monoculture of exotic varieties (e.g., tea, coffee, flowers, and vegetables for the export market (and with intensification, perhaps sugarcane can be added to this list). In addition, poor land use practices have reduced overall agricultural production, which results in more land being used for agriculture to compensate for under-production.

##### 4.1.6.1 Biodiversity: Birds

Kenya has 61 important bird areas<sup>17</sup> (IBAs) (of which eight are endemic bird areas (EBAs) or key sites for bird species diversity).

**Trends/constraints:** A 2003–2004 assessment of the status of Kenya's IBAs found that about 50% were in decline (25% were improving; 8% were stable; no information was available on the other IBAs). A 2009 IBA assessment focused on Kianya valleys (Mount Kenya), **Yala swamp**, and **Busia grasslands** indicated that some sites deteriorated during 2009 due to drought and overexploitation. Plans to convert the **Dakatcha woodlands** (north of Malindi on the Coast), **Tana River Delta**, and **Yala Swamp** into large-scale food and bio-fuel plantations pose additional threats to the area IBAs. (The Dakatcha woodlands project was stopped) (SOE 2010). Some bird species are considered endangered<sup>18</sup>. **Map 7 (Annex 1.1)** shows Kenya's important bird areas.

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<sup>15</sup> Kenya's biodiversity resources provide food, fuel, wood, medicines, and income from tourism. About 75% of Kenya's ecosystems (bushland, woodland, savanna and grassland) support a variety of wildlife, including Kenya's herds of grazing animals and large cats. Kenya has more than 35,000 known species of plants, animals and microorganisms. It is thought that many species remain unidentified (EU 2006).

<sup>16</sup> Other biodiversity hotspots include: Indian Ocean Islands of Lamu and Kisite; Northern dry lands that form part of the distinct horn of Africa region; and Afro-montane forests of Mount Kenya, Aberdare, and Mount Elgon.

<sup>17</sup> The IBAs are located in 22 forests (20 of 22 are protected areas); 18 wetlands (5 of 18 are protected areas); 12 arid and semi-arid areas (7 of 12 are protected areas); 6 moist grasslands (3 of 6 are protected areas); and 3 other unprotected sites. Forty-six (46) IBAs shelter globally threatened bird species, 29 host range-restricted birds, 32 contain biome-restricted bird species, and 13 hold globally important congregations of birds.

<sup>18</sup> In regards to bird species, KWS and Nature Kenya identified 27 breeding birds as endangered or threatened in 2010, for instance, the Taita apalis (*Apalis fuscicularis*) and Taita thrush (*Turdus helleri*), which are endemic to the upland forests of the Taita Hills in south-east Kenya. Other endangered and threatened breeding birds include the Madagascar pond-heron (*Ardeola idae*); Saker falcon (*Falco cherrug*); Egyptian vulture (*Neophron percnopterus*); Sokoke scops-owl (*Otus ireneae*); Aberdare cisticola (*Cisticola aberdare*) and the Basra reed-warbler (*Acrocephalus griseldis*).



**Trend/constraint:** The sugar sector should not encroach on Important Bird Areas (IBAs).

#### 4.1.6.2 Other Threatened Species

If an ecosystem is threatened, the species therein are also threatened<sup>19</sup>. Mainly in relation to Lake Victoria, KWS classified **26 threatened fish species**<sup>20</sup> with local extinction in 2010, including: Victoria tilapia (*Oreochromis variabilis*). Given that the data is incomplete, the number of threatened fish species could be as high as 71 (SOE 2010). Hybridization of the fish species is an issue and it hypothesized that decreased water transparency due to ***eutrophication and erosion*** is interfering with the fish species' visual cues during mating.

In general, large mammal species are declining in number, distribution, and abundance<sup>21</sup>. **Table 11** shows that the Tana Delta and western Kenya have some rare or endangered species.

**Table 11: The Locality and Status of Various Endangered Species**

Species	Locality	Status
Tana River red colobus monkey	<b>Tana Delta</b>	Critically endangered and endemic
Tana River mangabey	<b>Tana Delta</b>	Critically endangered and endemic
Kenya wattle bat	Arabuko-Sokoke forest	Endangered
Black rhinoceros		Critically endangered and endemic
Savannah elephants	Several parks	Vulnerable
Shimba Hills banana frog	Shimba Hill Forest	Endangered
African violets	Shimba Hills and other coastal forests	Endangered
Sokoke pipit	Arabuko-Sokoke Forest	Endangered and endemic
Sokoke scops owl	Arabuko-Sokoke Forest	Endangered and endemic
Hiroia	Coastal and northern areas	Critically endangered
Dugong dugon	East African coastal waters	Vulnerable
Sitatunga	<b>Wetlands in Rift Valley and Western Kenya</b>	Rare

**Source: EU 2006**

#### 4.1.6.3 Invasive Alien Species

Invasive alien species are associated with loss of biodiversity and are a threat to freshwater and terrestrial habitats because they suffocate, replace, and often result in the extinction of indigenous species. There are about 34 invasive alien animal and plant species<sup>22</sup> in Kenya — water hyacinth and Nile perch<sup>23</sup> being of high

<sup>19</sup> The endangered and threatened amphibians and reptiles in Kenya include: Du toit's torrent frog (*Petropedetes dutoiti*); Shimba hills banana frog (*Africalus sylvaticus*); Shimba hills reed frog (*Hyperolius rubrovermiculatus*); Forest frog (*Africalus sylvaticus*); Hawksbill turtle (*Eretmochelys imbricata*); Green sea turtle (*Chelonia mydas*); Olive ridley (*Lepidochelys olivacea*); and Rock python (*Python sebae*).

<sup>20</sup> Other Lake-Victoria fish species threatened with local extinction include: Singidia tilapia (*Oreochromis esculentus*); Lake Chala tilapia (*Oreochromis hunteri*); Jipe tilapia (*Oreochromis jipe*); Rainbow sheller (*Ptyochromis sp.*); Lake Victoria deepwater catfish (*Xenoclaras eupogon*); Montane dancing-jewel (*Platycephalus amboniensis*); Magadi tilapia (*Alcolapia alcalicus*); Giant wrasse (*Cheilinus undulatus*); Victoria stonebasher (*Marcusenius victoriae*), and possibly *Haplochromis ishmaeli*.

<sup>21</sup> In regards to mammals, the greatest concentration of mammal species (> 69 species) is **predicted** to be in Kenya's central and western highlands — areas now dominated by cropland and human settlements. Nonetheless, species diversity is high in the adjacent rangelands (i.e., bushland, woodland, savanna, or grassland) (e.g., south of Nairobi and near the Tanzanian border).

<sup>22</sup> The most pervasive *alien plant* species in Kenya include striga, mathenge (*Velvet mesquite*) (*Prosopis juliflora*), tick berry (*Lantana camara*), Mauritius thorn (*Caesalpinia decapeltata*), and water hyacinth (*Eichhornia crassipes*) (EU 2006, SOE 2010).

relevance to the geographical focus of this study, in particular, Lake Victoria. The hyacinth issue is discussed below.

The exact date when hyacinth invaded Lake Victoria is not known, but it increased rapidly between 1992 and 1998, was reduced by 2001, and has resurged to a lesser degree (sometimes in the mouth of rivers, such as the Nyando). The hyacinth infestation is associated with a number of environmental, social, and economic impacts<sup>24</sup>. Management techniques include (hyacinth-eating) insect control and manual beach cleanup efforts. A water hyacinth infestation is seldom eradicated; once introduced, it must be managed. The emergence of water hyacinth in the lake was attributed to a marked increase in levels of organic and inorganic compounds from industrial effluents and **chemical residues from agricultural activities in Kenya**, Uganda, Tanzania, Rwanda and Burundi—the whole catchment of Lake Victoria<sup>25</sup> (JICA 2002).

**General trend/constraint:** To safeguard biodiversity, the sugarcane sector should not contribute to the eutrophication and siltation of Lake Victoria and other important rivers because this threatens biodiversity in general (fish, birds, and mammal species) and promotes the growth of invasive species, such as hyacinth.

## **4.2 PHYSICAL ENVIRONMENT BASELINE , TRENDS, OPPORTUNITIES, and CONSTRAINTS**

The physical baseline covers a number of relevant topics, including: topography, geology, broad land classification, agro-ecological zones, soil/soil erosion, land degradation, land use (cropland, tree coverage, coverage by food crops, cash crops, maize, and other crops, milk production, and livestock), water basins and water resources (water supply, Lake Victoria Basin, Tana River Basin), hydropower and energy, irrigation, water quality and water pollution, climate, and climate change and rain fed agriculture, and last, but not least, air pollution.

### **4.2.1 Topography**

Kenya has these topographical types:

<b>Highlands</b>	Nairobi, Central (Mt. Kenya: 5,199 m); parts of Nyanza and Western Provinces (e.g., Mt Elgon: 4,375 m)
<b>Arid areas</b>	North Eastern Province and parts of Eastern Province
<b>Plains</b>	Rift Valley province, parts of Nyanza Province (Kano plains) and parts of Coast Province
<b>Lakes/Marshes</b>	Lakes Victoria (Nyanza), Turkana, Nakuru, Bogoria, Naivasha, Elemantaita (Rift Valley)
<b>Coastal Zone</b>	Coast Province bordering Indian Ocean

Source: JICA 2002

### **3.3.2 Geology**

The geology of Kenya is defined based on the major rock types listed below.

<sup>23</sup> The Nile perch (*Lates niloticus*) is an aggressive predator, which has had a devastating effect on the species composition of Lake Victoria. Lake Victoria originally had a high diversity of fish species, including 300 to 500 cichlid species. The introduction of Nile perch in the 1950s increased fish production nearly ten-fold, however, the Lake's biodiversity was considerably diminished: 60% of the Lake's endemic cichlids are now feared extinct (SOE 2010).

<sup>24</sup> The hyacinth weed can block boat access, transportation, and fishing. Where prolific, the weed creates excellent breeding areas for mosquitoes and other insects resulting in increased incidents of skin rash, cough, malaria, encephalitis, bilharzias, gastro intestinal disorders, and schistosomiasis. Water hyacinth interferes with water treatment, irrigation, and water supply. It can smother aquatic life by deoxygenating the water; it reduces nutrients for young fish in sheltered bays. It has blocked supply intakes for hydroelectric plants, interrupting electrical power for entire cities. The weed also interrupts local subsistence fishing, and can block access to the beaches.

<sup>25</sup> Lake Victoria Environment Management Programme (LVEMP) was established in 1994 to strengthen regional coordination in the management of Lake Victoria resources, including fisheries, water, and other resources.

#### 4.2.3 Broad Land Classification

Kenya covers an area of 591,958 km<sup>2</sup>: 98.1% land and 1.9% water. Of the total land surface, 20% is classified as medium- to high-potential arable land; 80% is classified as arid and semi-arid lands (ASALs). Of note, the arable land supports 80% of the human population. The ASALs support 20% of the population, 50% of the livestock, and 80–90% of the wildlife resources in the country. (See **Map 8** in **Annex 1.1** for the country's broad land classification).

**Trend/constraint:** The high- and medium-productive areas are under a lot of pressure from the fast-growing population.

#### 4.2.4 Soil Erosion and Pollution and Land Degradation

##### 4.2.4.1 Soil Types

The main soil types in the *uplands* of Western Kenya are:

Cambisols: Good for agriculture; generally fertile, well drained and not too acidic;  
Ferrasols: Low pH soil; well drained; not fertile; but have good soil structure;  
Nitrisols: Well drained; good water holding capacity; respond well to fertilizer;  
Acrisols: Low pH; not fertile; toxic levels of aluminium; erosive.

The most common soils in the *lower plains* of Western Kenya are:

Luvisols: Fertile; medium pH; good for agriculture;  
Planosols: Low and medium base status level; hydromorphic soil; low permeability in the B horizon;  
Cambisols: Similar to planosols  
Vertisols: Fertile; low permeability; difficult to work when dry;  
Solonetz: Saline soils; not good for crops.

The *Cambisol soil type dominates the upland areas in Kwale*; the *lowlands*, have similar soils as mentioned above for the lower plains of western Kenya (e.g., Luvisols).

The most common soil in the Tana Delta is:

Alluvial: Fertile, easy to work, good water-holding capacity.

##### 4.2.4.2 Land Degradation

Land degradation within the geographical focus of the study takes the form of soil erosion issues, soil fertility issues, and soil pollution, as outlined below:

- Soil erosion on steep slopes, in catchment areas, and in badly-managed agricultural farmlands;
- Deforestation due to encroachment for agricultural purposes, charcoal production, illegal excisions for human settlements, and illegal felling of trees;
- Loss of forage cover due to overgrazing;
- Decreased soil fertility because of inadequate replenishment of soil nutrients;
- Competition for cane (e.g., premature harvesting (and poorer incomes), harvesting during the rains (and soil compaction), and burning (and loss of soil organic matter);
- Pollution due to increased and inappropriate use of chemicals and agro-chemicals;

- Poor solid waste management (e.g., of bagasse or on-site residential wastes).

***Trend/constraint:*** Due to the population increase (2.9% per year), the pressure on the limited agricultural lands has increased substantially over the past 20–30 years, leading to unsustainable use of the land resource in some areas and land degradation.

#### **4.2.5 Land Use: Tree Coverage, Cropland, and Livestock**

**Map 10** (in Annex 1.1) shows the major crop growing areas in Kenya.

***Tree Coverage within Agro-ecosystems:*** Farmers' fields generally have patches of forests, woodlands, and other vegetation types. In the heavily cultivated highland landscapes, 10–30% tree cover is common (e.g., forage species and trees to produce fruits, fuel wood, and building materials).

***Cropland:*** Only a small portion of the land is intensively farmed (> 80% of land under crops) in Kenya's central and western highlands and in small patches of lowlands. The agro-ecosystems mostly consist of landscapes with 50 or 60% active cropland, mixed with less intensively managed land, and some land allocated to produce fuel wood and to graze livestock.

***Coverage by Food crops vs. Cash Crops:*** Croplands with high shares of food crops (>75%) are mainly in high-potential districts such as Trans Nzoia, Uasin Gishu, Lugari, Upper Nandi, and Nakuru (maize and other cereals); Narok (wheat); and lower Kirinyaga (rice). Areas with high food-crop shares also occur in more marginal cropping areas (e.g., areas bordering Lake Victoria, where farmers grow a lot of low-yielding maize). Areas with a food crop share of 25–50% include the coffee-growing zones of the Aberdare Range and Mount Kenya in Central Province. Tea-growing areas (e.g., Aberdare Range; Mount Kenya; and parts of eastern Bomet, Buret, Kericho, and Nyamira Districts) often have the lowest share of food crops (25%). In the west (e.g., Siaya, Kakamega, and Migori Districts), the low share of food crops is typically paired with sugarcane or tobacco crops.

***Maize:*** Most rural households grow maize<sup>26</sup> to help feed their families, but rely on the market for food security (between 25–70% of smallholder income is from non-farm sources). In 2003, maize covered the largest share of Kenya's croplands (1.67 million ha) vs. 1.25 million ha in 1985. The total area under maize cultivation has slowly increased, but yields have declined from 1.84 tonnes/ha (1985–1990), to 1.71 (1990–1995), and to 1.58 (1996–2004).

***Other crops:*** In 2003, beans accounted for 0.89 million ha; wheat and sorghum each for about 150,000 ha; millet for 108,000 ha; cassava for 50,000 ha; and irrigated rice for 10,000 ha. Wheat and rice production data show no major changes in yields over the period. In the 1989–2003 period, the area under fruits and vegetables (i.e., high value crops) has expanded. Fruit production increased from 110,000 to 150,000 ha and vegetable production increased from 80,000 to more than 100,000 ha.

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<sup>26</sup> Kenya's croplands can be divided into areas that receive on average less than 800 mm/year of rain and areas with higher annual rainfall. When evenly distributed, 800 mm/year of rainfall is sufficient to grow maize. However, the risk of crop failure is higher with a bimodal rainfall pattern (when the rainfall is split over 2 rainy seasons separated by a dry spell). With the exception of Rift Valley and the Western Highlands, maize is Kenya is grown in the "short" and in the "long" rainy seasons.

**Milk production:** At current demand (2008), the country is self-sufficient in milk<sup>27</sup>. But milk deficits are found in drier areas (e.g., Machakos and Mbeere Districts), where production per unit area is low. The central highlands and Rift Valley have a milk surplus. Areas north of Lake Victoria, Nyanza, and Western Province have high levels of milk output/km<sup>2</sup>, but do not produce enough milk to meet local needs. Many milk farmers in Siaya and Kisumu Districts raise low-yielding indigenous cow breeds.

**Livestock:** The highest livestock densities are in Trans Mara and parts of Narok Districts (i.e., in rangelands that receive relatively more rainfall). Livestock can be found throughout most rangelands of West Pokot, Baringo, Machakos, Makueni, Kitui, and Mwingi Districts, and the coastal area in Kwale and Kilifi Districts.

**Trends/opportunities/constraints:** Some farmers are converting their land to other crops<sup>28</sup>. It is unclear whether this trend will reverse with the increase in sugar milling capacity or whether in general the land currently under sugarcane is more profitable or sustainable under other crops (e.g., coffee or vegetables).

A number of farmers interviewed during this SEA have diversified their farming activities, by integrating some dairy, poultry, maize, other food crops, even fish ponds, in addition to sugarcane. This is in line with the food security policy.

#### 4.2.6 Water Basins and Water Supply

Kenya has a total area of about 582,646 km<sup>2</sup>, of which 1.9 % (11,230 km<sup>2</sup>) is covered by water. The freshwater resources comprise lakes, rivers, swamps, springs, dams, water pans, and groundwater. The major rivers are:

<b>Nzoia: 70 km;</b>	<b>Yala: 70 km;</b>	<b>Nyando: 50 km;</b>	Mara: 70 km;
Sondu-Miriu: 70 km;	Athi: 300 km;	<b>Tana: 1,012 km.</b>	

The main lakes include:

Fresh water:	Baringo: 129 km <sup>2</sup> ;	<b>Victoria: 3,755 km<sup>2</sup>;</b>	Naivasha: 210 km <sup>2</sup> ;
Brackish:	Turkana: 6,405 km <sup>2</sup> ;		
Saline water:	Elementaita: 21 km <sup>2</sup> ;	Nakuru: 52 km <sup>2</sup> ;	Magadi: 104 km <sup>2</sup> ;
	Bogoria: 34 km <sup>2</sup> , and Jipe: 39 km <sup>2</sup> .		

Most of the permanent rivers have their headwaters in the highlands<sup>29</sup>. In general, the network of perennial rivers is dense only in the central and western parts of the country, but the Tana and the Athi rivers flow year round and travel long distances through dry landscapes (WRI 2007).

**Table 12** summarizes information on the 5 drainage basins. Kenya's annual freshwater resources are about 20.3 billion m<sup>3</sup> (19,700 million m<sup>3</sup> of renewable surface water and 600 million m<sup>3</sup> ground water potential), or 548 m<sup>3</sup>/capita/yr. This is lower than the neighbouring countries (Uganda: 1,273 m<sup>3</sup> and Tanzania: 2,035 m<sup>3</sup>)

<sup>27</sup> Total milk production was about 5.1 billion liters (l) (KSh 100 billion) (2008). Kenyans drink about 100 l of milk/year/capita, produced by 600,000 households, primarily from central & western Kenya. Milk production varies across regions. The highest densities (>100,000 l/km<sup>2</sup>/yr) are in the densely settled & farmed foothills east of the Aberdare Range and south/southeast of Mount Kenya, Gucha, Central Kisii, Nyamira, and Butere–Mumias Districts. The drier lowland areas of Mbeere, Mwingi, Machakos, and Makueni Districts have lower outputs/km<sup>2</sup>.

<sup>28</sup> Another important issue is that urbanization is also resulting in the loss of prime agricultural land.

<sup>29</sup> Rangelands mostly have intermittent rivers.

and the United Nations'-recommended 1,000 m<sup>3</sup>/capita/yr. Kenya is classified as a net-water-deficit/chronically water-scarce country. The total annual demand was about 3,874 Mm<sup>3</sup> in 2000, and at the time, water demand was increasing rapidly (EU 2006).

Kenyan households mostly obtain their water supply as follows: 29% rely on surface water; 32% rely on groundwater; about 32% use piped water (mostly urban households) (WRI 2007). People generally depend on surface water when they live along permanent streams and freshwater bodies in the highlands, along Lake Victoria, or close to permanent rivers crossing more arid areas<sup>30</sup>. Groundwater is a dominant water source in some districts in western Kenya. Access to potable water is relatively low, at about 45% overall (and only 33% in the rural areas). Women spend about 15% of their time fetching water. **Map 12 (Annex 1.1)**<sup>31</sup> shows areas that experienced water shortages or required water transfers from other sub-drainages to meet their growing water demand (for year 2000 and *projected* for year 2010).

According to the World Bank (2009), Kenya has one of the world's lowest water replenishment rates per capita. Already, the combined effect of rising temperatures, climate change and variability (and more frequent droughts<sup>32</sup> and decreasing rainfall), watershed degradation, and the use of water for irrigation has lowered rivers, lakes, and groundwater levels. Some seasonal rivers have disappeared and the level of some permanent rivers is falling. Within our geographical focus, the Nyando River had low discharges for most of 2010 (this jeopardized the viability of the rice irrigation schemes on the Kano plains). Water scarcity affects/constrains water services, fisheries, agriculture, tourism, and industry.

Overall, there is insufficient attention to watershed protection, erosion control, protection of riverbanks, and protection of trees. Soil erosion is causing siltation and sedimentation in water bodies. There is a strong drive to install irrigation systems, and other water storage or harvesting systems to supply water, improve yields, and to mitigate for climate change. This will need to be done in an environmentally sound manner to safeguard the watershed and biodiversity.

Water resources increasingly need to be carefully managed to avoid negative impacts on food production or economic development. Population growth alone will continue to reduce per capita water availability. Even in areas with perennial surface water flows, high local demand can outstrip local supply.

**Trends/constraints:** The Study on the National Water Master Plan projected local water deficits for selected sub-drainage areas in the upper Ewaso Ngiro, Tana River, and in Western Kenya.

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<sup>30</sup> Many households in the country's arid and semi-arid areas (and a few communities along the Indian Ocean) depend solely on groundwater from wells and boreholes for drinking water.

<sup>31</sup> Map 12 considers the potential annual water supply and projected annual water demand from households, agriculture, and industry.

<sup>32</sup> The 1998–2000 drought resulted in an estimated economic loss of about US\$ 2.8 billion (i.e., loss of crops and livestock, forest fires, damage to fisheries, reduced hydropower generation, and reduced industrial activity).

#### 4.2.6.1 Lake Victoria Basin

Lake Victoria<sup>33</sup> receives about 80% of its water from precipitation and from thousands of small and large streams, the largest being the Kagera River on the western shore. On the Kenyan portion of the lake, the main influent rivers are the Sio, **Nzoia**, **Yala**, **Nyando**, Sondu-Miriu, Mogusi, North Awach, South Awach, and Gucha-Migori — the rivers shown in bold being the most relevant to the geographical focus of this SEA. Another inflow is from the Akagera River, sourced in Rwanda. The quantity of water in Lake Victoria is determined by rainfall, evaporation, and inflows and outflows from the lake basin. The main outflow is through the Nile River to the north. **Table 13** summarizes Lake Victoria's main inflows and outflows.

**Table 13: Lake Victoria Inflows and Outflows**

Average 1950–2000	Flow (m <sup>3</sup> s <sup>-1</sup> )	Percentage
<b>Inflows</b>		
Rain over the lake	3,631	82%
Basin discharge	778	18%
<b>Outflows</b>		
Evaporation from the lake	-3,330	76%
Victoria Nile outflow	-1,046	24%
<b>Balance</b>	<b>33</b>	

*Source: SOE 2010*

The water level of Lake Victoria has been monitored since 1896. The water level in 2005/2006 was the lowest since the 1961/1962 floods and was only slightly above the lowest level recorded in March 1923. Of late, Lake Victoria levels have dropped by more than 0.50 meters, seriously affecting water transport.

#### 4.2.6.2 Tana River Basin

The Tana River Basin is about 126,000 km<sup>2</sup>. It drains the eastern slopes of the Aberdare Range, the southern slopes of Mount Kenya, and the Nyambene Hills. It discharges into the Indian Ocean. The Tana River is about 1,000 km, with an average width of 39.3 m, a mean depth of 2.5 m, and an average flow rate of 42 m<sup>3</sup>/sec. Its mean annual discharge at Garissa is 5 BCM (billion cubic metre). Minimum levels were recorded in 2000 and 2009, correlating with those severe droughts. **Map 13 (Annex 1.1)** shows the trend in the Tana River water levels over a 20-year period.

**Trends/constraints:** The Tana River Basin has experienced water shortfalls and there are already some water-use conflicts between upstream and downstream users.

#### 4.2.7 Water Quality and Water Pollution

Ambient water quality is not monitored regularly because of financial constraints. Nevertheless, research shows that surface water pollution is caused by soil erosion, poor agricultural practices (e.g., cultivation close to the river banks), effluent from agricultural activities and related industries, industrial and household effluent, and leachate from waste landfill sites. The level of suspended sediment in the rivers and agricultural chemical run-off is said to be high. JICA (2002) quotes these figures

<sup>33</sup> Lake Victoria is Africa's largest lake by area (68,800 km<sup>2</sup>) and the world's largest tropical lake. It has a maximum depth of 84 m, an average depth of 40 m, a catchment area of 184,000 km<sup>2</sup>, and a 4,828 km shoreline. It is shared by 3 countries: Kenya (6% or 4,100 km<sup>2</sup>), Uganda (45% or 31,000 km<sup>2</sup>) and Tanzania (49% or 33,700 km<sup>2</sup>), but some sub-catchment waters from Burundi and Rwanda enter the Lake. Two rivers leave the lake, the White Nile and the Katonga River, both part of the Upper Nile river system.

(which are now quite dated) for the volume of soil erosion by basin<sup>34</sup>:

Lake Victoria–Nzoia River Basin: 2.0 million tons/year

Tana River Basin: 4.0 million tons/year

Fertilizers and pesticides from agricultural industries (coffee and sugar plantations) and silt from the soil erosion on agricultural lands are said to be important sources of pollution. JICA (2002) reported that about 0.4 million tons of inorganic fertilizers were used per year and about 10,000 tons of pesticides were used per year, some of which finds its way into water bodies. The JICA (2002) study also shows sugar mills as significant polluters in terms of Biological Oxygen Demand (BOD) (see **Table 14**). Stakeholder interviews at the sugar mills during the course of this SEA confirmed that the BOD levels of the factory effluents are still above the acceptable standard.

**Table 14: Main Areas Polluted by Industrial Effluent and the Sources of Pollution**

Source	Polluted Area	BOD
<b>A. Industrial Effluent (incl. households)</b>		
▪ Nairobi	Nairobi and Athi River	>1,000 mg/l
▪ Eldoret	Sosiani River	400–1,000 mg/l
▪ Nakuru	Lake Nakuru	1,471 tonnes/year
<b>B. Local Industrial Effluent</b>		
▪ Pan African Paper Manufacturing Plant	Webuye and Nzoia rivers	>600 mg/l
▪ Chemical pollutants	Sosian River	800–1,000 mg/l
▪ <i>Sugar factories</i>	<i>Nzoia and Nyando rivers</i>	<i>&gt;1,000 mg/l</i>
▪ 1,800 coffee factories		>1,000 mg/l

**Source: Jica 2002**

Lake Victoria exhibits some eutrophic conditions (i.e., an over abundance of nutrients<sup>35</sup>). The main pollution sources include sediments (i.e., soil nutrients), run-off fertilizer, farm chemicals, raw sewage, domestic waste, and industrial waste (from the factories that discharge directly into the Lake and its influent rivers). Increased nutrient loads have led to algal blooms and reduction in fish yields in the wetlands near areas with major settlements, industries, and agriculture. The pollutants act as nutrients and help spread invasive species, such as water hyacinth.

Kenya signed the International Declaration on Cleaner Production Technology in 2000. Cleaner Production promotes continuous environmental improvements, through reducing the use of natural resources, preventing pollution at source, and reducing waste generation. A number of cleaner production projects are being implemented, with some examples in the sugar sector. Efforts here should be supported.

**Trends/constraints/opportunities:** Sugar-mill effluents are insufficiently treated. The downstream effects include contamination of potable water supply and eutrophication. Most sugar mills (even the new mills) have old machinery and/or insufficient capacity to treat their effluents. Perhaps KESREF could research the current sugar mill effluents

<sup>34</sup> The 2002 JICA study quotes these erosion volumes for Rift Valley–Pekera River Basin: 0.1 million tons/year and Athi–Central Athi River Basin: 8.5 million tons/year.

<sup>35</sup> The oxygenation level in the deeper (non-circulating) layers of the lake have decreased over time, which is consistent with having higher algal biomass and productivity due to nutrient and pollution inflows. Algal blooms are associated with fish kills.



more fully, but it is time for the sugar mills to comply with water discharge standards.

## **4.2.8 Climate**

### **4.2.8.1 Temperature and Rainfall**

The climate in Kenya varies with altitude and location and is generally controlled by variations in the inter-tropical convergence zone (ITCZ). Mean temperatures range from 10 to 34°C, with great diurnal variations. Kenya has 2 distinct seasons – rainy and dry. The total annual rainfall varies from 200–400 mm in northern and eastern Kenya, to more than 1,600 mm in western and central Kenya, and to 2,000 mm in highlands and forested areas. Low-lying areas receive much less rain, usually between 200 and 800 mm/yr. Only 12% of the country receives reliable rainfall. Elsewhere, rainfall is erratic. Some areas have evapo-transpiration rates that exceed the rainfall amount. Rainfall shows a high variability throughout the seasons, between years, and between locations. This high variability contributes to a great diversity of wild plants and animals, but creates a challenge for growing crops.

Areas east of the Rift Valley have 2 rainy seasons: one long (March–May) and one short (October–November). Areas bordering Lake Victoria generally experience one long rainy season from March to September. For areas subject to 2 rainy seasons, the rains are not quite long enough to allow very high yields. In most parts of the country, the “long” rains account for most of the annual rainfall, but the “short” rains are essential for crops to mature. The dry period is usually from December to February.

**Map 15 (Annex 1.1)** shows that the sugarcane zones in western Kenya have comparatively good average annual rainfall, 1200–1600 mm; the coastal zone has comparatively less annual rainfall (800–1200 mm). **Map 16 and 17 (Annex 1.1)** show that the western sugar zone receives on average 200–400 mm of rain at the peak of the rainy season in April and 100–200 mm during November (WRI 2007).

### **4.2.8.2 Climate and Agriculture**

Kenya has two agricultural production systems: rain-fed<sup>36</sup> and irrigated. Rain-fed agriculture accounts for about 98% of the agricultural activities. Because of the bimodal rainfall pattern in most of the country, there are two cropping seasons (except in the very high-altitude areas). The performance of rain-fed agriculture varies spatially. In the humid, high-altitude areas, agricultural productivity and predictability are high. However, the population density in these areas is rising and land is increasingly subdivided into small parcels that are not efficient for farming.

In the medium altitude and moderate-rainfall areas, rain-fed farming is moderately suitable. However, there is a relatively high risk of crop failure due to the increased frequency of dry spells and the uneven rainfall distribution. Increasing productivity in these areas will require better selection of crops, adoption of improved technologies, and better crop husbandry.

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<sup>36</sup> More than 80% of Kenya is classified arid and semi-arid. About 15% of the country receives enough rain to grow maize and other non-drought-resistant crops; 13% of the country has sufficient rains to grow some drought-resistant crops; 72 % of the Kenya does not have enough rain for (rain fed) agriculture.

#### **4.2.8.3 Climate and Natural Disasters: Floods and Droughts**

Agricultural productivity is vulnerable to droughts, floods, and increasing temperatures. Droughts cause agricultural losses, reduce water quality and availability, and increase food insecurity. Floods cause erosion, destroy crops, and endanger livestock<sup>37</sup>.

Wetlands and areas prone to flooding provide high benefits. The regular flooding of the Tana, Nyando, and Yala rivers deposits rich alluvial soils on the riverbanks, which are excellent for growing crops. However, Kenya has had major disasters in the form of severe floods<sup>38</sup> and droughts over the past 20 years. Severe floods destroy homes, schools, and crops, and kill people and animals. Frequent droughts cause crop failures, water shortages for all users, and accelerate desertification.

**Trends/constraints:** Climate change and variability will increase the number of flooding and drought events.

#### **4.2.9.4 Climate Change**

Climate studies in Kenya<sup>39</sup> indicate that temperatures have increased, especially near large water bodies. Some projections show an increase in mean annual temperature of 1 to 3.5°C by 2050. Mean temperatures are predicted to increase with a greater frequency of ‘hot’ days and nights and fewer ‘cold’ days and nights<sup>40</sup>.

Increasing temperatures are likely to affect the growing area of some major crops (e.g., tea). (Such studies have not been carried out for sugarcane). For instance, the traditional tea growing areas are expected to shrink with an average temperature rise of 2°C or more (See **Map 18, Annex 1.1** for the effect of temperature rise on tea-growing areas). This will affect the livelihood of many farmers, processors, and exporters and lead to some migration and land use change. Given its large but shallow surface area compared to volume and limited river inflow, Lake Victoria is considered quite **vulnerable to the effects of climate change**. ([http://en.wikipedia.org/wiki/Lake\\_Victoria](http://en.wikipedia.org/wiki/Lake_Victoria)).

Climate models for Kenya predict an increase in rainfall, an intensification of heavy rainfall during the wet seasons, and an increase in flood risk. However, seasonal rainfall trends are mixed: some locations may get more rain and other locations may show no significant changes. The annual rainfall **totals** show either neutral or slightly decreasing trends due to a general decline in the long March–May rains. What is clear

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<sup>37</sup> For example, perennial floods in the Nyando River catchment have put KSh 1.16 billion worth of livestock at risk in the lower reaches of the Nyakach, Miwani, and Nyando areas.

<sup>38</sup> The shores of Lake Victoria, the banks of the Tana River, low-lying areas, major swamps, and many rivers (e.g., Nzoia River) are prone to flooding. The 1997/1998 floods affected 1 million people. It cost the economy about US\$ \$0.8–1.2 billion in damage to infrastructure (roads, buildings and communication systems), public health (including fatalities), and loss of crops. Damage to property destruction, soil erosion, mudslides, landslides, surface and groundwater pollution, and sedimentation of dams and water reservoirs cost another US\$ \$9 million. The 2002–2006 floods near Lake Victoria had significant impacts due to high population density (See **Map 6 in Annex 1.1**) (WRI 2007 and SOE 2010).

<sup>39</sup> General trends for all of East Africa show an increase in precipitation over the 1961–1990 baseline. Concurrently, the sea level is expected to rise, which will increase the impact of storm surges that have the potential to destroy coastal infrastructure, inundate agricultural lands, and cause groundwater salinity (SOE 2010).

<sup>40</sup> For example, the occurrence of extreme cold temperatures has decreased in the ASALs, leading to glacier melt on Mount Kenya.

to most everyone who has a climate-sensitive livelihood is that the rainfall *pattern* has changed (e.g., rains are often delayed).

Major droughts and floods have occurred regularly in Kenya in each decade over the past 30 years. Minor droughts occur every 3–4 years. During field visits for this SEA in July 2012, some sugarcane fields in Kibos (Nyando belt) and in South Nyanza showed signs of the most recent drought (i.e., decreased growth rate). KESREF scientists are preparing a paper on drought, but in general, much more research will be needed to adapt the sugar sector to climate change.

Climate change and variability will undoubtedly exacerbate existing issues within and outside the sugar sector, including issues related to low yields/high cost of sugar, droughts and flood events, population growth, migration of people into marginal land, inadequate infrastructure and provision of social services, poor soil management, deforestation, poverty and development issues, and environmental degradation, as was highlighted by the 2008–2011 drought<sup>41</sup>.

Recurrent, extreme weather events have high economic costs (e.g., up to US\$ 500 million/yr or 2 % of the GDP) and can restrict long-term growth. Competition for water, which is already evident, could generate natural resources conflict, food insecurity, and malnutrition.

The National Climate Change Response Strategy (NCCRS) and Lake Victoria Basin initiatives have proposed various measures to reduce the impacts of climate change on agriculture (but not specifically for sugarcane). Many of the measures (listed in the footnote below<sup>42</sup>) could be adapted to the sugar sector. In a study conducted in Kenya on climate change, households in all regions indicated that they lacked credit or savings to adapt to climate change, followed by lack of knowledge about appropriate adaptations (**Table 15**).

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<sup>41</sup> The *Kenya Post-Disaster Needs Assessment (PDNA) Drought Report* states that the overall effects of the 2008–2011 drought was estimated at KSh 978.6 billion (US\$ 12.1 billion), which included KSh 64.4 billion (US\$ 805.6 million) for the destruction of physical and durable assets and KSh 904.1 billion (US\$ 11.3 billion) for losses in the flows of the economy. *N.B. This 2008–2011 drought was defined as a: Meteorological drought (i.e., lower-than-normal precipitation duration & intensities at various times); Agricultural drought (i.e., inadequate soil moisture to meet the needs of various crops in the country); Hydrological drought (i.e., deficiencies in the availability of surface and groundwater supplies over periods of time; and Socio-economic drought (i.e., with physical water shortages affecting the health, well-being, and quality of life of communities across the country).*

<sup>42</sup> The National Climate Change Response Strategy (NCCRS) proposed these measures, among others, to reduce the impacts of climate change on agriculture: Irrigation; early maturing and high yielding crop varieties; drought- and pest-resistant crop varieties; disease-resistant livestock; diversification of livelihoods; adaptation of agricultural technologies; and enhancing early-warning-systems with drought monitoring and seasonal forecasts (to enhance food security).

Climate change strategies reported in the Lake Victoria Basin include to: create awareness on importance of environmental conservation; improve soil fertility; promote good agricultural practices; encourage best agro-forestry practices; protect shore lines and riverbanks; support small-scale irrigation; use drought- and disease-tolerant varieties; provide water services to the rural poor; protect water sources; dig trenches on land to channel excess water during floods (and release it using well-designed secondary drains); provide support for people who are displaced during floods; improve infrastructure in areas with high vulnerability to ensure effective readiness and preparedness for handling effects of climate change; national government to come up with long-term strategies and capacity building on climate change and its effects; and carry out awareness building at all levels (including within the education sector and health-care sector).

**Table 15: Constraints on Short-term Climate Change Adaptation (% of households)**

Constraints faced (all regions)	All regions	High potential	Medium potential
Lack of information about short-term climate variation	8	7	10
<b>Lack of knowledge of appropriate adaptation</b>	<b>19</b>	<b>16</b>	<b>25</b>
<b>Lack of credit or savings</b>	<b>59</b>	<b>56</b>	<b>64</b>
No access to water	8	12	3
Lack of appropriate seed	5	4	6
Other constraints	13	12	14
No barriers to adaptation	8	9	8

Source: SOE 2010

**Trends/constraints/opportunities:** Developing and implementing mechanisms to help sugarcane farmers to adapt to climate change is a priority. The current and emerging climate-related hazards need to be researched and managed to minimize negative impacts at the sub-sector level, and then sector-specific adaptation measures need to be harmonized with other sectors. Delays in adapting the sugar sector to climate change and variability may exacerbate resource use conflicts with other climate sensitive sectors (e.g., between sugarcane and other crops, and with hydro-energy, agriculture, and tourism).

#### **4.2.8.4 Carbon Sinks and Carbon Trading**

Kenya ratified the Kyoto protocol in 2005 and was the first African country to engage in carbon trading<sup>43</sup>. Within the sugar sector, Mumias Sugar Company has an agreement with Japan Carbon Finance to buy carbon emission reductions; MSC is reducing its carbon and methane emissions by using bagasse to generate electricity for sale to the grid. N.B. MSC has been using bagasse to generate electricity for its internal needs for a long time; what is new and interesting is that sugar mills now have an incentive to apply energy saving measures in the factory, so that more of the steam generated by burning bagasse can be used to generate electricity for sale.

**Trends/constraints/opportunities:** One point for concern was that the need to generate electricity to sell to the grid through cogeneration (allegedly) has led or could lead to some poor environmental and poor agricultural practices (e.g., cutting down trees to feed the boilers and premature harvesting of sugarcane). This negates the environmental improvements of a CDM project.

#### **4.2.9 Air pollution**

Vehicles emissions, industrial emissions, use of charcoal and wood fuel, and open burning of waste are some of the main sources of atmospheric pollution. In the sugar sector, it was common previously to harvest sugarcane using the burning method. This produced soot that polluted the air, which came down on the local population. This is no longer the common practice, even though burning cane is still the preferred harvesting method of cane cutters (as cutting green cane is tedious work). Nowadays, cane fires are accidental or malicious. In the areas visited during this SEA, most farmers seem to be following the rules about not burning cane. This was substantiated

<sup>43</sup> Three hydropower plants and one geothermal project were approved by the World Bank Carbon Finance Unit: Olkaria II 3rd Unit at Eburru; Kipevu Combined Cycle at Kiambere; Sondu Miriu; and the redevelopment of Tana Power Station. These projects displace about 2.4 million tonnes of CO<sub>2</sub> and will generate about US\$ 17.9 million in revenues for KenGen (SOE 2010).

by the fact that sugarcane trash was often seen in the fields. Due to the risk of fire, neighboring farmers have a stake in preventing fires.

Otherwise, the boiler emissions from the sugar mills are subject to regulations, although the extent to which the regulation is enforced is questionable. During a scoping phase field visit to a sugar mill for this SEA, soot and ash was flying into the interview room.

**Trend/constraint:** Air emissions from the factory chimneys are often not within acceptable limits. This requires enforcement.

### **4.3 SOCIO-CULTURAL BASELINE, TRENDS, OPPORTUNITIES, and CONSTRAINTS**

The socio-cultural baseline covers a number of relevant topics, including: Population, governance, gender, health (malaria, HIV/AIDS, agrochemicals, access to water), food security (and livelihoods), poverty, and incomes.

#### **4.3.1 Population**

Kenya's population has changed dramatically, from 5.4 million in 1948, to 10.9 million in 1969, doubling again to 23.7 in 1989. This rate of increase has slowed somewhat, to 36.5 million in 2010. From having the highest population growth rate in the world in the 1970s, Kenya's population growth rate has stabilized at around 2.9%. Population density ranged from 2 persons/km<sup>2</sup> in the ASALs to more than 2,000 per km<sup>2</sup> in the high-potential areas (1999?). The rural-urban split was 78:22, and in 1999, the overall growth rate of Kenya's urban population was 6% — a high rural-urban migration pattern<sup>44</sup> ([Sessional Paper NLP 2009](#)).

In 1999, about 75% of the population lived within the medium- to high-potential agricultural areas (or within 20% of the land mass), near major fisheries in Lake Victoria and along the Indian Ocean coast. **Map 19 (Annex 1.1)** shows the Human Population Density for 1989 and 1999.

**Trend/constraint:** In western Kenya (in the medium- to high-potential agricultural areas), the number of densely populated areas has risen sharply over the past decade.

#### **4.3.2 Socio-cultural Characteristics of the Sugarcane Zones**

Sugarcane growing is undertaken on large-scale and on small-scale farms. Large farms are mainly owned by sugar factory companies (nucleus estates), but there are some individually-owned large-scale farms near Muhoroni and Sony. But overall, sugarcane farming is undertaken mostly by smallholders, with various ethnic and/or religious groups dominating in the different locations<sup>45</sup>.

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<sup>44</sup> Kenya has experienced rapid urbanization mainly because of the shrinking livelihood base in the rural areas. Between 1969 and 1999, the urban population increased from 1.2 million to 7.7 million people (from 10% to 27% of the total population). In the period 2000–2005, the rate of urbanization was 7.05% —the highest in the world. People mostly migrate to the urban centres of Nairobi, Mombasa, and Kisumu. Urban policy and planning have been unable to keep up with the rapid urbanization, resulting in slums, squatter settlements, and inadequate water, sanitation, health facilities, and other basic infrastructure (EU 2006).

<sup>45</sup> Kenya has more than 40 different ethnic groups divided into 3 broad linguistic groups: the Bantu, Nilotic and Cushitic. The Bantu group comprises about 66% of the population, including the Kikuyu, Kamba, Mijikenda, and Luhya. The Nilotic group comprises the Luo, Maasai, Turkana, Samburu, and Kalenjin. Kenya's smallest ethnic

### 4.3.3 Governance

**Trend/constraint:** In general, sugarcane farmers know very little about the plans of the sugar mills, one reason being is that they are treated as suppliers of cane, rather than “sugarcane owners”. Farmers further admit that they are not in a position to purchase shares should the mills be privatized. The idea of buying shares in a mill is unfamiliar.

### 4.3.4 Gender (and Education)

School enrolment from primary to university level is generally improving within the geographical focus of the SEA<sup>46</sup> (See example in **Table 16**). However, important gender differences persist, with the number of males attending primary, secondary, and university education still outnumbering the number of females. This is generally attributed to the fact that girls have a heavier workload than boys and will skip school to complete domestic chores (see **Map 20** for *Secondary School Enrolment by Sex*).

**Table 16: Primary School Enrolment (2004 to 2009)**

Province	2004	2005	2006	2007	2008	2009
Coast	556,013	585,543	600,041	643,355	658,860	689,798
Western	1,101,162	1,143,972	1,122,557	1,273,510	1,333,640	1,365,127
Nyanza	1,321,901	1,324,239	1,334,597	1,441,735	1,508,264	1,576,779

Source: SOE 2010

A large proportion of the economically active females are working within the agricultural sector<sup>47, 48</sup>.

**Trend/constraint:** The average age of farmers is high and the tendency to take risks and to try new things is low. The majority of people who live at the farm tend to be women and children, who are generally less able to undertake new strategies to improve their own livelihoods. In farming, women (and young people) have relatively less freedom than men to make major decisions and to spend household incomes. Women have little access to and control over land, owning only 5% of the registered

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group is the El Molo, of the Cushitic linguistic group.

Cane growing is undertaken primarily by the Luo and Kipsigis communities in the Nyando sugar belt; by the Luo and Kisii in the South Nyanza belt; and by the Luyha in the Mumias/Nzoia area (Kakamega belt) in western Kenya. In the past, the Mijikenda (Giriama, Pokomo, and Taita) formed the major sugarcane growers in Ramisi. In the proposed sugarcane project in the Tana Delta, the major ethnic groups likely to grow sugarcane are the Orma, Pokomo, and the Wardei pastoral community. Most sugarcane growing communities belong to three main religious groups: Catholic, Protestant, and Muslim.

<sup>46</sup> The SOE (2010) reports that primary and secondary school enrolment is increasing due to general population increase and also in line with the GOK's introduction of the *Free Primary Education* (FPE) (2003) and the *Free Tuition Secondary Education* (FTSE) (2008) programmes.

<sup>47</sup> Women have low representation in fishing, construction, transport, and many other sectors. Furthermore, women dominate the category of unpaid family work and the unemployed in urban and rural settings in Kenya.

Fifty seven (57) % of Kenyan women and 86% of men aged 15 to 49 years are currently employed (GoK 2010d). Women from Central and Nyanza provinces stand the highest chance of finding jobs, while women in North Eastern province are least likely to find employment (19%). Thirty nine (39) % of working women and men between 15 and 49 years of age are engaged in *agricultural occupations*, although 10% less women and 3% less men are dependent on the sector than they were in 2003 (GoK 2010d, quoted in SOE 2010).

<sup>48</sup> Children do not work in sugar mills, and the stakeholders (including sugarcane farmers) interviewed during this SEA indicated that child labour is not common in the sugarcane fields at the farm level.

land in Kenya. One important constraint to women is that customary inheritance law bestows land inheritance rights to male progeny. Access to credit and other services is also significantly regulated by socio-cultural factors. For example, commercial banks normally require collateral, and women are often forced to ask the permission of men to use household land and other assets to secure loans. Where the men do not consent, the women have very few alternatives. Another example of a socio-cultural restriction is that although women undertake the actual sugarcane farming, it is the men who normally attend training sessions outside the home and it is the men that generally access the sugarcane payment. But when female sugarcane farmers get access to sugarcane payments, they do get the same payment as male farmers.

#### **4.3.5 Health<sup>49</sup>**

##### **4.3.5.1 Malaria**

Malaria is the leading cause of morbidity and mortality in Kenya, and in Nyanza, Western, and Coast provinces<sup>50</sup>. It's the leading cause of morbidity on sugar estates too. Malaria is linked to poor environmental management and to areas where stagnant water tends to form. The poor are disproportionately affected by malaria, due to their sub-standard living conditions and lack of capacity to obtain and pay for medical care.

**Trend/constraint:** Climate change is viewed as a driving force for a number of health problems, including an increase in malaria in the Lake Victoria Basin (LVB). The rise in temperature allows the spread of malaria mosquitoes, resulting in an increase in the prevalence of malaria, including the expansion of malaria into the highland ecosystem that was previously free of malaria.

##### **4.3.5.2 HIV/AIDS**

Kenya has a moderate rate of HIV infection, compared to other Sub-Saharan countries. Reported rates increased from 4.8% in 1990, to 13% in 2000, to the current 7% (EU 2006). In Kenya, *Nyanza province* is worst affected, with an overall prevalence rate of 14% (SOE 2010).

**Trend/constraint:** A high rate of urbanization and transformation of the local social fabric has occurred as a result of the presence of the sugar industry in the western region. One negative result has been an increase in the infection rate for HIV and AIDS. HIV and AIDS have adverse effects on both smallholder and commercial agriculture, especially through loss of skilled and unskilled labour, decline in labour productivity, loss of remittance income because of AIDS related deaths, and has resulted in a high number of orphans, and households headed by children, single parents, or grandparents. A study on the impact of HIV and AIDS in some commercial agro-estates in Nyanza province revealed that the cumulative cases of AIDS affected as much as 30% of the workforce.

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<sup>49</sup> In Kenya, adult and childhood mortality rates increased from 1993 to 1998, with infant mortality rates increasing from 63 to 71 deaths per 1000 live births. Similarly, in the 1995 to 1998 period, the under-five mortality rate increased from 365 to 590 deaths per 1000 live births. From 1989 to 1999, life expectancy decreased from 58 to 54 for males and from 61 to 57 for females (EU 2006).

<sup>50</sup> Malaria epidemics of varying severity & extent were reported in the LVB in 1992, 1994, 1997/98, & 2000/01.

#### **4.3.5.3 Health and Use of Agrochemicals**

Most farmers do not currently apply the recommended levels of fertilizers to sugarcane. In fact, some farmers divert the fertilizer supplied by the mills to their maize field. Some sugarcane farmers may use some herbicides to control weeds, but usually they only use pesticides to control anthills (1 packet purchased per anthill). The use of agrochemicals may increase in the future, to improve productivity.

**Trend/constraint:** Training in the safe handling and disposal of expired chemicals and containers has not been provided to farmers, due to lack of capacity on the part of extension providers. The task has been left to the chemical vendors. Even though the SEA team did not encounter a direct complaint about the use of agrochemicals, the safe management of agrochemicals (storage, use, and disposal) is an important capacity-development issue for best-practice environmental management.

#### **4.3.5.4 Health and Access to Potable Water**

**Trend/constraint:** Some households have access to boreholes and shallow wells and some communities that live near sugar factories often receive potable water from the sugar mills. But in general, even though sugar belt zones have a number of permanent rivers, access to clean water remains difficult for most households (i.e., the surface water is often dirty).

#### **4.3.6 Food Security**

Most farmers that were interviewed during the course of this SEA admitted that food security<sup>51</sup> is a challenge, especially because of the size of their small farm. On average only about 0.4 ha (1 acre) is devoted to sugarcane (and sometimes even less to maize). In many parts of Nyando and South Nyanza, sugarcane is the only competitive cash crop. Some farmers have taken advantage of planting sugarcane to earn cash, and plant some maize for food security. Given the small land sizes, some farmers intercrop maize and sugarcane; the idea is that maize will be harvested early, and the cane will continue to grow in the space left.

**Trend/constraint/opportunity:** Drought and flood episodes cause crop failure, and with climate change, food security issues are likely to increase. Agricultural guidelines say that farmers should maintain 1/3 of their land for subsistence crops, but the guidance can be ignored. The Ministry of Agriculture has developed a model for farmers who wish to practice a mixed-farming system: 2 rows of sugarcane and 1 row of maize. The model dictates that the land is well fertilized to reduce competition between the maize and the sugarcane (the model is not always well implemented).

#### **4.3.7 Poverty**

About 53% of rural and 50% of urban Kenyans were poor<sup>52</sup> in 1997<sup>53</sup>, <sup>54</sup>. More recent

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<sup>51</sup> According to the SOE (2010), the increase in fish export has negatively affected the local fish price and hence the nutritional status of communities that rely on fish as their sole protein source (e.g., in the Victoria Lake area).

<sup>52</sup> The causes of poverty include high population growth rate, insecure land tenure, poorly planned urbanization, political marginalization, illiteracy, unemployment and under-employment, and income inequality, lack of access to basic services (e.g., primary healthcare, education, clean and potable water, and adequate housing and sanitation) (SOE 2010).



data show that about 46.6% of Kenya's population lives below the national poverty line. Poverty is still generally widespread, being more prevalent in the rural setting and in some regions. The poverty rate ranges from less than 30% to 80–90% (ASALs). **Map 21 (Annex 1.1)** shows the percentage of the population living below the national poverty line; it highlights the high poverty rate in the areas covered by this SEA.

The poverty gap is a measure that captures not only the proportion of the population that is poor, but also the extent of the poverty. In Central and Nairobi Provinces, poverty gaps are often less than 10% of the poverty line, meaning that the average poor person needs only about an extra KSh 124 (US\$ 1.77) per month to move out of poverty. In contrast, areas with large poverty gaps occur in many parts of *Nyanza and Coast Provinces*. In these areas, an extra KSh 350 (US\$ 5.00) per month may be needed to lift the average poor person above the poverty line (i.e., these provinces have many of the poorest of the poor).

***Trend/constraint/opportunity:*** Tackling poverty within the geographical focus of this SEA will entail, among other efforts, raising the average annual incomes per person (including the income of sugarcane farmers) and more fully implementing the GOK's *Social Protection Policy*<sup>55</sup>.

The over-reliance on farming has a downside: households are becoming less resilient and more vulnerable to existing and emerging risks and shocks (e.g., climate change and land degradation<sup>56</sup>). Land degradation leads to more poverty by reducing productivity of the land, and thereby reducing household incomes.

#### **4.3.8 Livelihoods**

Many Kenyans remain subsistence farmers. Livestock, cropping, mixed farming, fishing, and hunting–gathering are important sources of food and livelihoods in rural Kenya. Sugarcane farmers often adopt several livelihood strategies at any given time. The most relevant livelihood strategies are described in more detail below.

***Livestock (&and pastoral) livelihood strategies:*** Livestock activities play a role almost everywhere in Kenya, but this strategy accounts for about 25% of the income along the coast and around Lake Victoria<sup>57</sup>.

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<sup>53</sup> The poverty rate (% of people below the poverty line) reflects how widespread poverty is in an area. Official poverty statistics are based on household expenditures. For 1997, the poverty line used was KSh 1,239 (rural) and KSh 2,648 (urban) per month.

<sup>54</sup> In Kenya, human development declined in the early 1990s. In 3 years, Kenya fell 20 places on the UNDP Human Development Index (falling to 154 out of 177 places). By 2005, it ranked 10 places below Uganda (EU 2006 and WRI 2005).

<sup>55</sup> The Social Protection Policy includes a cash-transfer programme, allowing for free primary education, subsidized secondary education, food subsidies, subsidized agricultural inputs, and other price subsidies, including micro-finance programmes (e.g., *Women Enterprise Development Fund* and the youth fund).

<sup>56</sup> Land degradation can occur because of improper farming methods (e.g., either through ignorance, lack of needed skills, or lack of inputs).

<sup>57</sup> *Livestock strategies* accounts for more than 50% of the income in the semi-arid and arid lands of southern, eastern, northern, and northeastern Kenya; livestock accounts for about 25–50% of the income in much of central Kenya. *Cropping and livestock raising* is an agro-pastoral strategy that is clustered along the margins where rainfed agriculture is possible and around more permanent water sources (e.g., the mountains close to Marsabit and along the Tana River near Garissa).

**Mixed farming:** Mixed farming, combining dairy cattle, and food and cash crops is the dominant livelihood in the high-potential agricultural lands of central and western Kenya<sup>58</sup>.

**Fishing:** Fishing can be combined with raising livestock or cultivating food crops, but fishing is a very localized livelihood strategy, being dominant for communities along the shores of Lake Victoria and the Indian Ocean (north of Malindi) (and Lake Turkana)<sup>59</sup>. About 92% of the fish landed in Kenya is from Lake Victoria.

**Hunting and gathering:** Income from hunting and gathering (excludes the sale of woodfuel) plays a role almost everywhere in Kenya. Throughout the highlands, and in Nyanza and Western Provinces, there is a diverse mix of reliance on hunting and gathering activities<sup>60</sup>. Where available, gathering nuts, fruits, and tubers, collecting honey, and hunting wildlife (e.g., rodents, guinea fowl, other birds, and larger animals such as antelope) are important sources of food.

**Wage labour:** In parts of the coastal hinterlands, plantation labour, mining, and other wage labour are important. The nucleus estate of sugar mills provides some wage labour.

#### 4.3.8 Incomes and Sugarcane

Some farmers (especially in South Nyanza) identified sugarcane as their prime income source and their only cash crop. Sugarcane income has helped them to build new houses and to meet other expenditures, such as school fees for their children. It was concluded during the SEA fieldwork that serious, competent farmers feel considerably richer on account of participating in the sugar industry, whereas some poorer farmers are still struggling, unable to finance some field operations. For some *serious, competent* farmers, the income from cane is often enough to get by and even enough to invest in some new ventures. When thinking about the future, some sugarcane farmers anticipate that not all of their children will become farmers or be employed within the local area. In that case, sugarcane is seen as a means to pay school fees and to provide their children the education and opportunity to transition away from farming.

Notwithstanding the above, a recent study on sugarcane contract farming<sup>61</sup> showed

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<sup>58</sup> Generally, there are lower yields and incomes from *mixed farming* when it is practiced in more marginal areas having more erratic rainfall and less-fertile soils (e.g., the shores of Lake Victoria, the coastal hinterlands, and large parts of Laikipia, Machakos, Mwingi, Kitui, Makueni, Taita Taveta, Kwale, Kilifi, and Malindi Districts).

<sup>59</sup> Fishing accounts for a substantial amount of income on the shores of Lake Victoria south of Kisumu, along the western shore of Lake Turkana, and at marine fishing sites in Malindi and towns further north on the coast. Elsewhere, fishing typically provides < than 10% of total cash income. About 40,000 people fish for a living (sometimes combined with livestock raising or food cropping) in selected areas along Lake Victoria, Lake Turkana, and the Indian Ocean.

<sup>60</sup> Areas where hunting and gathering provide >60 % of income are scattered across different regions of the country, bordering the edge of major national parks or other areas in the north (e.g., near Lake Turkana).

<sup>61</sup> Waswa et al. J. Appl. Biosci. 2012, *Contract sugarcane farming and farmers' incomes in Lake Victoria Basin, Kenya*. This study sought to clarify the relationship between contract-sugarcane-farming, poverty, and environmental management in the Lake Victoria basin using data collected from 117 sugarcane farmers from Lurambi, Koyonzo, and Chemelil in western Kenya. The payment statements of the farmers were used to collect data on incomes.

that on average farmers retained only 31–34% of the gross income. The sugarcane yield was a key determinant of gross income, but net income was significantly depressed by company-driven deductions, which farmers could not control. Such skewed income sharing, where the sugar companies retains about 60% of the gross income (because of inputs that were provided), raises sustainability concerns. The authors concluded that to profit from sugarcane contract farming, farmers (having > 5 acres) needed to double their current mean yields per unit area<sup>62</sup>.

In general, current attempts to reduce the cost of land preparation, and cane cutting, transport, and milling have yet to translate into higher incomes for farmers. There is also the issue that some farmers feel that the deductions made by sugar mills are excessive. Another important issue is the type of contracts made between farmers and millers, which not only make achieving a sustainable livelihood more difficult, but also make sustainable land management and extension efforts more difficult, given that the perspectives of a ‘laborer’ are different from that of a ‘crop owner’.

**Trend/constraint/opportunity:** It is urgent to address the profit sharing/farmer-income issues and the equitability of sugarcane farming contracts. Poor rural incomes increase the rural–urban migration rate, particularly with the youth.

#### **4.4 SOCIO-ECONOMIC ENVIRONMENT BASELINE**

The socio-economic baseline covers a number of relevant topics, including sugarcane productivity (and cost figures), value addition, competition and privatization, agricultural economic development, and economic development (in general).

##### **4.4.1 Sugarcane Productivity**

**Trend/constraint/opportunity:** The main constraints to the productivity of sugarcane farming in the western part of Kenya include erratic rainfall, seed quality and variety, low yields, low knowledge or implementation of best practices, the cost to transport cane to the mill, benefit sharing arrangements, and socio-cultural constraints. These are discussed below.

**Erratic Rainfall:** The sugar sector needs to adapt to climate change and variability, as discussed in **Chapter 4.2.9**.

**Seed Quality and the Adoption of New Cane Varieties:** Mills need to provide top-quality seed cane and related extension services at cost. There will be a clear difference in the future between varieties recommended for high vs. low altitude locations and for irrigated vs. rain-fed sugarcane. With the erratic rainy and dry periods due to climate change and variability, it will be important to select cane varieties with good drought resistance and good ratooning capacity.

However, despite the effort made over the last decade to multiply and distribute higher yielding, better adapted, and treated seed cane, farmers have been slow to adopt the technology. A study<sup>63</sup> was conducted in Nyando zone to determine the

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<sup>62</sup> Where this option is not feasible, farmers were encouraged to diversify their livelihoods with other cash crops (or through other sustainable, intensive systems).

<sup>63</sup> See Odenya, J.O, C.O. Ochia, C. Korir, V. Otieno and G.K. Bor: *Adoption of Improved Sugarcane Varieties in Nyando Sugarcane Zone, Kenya*. Kenya Sugar Research Foundation, Kibos, Kisumu). The respondents for this study were drawn from 3 districts: Nyando, Kericho, and South Nandi. Data was collected from 8 members of

adoption level of improved sugarcane varieties. The study concluded that the decline in area under improved varieties was in part due to the inadequate supply of planting material. Also, farmers lacked knowledge and awareness about the improved varieties and how to obtain the (higher-yielding and disease-free) planting material.

**Opportunity:** The study recommended that KESREF establish more demonstration plots in sub-locations for farmers to see and appreciate the attributes of new varieties. It was also recommended that KESREF should embrace the idea of finding a more effective and innovative extension-service-delivery-model to cater to the large number of sugarcane farmers.

**Low yields and low knowledge or implementation of best practices:** Most farmers have low and decreasing sugarcane yields. Yields are a function of a number of factors, including: time of planting; variety; fertilizer application; timely weeding; rainfall; and number of ratoon crops. Mills need to provide top-quality extension services at low cost.

Some farmers say that they know how to improve their productivity, but lack the capital to do so. Late planting, inadequate weeding, and low fertilizer application were common problems with the sugarcane plant crop. The ratoon crop is mainly affected by poor weeding, low application of fertilizer, and harvesting of cane during wet weather (resulting in stubble damage). One thing that every farmer can do is to cover the fertilizer with soil at time of application, to ensure that it does not run-off at the first rain. Farmers need to ensure that inputs are received on time and provided for at the lowest costs (e.g., through farmers' groups).

**The cost to transport sugarcane to the mill:** The SEA team visited two rural areas where the access roads were maintained. However, in the Kano plains, roads were often impassable, mainly due to flooding and erosion gullies.

Poor roads lead to high transport costs and road accidents. In the Nyando Belt, transport costs can be as high as 46% of the total costs to get the cane to the weighbridge of the sugar mill. Furthermore, cane spills due to bad roads are said to account for a loss of about 3% on transit from farm to factory<sup>64</sup> (Annexes to the EU 2012 Action Fiche, p.13). Altogether, poor infrastructure hampers all efforts to achieve a competitive, efficient sugar sector. Mills need to be more strongly involved in cane haulage issues.

**Benefit sharing arrangements:** A formula should be developed to equitably share the costs between the millers and the farmers related to weighbridges, spillage of cane, roads and bridges, and the cane quality (including sucrose content, fibre content, staleness, and extraneous matter). Farmers could negotiate a better deal through

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Farmers' Research Groups (FRG). The study found that the improved-sugarcane-variety that was most adopted was KEN82-808; the main source of planting material was from other farmers (69%); and most farmers (60%) used plant seed; only 26 % used ratoon crop. The decision to plant sugarcane was made by men, even though most of the labour was provided by women and children.

<sup>64</sup> This is why farmers generally want the weighbridges to be located near the farms, so that they can get paid for the sugarcane that they provide. Farmers are of the opinion that any cane lost during transport is the responsibility of the transporter.

Farmers Groups. In general, farmers need to know that they can only break even in terms of costs for plant cane; they can make good profits on the ratoons (but the mills tend to want to reduce the number of ratoons).

**Constraint/Opportunity:** The Sugar Act 2001 needs to be amended to revise the profit-sharing arrangement between the miller and farmer. It is 50:50. It is common elsewhere for farmers to get 60–70%.

**Socio-cultural Constraints and Land Fragmentation:** Rapid population growth is having a major impact on sugarcane farming. With each passing generation, each male child (and now under the new Constitution, each female child) is entitled to a portion of the parent's land; this leads to smaller and smaller land parcels over time. Rapid population growth and the consequent land subdivision is a major challenge to the sustainability of cane growing in regions with high population densities, such as West Kenya and Nyanza. It seems clear that in areas with high population growth, growing sugarcane (at a competitive cost and at high production levels) is not compatible with the cultural practice of sub-dividing land. The average parcel of land for sugarcane is now about 0.4 ha and below that amount, growing cane is not economical.

**Constraint/opportunity:** It is urgent that a practical solution be found to the cultural practice of sub-dividing land, to avoid the collapse (or severe reduction) of the sugar industry in western Kenya.

#### **4.4.2 Value Addition**

Most of the sugar mills are enthusiastic about green energy, including cogeneration and ethanol production.

**Trends/constraints/opportunities:** There is potential for conflict between producing energy for sale, environmental management, and the sugar business e.g., a CDM-certified plant is allegedly using wood fuel, harvesting cane prematurely, harvesting during the rainy season, and using the burning method rather than the green harvesting method when it has a shortage of bagasse for cogeneration<sup>65</sup>.

Cogeneration to sell energy could also lead to conflicts<sup>66</sup> between optimizing sugar production and producing energy. Cogeneration plants also have high air emissions and have to dispose of their ash.

Producing ethanol produces large volumes of vinasse; its correct management and treatment is important.

Another issue is that the molasses used to make ethanol already has several markets (e.g., used by distilleries and in livestock feed) and a switch to ethanol production for energy will affect these markets. This will also need to be assessed.

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<sup>65</sup> This behavior is apparently as a result of over-sizing the cogeneration plant & will require further investigation.

<sup>66</sup> N.B. Cogeneration does best with high-fiber/low-sugar-content varieties, whereas sugar production is optimized by using early maturing/lower fiber/high-sucrose varieties.

#### 4.4.3 Competition and Privatization

On the issue of competition between growing sugarcane or another crop, there is some past experience. When sugar mills failed to pay farmers in a timely way, farmers switched to maize production<sup>67</sup>.

On the issue of competition between sugar mills, the situation in some locations has changed dramatically. For instance, with the entry of 2 new sugar mills (Sukari in Ndhiwa and another mill in Transmara some 30–40 km away), the competition for cane between the 3 mills has benefited farmers to the extent that they now get paid within 1 month at Sony; some mills even pay cash on delivery. In general, farmers believe that the organisation of the sugar sector is improving with the introduction of competition between mills and with the plan to privatize the public mills.

On the issue of privatization *per se*, there is some concern about whether the private mills will improve environmental and social management compared to public mills. Currently, sugar mills (private and public) do not comply with wastewater standards. Presently, many sugar mills provide some social support. One public mill argued that with privatization, mills could reduce the social benefits that they currently provide to farmers (e.g., malaria control, schools, clean water, clinics, and/or AIDS awareness programs, and advice on integrated farming, food, and nutrition). This could jeopardize the food, nutrition, and health security of farming families.

**Constraints:** Getting credit on time is still a problem and many farmers are unable to weed on time due to a shortage of funds. The problem lies between the KSB and the farmers' organisation: loans are not approved in a timely manner.

#### 4.4.4 Agricultural Economic Development (Irrigation)

Given that 98% of Kenya's crops are rainfed, the high variability of rainfall within and between years poses a significant risk to farmers. Expanding irrigation has the potential to increase cropland substantially and to boost agriculture. Currently, irrigation (2% of the cropland) is carried out by smallholders (46%), larger commercial firms (42%), and through public schemes (12%), but only 19% of the land that could be irrigated is equipped for irrigation. The area under irrigated agriculture increased from 52,000 (1985) to 105,000 ha (2003), but the potential has not been fully developed due to the high cost of infrastructure.

**Map 14 (Annex 1.1)** shows the small-scale and large-scale irrigation schemes in Kenya. Some irrigated areas are located close to Kisumu and along the lower Tana River. There are clusters of small-scale irrigation points around the shores of Lake Victoria and the base of Mount Kenya. The *National Water Master Plan (1992)* identified an irrigation potential of almost 540,000 ha based on 80% dependable flow. **Map 14** also shows the 18 irrigation schemes proposed in the 1992 study.

None of the farmers interviewed (in the west and in the coastal area) had any experience with irrigated sugarcane production. Nyando farmers are keenly aware of the water shortage in their zone and welcomed the idea of irrigation, if suitable water sources could be identified. In contrast, the rainfall in South Nyanza belt is more

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<sup>67</sup> Some 2 to 3 years ago, the situation in the sugar industry was desperate when for example, SONY Sugar was unable to receive the farmers' cane or pay farmers in a timely way (some cane payments were delayed up to 3 years).

reliable and farmers there did not see the need for irrigation. The South Nyanza farmers felt that investment in irrigation would be costly, and that with the right varieties and correct agricultural practices, they could get high yields, even without irrigation. Some farmers indicated that if irrigation water was available, that they would switch to growing rice to benefit from the quicker time to harvest.

Chemelil Sugar Company has experimented with furrow irrigation in Nyando zone, but the effort was abandoned, perhaps because of the difficulty of working with black cotton soils. In the coastal zone, Kwale International Sugar Company Limited (KISCOL) is a new entrant to the scene and is making a paradigm shift by investing in large-scale drip irrigation. The venture is likely to face water constraints in general, and water competition with other nearby users (e.g., Base Titanium).

**Trend/constraint:** There is little experience with irrigated sugarcane production in Kenya. Introducing irrigation for sugarcane will require a lot of awareness raising and capacity development.

#### **4.4.5 Economic Development in Other Sectors (Hydropower and Energy)**

In Kenya, access to electricity is associated with a rising quality of life. However, the high cost of electricity puts it out of reach of many of the poor. Hydropower provides 55% of the installed (electricity) grid capacity, of which 84% is located on the upper Tana River<sup>68</sup>. The Tana River has an estimated installed capacity of 480 MW out of a total estimated potential of 960 MW. The current hydroelectric power potential in Kenya has not yet been fully exploited, with only 719 MW developed against a potential of 6,000 MW.

To meet the demand for clean energy and water, several large and medium-sized multipurpose dams are proposed, some within the area of our geographical focus. At least two dams are proposed on the Sondu-Miriu River<sup>69</sup>: the *Magwagwa Dam Multipurpose Development Project* and the *Sondu Miriu Hydro Power Project*. The *Magwagwa Dam Multipurpose Development Project* has the potential to generate 120 MW of hydropower, irrigate 15,000 ha, and supply adequate water to about 600,000 people. The *Sondu Miriu Hydro Power Project* is a 60 MW power project based on a run-of-river diversion from a weir structure on the Sondu Miriu River. Other dams and hydro projects are in various steps of planning and implementation, for instance, the *Mutonga-Grand Falls scheme* will capture the remaining permanent rivers feeding the Tana River from Mount Kenya.

Even though hydroelectric power is considered a cleaner energy source than thermal oil, it relies on the vagaries of weather, and in drought periods, electricity has had to be rationed.

**Trend/constraint:** Dams for electricity (or other uses, including irrigation) are associated with a number of adverse environmental impacts, ranging from slowed river flows and loss of biodiversity to destruction of upstream riparian habitats. The 60 MW Sondu Miriu hydropower plant is a run-of-the-river plant, so it reduces some

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<sup>68</sup> There are also a number of small hydropower sites built between 1919 and 1955 and other small hydro schemes associated with tea companies and community groups.

<sup>69</sup> The Sondu-Miriu River is one of the 6 major rivers in the Lake Victoria Basin; it drains a total area of 3,470 km<sup>2</sup> in the western part of Kenya. The river originates from the western slopes of the Mau Escarpment.

of the reservoir related environmental impacts, but critics have argued that even without a reservoir, the construction of the hydropower plant polluted the river, led to the disappearance of streams and springs, and caused the extinction of endemic fish species like Okoko (*Synodontis sp.*) (International Rivers Network 2000).

The *Mutonga-Grand Falls scheme* is predicted to have significant impacts on the downstream ecosystems (e.g., on the seasonally flooded grasslands important for livestock grazing and wildlife, the forests along the river's shores (with key primate and bird habitats), and the coastal ecosystems (valuable for fisheries) in the Tana estuary).

Going forward, Kenya is trying to reduce her reliance on both hydroelectric and thermal power by developing geothermal and wind energy, and also encouraging rural and urban households to reduce their reliance on the national grid by investing in cleaner, renewable sources of energy, such as solar, wind, and biogas.

## 5. Impact Identification and Evaluation

As noted in Chapter 2.2.2, the 6 NAS objectives are:

1. Improve sugarcane production and productivity;
2. Privatization and financial restructuring of public mills;
3. Rehabilitate, modernize, and expand sugar factories;
4. Diversify products and add value;
5. Promote trade and marketing;
6. Protect the environmental and social components.

The EU objective is specifically: *to increase the competitiveness of the sugar industry by improving efficiencies and reducing production costs (e.g., through better rural roads, cane quality, capacity development, and environmental management).*

The impact identification and evaluation work of this SEA comprised three exercises: 1. *consistency analysis*, 2. *compatibility analysis*, and 3. *qualitative impact analysis*. The results of the three exercises are discussed below.

***N.B. The environmental and social baseline, trends, and constraints presented in Chapter 4 were at all times considered while completing the three impact identification exercises.***

### 5.1 Consistency Analysis of the NAS Objectives

*NOTE: Text deleted by training course management*



**Table 17 (Annex 1.2.1): The NAS Consistency Analysis**

INTERNAL CONSISTENCY / COHERENCY ANALYSIS OF NAS OBJECTIVES (28 cells)

	1. Improve sugarcane production and productivity	2. Privatize and financially restructure public mills	3a. Rehabilitate and modernize sugar factories	3b. And, Expand sugar factories	4. Diversify products & add value	5. Promote trade and marketing	6. Protect the environmental and social components	7. EU: Increase competitiveness of industry by improving efficiencies & reducing production costs	Comments / Mitigation
1. Improve sugarcane production & productivity							Inconsistent?		7= Strictly apply & enforce env. management measures
2. Privatize & financially restructure public mills							Inconsistent?		"
3a. Rehabilitate, modernize sugar factories							Inconsistent?		"
3b & Expand sugar factories							Inconsistent?		1= Avoid sensitive habitats? Is the land use change sustainable?
4. Diversify products & add value							Inconsistent?		As in Row 1
5. Promote trade and marketing							Inconsistent?		As in Row 1 Remove safeguards
6. Protect the environmental and social components									As in Row 1
7. EU: Increase competitiveness of the industry (i.e., improve efficiencies & reduce prod. costs)									

The most important outcome of this analysis was that it highlighted that the NAS did not provide a specific objective to target some important farm-level issues. Many of the issues related to sugarcane production and productivity and the degradation in sugarcane yields per hectare (and the associated environmental degradation) stem from what is happening at the level of individual farms. Some of the obstacles preventing higher yields per hectare are provoked by the type of relationship that has emerged between the farmers and millers, especially through the process of ‘contract’ farming<sup>70</sup>. Many farmers sign contracts with millers or lease their land to investors, and become casual labour on their own farm. The millers and the investors ‘own’ the cane. It is difficult to expect good husbandry, good environmental management, and higher yields at farm level from this type of relationship.

In that respect, the NAS does not significantly address some of the core issues causing the low yields, high costs, and low competitiveness. ***This SEA exercise resulted in a strong recommendation to add an objective that specifically targets the relationship between farmers and millers in the next amendment of the NAS.***

The consistency analysis also highlighted the need to more clearly define some objectives or to update/revise some objectives. One example relates to Objective 3: *Rehabilitate, modernize, and expand sugar factories*. This objective could be refined to emphasize ‘rehabilitation and modernisation’, including a focus on factory efficiency and maximizing sugar extraction, and could be refined to de-emphasize the horizontal expansion in the sugar sector.

<sup>70</sup> Under a contract, farmers essentially commit to supply a sugar mill with his/her sugarcane harvest. In return, the mill generally supplies inputs, such as land preparation, seed cane, fertilizers, perhaps some herbicides, and sometimes cane cutters and cane transport. Often the mills outsource the inputs, for example, cane transport and fertilizer provision, adding a middleman (and costs) to this complex of relationships. The farmer is generally responsible for manual weeding. At time of payment, all that was supplied by the mill (directly or indirectly via middlemen) is deducted from the farmer’s payment. Farmers claim that the ‘deductions’ applied to the payments are excessive, leaving them with pittance. A similar type of relationship can be agreed when an outside investor leases the farmer’s plot to grow sugarcane.

## 5.2 Compatibility Analysis of the NAS Objectives with External Policy Objectives

The analysis in **Chapter 5.1** focused on the internal consistency of the NAS. This analysis focuses on the relationship of the NAS to its external policy and legal framework. **Table 18** shows the 22 policy and legal framework items that were analyzed in detail to show areas of potential compatibility and potential incompatibility. The analysis covered the Constitution and Vision 2030, and the following sectors/sub-sectors/or policies: agriculture (including irrigation and land reclamation), water, environment (including EMCA, natural resources, and forests), MDGs and poverty alleviation, food and nutrition security, health, and transport and land policy.

The most important outcome of this compatibility analysis was that it highlighted that without stakeholder compliance to environmental protection regulations, the NAS could have significant negative impacts on the environment (especially through intensification of agriculture and the use of agrochemicals) and expansion into new areas (e.g., sensitive areas).

As it cannot be assumed that the private sector will automatically be a good environmental steward, the implementation of environmental management by the private sector will have to be monitored (and enforced, as needed). The private sector has some avenues that are promising (and already in some practice), including cleaner production, cleaner development mechanisms, ISO14001 certification, and some interest in developing the corporate social responsibility (CSR) credentials.

There has not been a focus at any level on the safe use, storage, management and disposal of agrochemicals, and this needs to be addressed.

It is unclear how the NAS objectives will interact and affect the social protection objectives (e.g., poverty alleviation, improvement of livelihoods, and food security) and this aspect will need specific monitoring (See **Chapter 8, *Mitigation, Optimizing Measures, and Indicators***).

**Table 21 (Annex 1.2.3): (Qualitative) Impact Analysis of the NAS Objectives on the Key Environmental Components**

Annex : (Qualitative) Impact Analysis of the NAS objectives on the Key Environmental Components																				
	N=NEGATIVE-RED P/N=POSITIVE/NEGATIVE-YELLOW ?=UNCERTAIN-NEGATIVE-RED	BIOLOGICAL		PHYSICAL ENVIRONMENT				SOCIAL ENVIRONMENT						INSTITUTIONAL CAPACITY				COMMENT		
		HABITAT	SOILS & LAND USE	WATERSHED		ADAPT TO CLIMATE	SOCIAL CULTURAL:		SOCIAL ECONOMIC DEVELOPMENT				Capacity							
		Habitats, incl. wetlands; forest trees,	Soil (e.g., erosion and pollution)	Land use & Land Use Change	Water Catchment & flood risk	Water Supply availability & Water Quality	Adapt to climate change & air quality	Governance, equity, gender equity, children	Health (AIDs, malaria)	Food security & Nutrition, Livelihoods	Sugarcane productivity & competitiveness	Value addition & market access	Agricultural Economic Development	Economic Development other sectors, e.g., tourism	Planning, Capacity, & Coordination	(Expand & Disseminate) Research	Extension Services	Outgrowers' Organisations	Legal Compliance	Monitoring & Evaluation
	NAS activities & EU supported activities																			
	Improve sugarcane production and productivity (row 2-7 are sub-objectives)																			
1	Improve infrastructure in the sugar cane producing areas, including rehabilitate roads	P/N	P/N	P/N	P/N		?													
2	Improve cane yields (i.e., intensify)	P/N	P/N	P/N		P/N	?							P/N						
3	Develop cane (varieties) and (strengthen) cane husbandry																			
4	Introduce & support a cane-payment system based on sucrose content																			
5	Build the capacity of Outgrowers Organisations																			
6	(Provide) Training and capacity building; Strengthen KESREF & Support KESREF research																			
7	Privatize & financially restructure public mills (support privatization of sugar industry & write-off debts)	P/N	P/N	P/N	P/N	P/N		P/N	?	?				?		N	?	?	?	
8	Rehabilitate & modernize sugar factories:																			
9	Expand sugar factories	N	N	N	N	N	N			P/N				N	N	N	N	?	?	N
10	Diversify products and add value:		P/N		?	N														
11	Promote trade and marketing (extend COMESA safeguards; control legal imports; promote diversification & export)	P/N	P/N	P/N		N				N										
	Protect the environmental and social components (conduct environmental audits, EIAs, reduce wastes; improve social services)																			

Given the six main NAS objectives (and the five more detailed sub-objectives listed under NAS Objective 1), this provided 11 rows of NAS activities to be evaluated against the biological, physical, socio-cultural, socio-economic, and institutional components.

The analysis showed that the following sub-objectives and objectives had significant potential to have positive **and** negative impacts on habitats, soils and land use, and water catchment and water supply:

- Row 1: Improve infrastructure in the sugarcane producing areas, including rehabilitate roads;
- Row 2: Improve cane yields (i.e., intensification of the agricultural practices);
- Row 7: Privatize and financially restructure public mills;
- Row 11: Promote trade and marketing.

Usually, at issue was whether the activity (e.g., improve infrastructure) would in fact be conducted in compliance with good environmental practice and standards (e.g., would the road avoid sensitive habitats? Would the road design manage water well-enough to minimize soil erosion? Would quarries and borrow pits be rehabilitated? Would soil fertility be safeguarded?).

With regards to row 7, *privatization*, the assessors felt that the impact on the biophysical and socio-cultural, and institutional component was uncertain. It can be expected that certain private firms will apply good environmental and social practice,

especially if they value accreditations such as ISO, CDM, and other environmental management systems. However, at the moment, most mills, private and public, do not comply with water quality standards and there is insufficient capacity at the institutional level to enforce compliance.

Strict requirements for environmental and social reporting and monitoring, and where necessary, strict enforcement of environmental and social standards will help maintain the good environmental behavior of private (and public) sugar mills.

As was the case with the consistency and compatibility analyses, the objective to '*expand sugar factories*' (Row 9) was identified as being the most problematic, in this case, as having a large number of potentially negative impacts, not only on the biophysical environment (habitat destruction, pollution, land use change, and water supply issues), but also on the institutional capacity component. A sugar industry that expands in total area (hectares) tends to stretch to the limit the available capacity to plan, coordinate, disseminate research, conduct extension, enforce, and monitor. Institutional capacity is already weak, without this horizontal expansion.

This qualitative impact assessment matrix was also useful to gain insight into cumulative impacts. This is done by examining the matrix results in a vertical manner. In this case, it can be seen that the column for '*water supply and water quality*' has 3 cells that are clearly negative impacts (*expand sugar factories*, *diversify products and add value*, and *promote trade and marketing*) and 2 cells that show potential for positive and negative impacts (*improve cane yields* and *privatization*). This implies that the NAS activities when implemented together are likely to have a cumulative negative impact on water supply and water quality. It calls for explicit mitigation measures to manage water scarcity, to adapt to climate change and variability, and to safeguard water quality.

## 6 Analysis of Alternatives

Four (4) reasonable alternatives were identified during the scoping period by reviewing the NAS, analysing the (preliminary) baseline environment, reviewing international and local best practice, and through further consideration of the SEA objectives, the policy and legal framework, and the inputs of stakeholders.

The four alternatives (which were introduced in Chapter 2.6) are:

**Alternative 1:** Expand the sugar industry in a *horizontal* manner (using a larger area, but with the existing cane production per ha). This is equivalent to the zero-alternative or business-as-usual alternative.

**Alternative 2:** Fully implement the NAS. This alternative looks at all the elements of the NAS.

**Alternative 3:** Cane production under irrigation in the 3 agro-ecological zones in western Kenya. Smallholders are integrated into the whole set up:

*Alternative 3a:* at Kakamega

*Alternative 3b:* at Nyando

*Alternative 3c:* at South Nyanza

**Alternative 4:** Large-scale, irrigated, nucleus estate for sugar production. The location for such a complex could be in an area where flood-control measures are planned, e.g., near a dam site.

The 4 alternatives were analysed using 2 methods: 1. Qualitative scenarios (SEA team) and 2. Multi-criteria analysis (SEA team and participants at the July 24 Draft SEA workshop, in Kisumu).

### 6.1 Analysis of Alternatives by Developing Qualitative Scenarios

*NOTE: Text deleted by training course management*

Table 22: Summary of Alternatives and Key Points of Each Scenario			
Alternative	Technical Description	Environmental and Social Impacts	Economic Impacts
<b>Alternative 1:</b> Expand sugar industry in a horizontal manner (using larger area, but same production/ha)	Same production per hectare;  Millers forced to sell sugar at competitive price, so must lower the cane price given to farmers;  Miller reduces costs by reducing maintenance and social benefits.	More trees are cut to feed cogeneration plants, leading to more erosion, land degradation, and sedimentation; loss of fertile soil; disturbance to water habitats;  Because of low price, some farmers reduce acreage under cane; other farmers simply weed less and apply less fertilizer; soils are quickly depleted; Some farmers expand to new sensitive areas, and land degradation increases overall.	Sugarcane is in competition with other crops; Kenya sugar competes with cheaper imported sugar. The sugar industry either collapses, or finds a way to increase cane production per hectare (e.g., through some mechanization).  Extension workers need to provide extension on how to diversify livelihoods, how to grow other cash crops, or how to do other income earning activities. Some villagers abandon farming, and move to town.
<b>Alternative 2:</b> Full implementation of the NAS	Full implementation of the NAS leads to higher cane yields per ha; private, modern mills that produce a diversity	The pressure on existing land and water resources increases, because of intensification; sugar cannot expand to	Land fragmentation eventually leads to 'block' farming or 'group farming'

**Table 22: Summary of Alternatives and Key Points of Each Scenario**

Alternative	Technical Description	Environmental and Social Impacts	Economic Impacts
	of by-products; good local sales and some export products, all within acceptable environmental and social standards.	new areas because of population pressure; Due to land scarcity, food crop cultivation spreads into sensitive areas, including forested and uncultivated land; significant erosion and water-use conflicts are likely.	(and a certain amount of land consolidation). With rural–urban migration, some land may become available for purchase, and external investors may be lured in. External investors however will have little interest in developing local infrastructure (e.g., roads).
<b>Alternative 3:</b> Cane production under irrigation (to better deal with climate change and variability)	<b>3.a Kakamega:</b> Vast hilly area; some areas with gentle slopes, which would be suitable for irrigation; Some good roads; sugarcane follows contour lines; patchy distribution; 1,500 mm of rain; some pans are used to intercept water; some larger-scale irrigation projects are in operation.	In western Kenya, there is a variety of sugar firms, from small jaggeries to Mumias (the largest). The potential to irrigate is larger on nucleus estates (a large number of small-scale schemes would be expensive).  It will be a challenge for farmers to grow low-cost, high-yield, high-sucrose sugarcane.  The small number of farmers that have a water source probably cannot get a loan for small-scale irrigation.  Some farmers will abandon growing cane. Will the mill buy their land? Will the farmers obtain alternative livelihood training?	Implementing irrigation in an undulating landscape for a large number of scattered farmers is not likely (it would be too expensive).  The ratio of nucleus estate hectares to outgrowers' hectares is low, and does not guarantee a smooth supply of sugarcane to the sugar mills.  A better business approach would be to grow more cane under irrigated nucleus estates.  Neighbouring mills could consolidate some of their operations, for economies of scales (e.g., haulage).
	<b>3.b. Nyando:</b> Wide valley with escarpment, plateau, and valley bottom; Kibos receives about 700 mm of rain/year; there are 2 existing irrigation schemes; irrigation can compensate for the rain shortfall and climate variability (but requires a fairly large/expensive storage structure); Kibos sugar mill will irrigate its nucleus; Chemelil has made some attempts; KESREF has completed some irrigation research.		
	<b>3.c. South Nyanza:</b> Undulating landscape, similar to Kakamega; Homa Bay has less rainfall; bananas and sugarcane at Kissi; coffee and tea are cash crops; maize and groundnuts are also grown; farmers have been back and forth with maize vs. sugarcane due to experience at Sony; no irrigation projects planned to supply 'complementary' irrigation; it would be too expensive.		
<b>Alternative 4:</b> Large-scale, irrigated, nucleus estate for sugar production	Given the economic conclusion from Alternative 3 (i.e., <i>Implementing irrigation in an undulating landscape for a large number of scattered farmers is not likely</i> ), what else can be done?  Alternative 4 looks at irrigating a large-scale nucleus estate with vertical intensification. For example, a 10,000 TCD factory (20,000 ha of cane) in the Tana Delta; Cane produced at a very competitive price; Harvesting and haulage can be mechanized; Field operations strictly follow a determined layout; Roads, irrigation, and drainage are integrated. All operations are efficiently organized.	Must apply a lot of environmental and social safeguards, given that the coastal area has low rainfall, and there are many water users, and a potential for water conflicts between upstream and downstream water users;  Constructing the site will damage some sensitive habitats, provoke some land use change, and displace some people; Project design has integrated wildlife corridors and some on-site natural spaces; The main issue is the flow of the Tana River; There is provision for basic water flow to support the Tana Delta.	If this project were located a bit more upstream, the investment and operational costs would increase.  There is a need to further assess what is the best land use for the area: oil palm, cattle rearing, flowers, rice, tourism, or sugarcane? A preliminary assessment is that the sugar industry would employ the most number of staff, and provide market opportunities for the local villages; the sugar estate would prioritise the use of local labour and minimise the need for migrant workers.

## 6 Institutional Capacity Assessment for Environmental Management (in General) and to Implement this SEA

*NOTE: Text deleted by training course management*

**Table 26: Summary of the Capacity of Key Sugar Sector Stakeholders for Environmental Management and for Implementing the Recommendations of this SEA**

Institution	Policy (mandate, regulatory instruments, guidelines)	Human resources (skills and hardware)			Institutional (finances, network, organisational mechanism)
		1. Skilled staff	2. # of staff	3. Hardware (database, equipment)	
NEMA	√ Has some Environmental monitoring guidelines and systems, but insufficient for monitoring this SEA	1. √ has skilled staff for environmental management  2. Insufficient # of staff  3. Insufficient data and equipment to monitor sugar sector			Insufficient finances  Insufficient contacts/network to coordinate with MOA, KSB central, KSB county level, and sugar mills
MOA	√ Has environmental mandate, but the agricultural monitoring system, (including for environmental quality) is insufficient	1. √ Has skilled staff, but MOA staff may not necessarily know the details of the sugar sector  2. √ Has a good # of staff, but not generally assigned to sugar sector  3. √ Has some scattered agricultural monitoring data, but insufficient system to monitor sugar sector impacts			√ GOK financed  It is unclear whether its mechanisms to coordinate with Land Commission on environmental management in the agricultural sector are sufficient
KSB	√ Environmental and social management roles are not explicit enough in Sugar Act	1. √ Has skilled staff, but may need environmental management training  √ Has a good number of staff, but no designated Environmental and Social management staff (at central and County level)  3. No database for Environmental management and monitoring system			<b>No:</b> * Environmental management and monitoring budget line * Network of environmental contacts within key sugar-stakeholder institutions (e.g., NEMA, mills)  Extension model is insufficient to the needs
KESREF	√	√ Has skilled staff  2. Insufficient # of staff for environmental research and extension work  3. √ Has some equipment and data, but no database for Environmental management and monitoring; Insufficient soil testing capacity			Some SDF funding, but insufficient to fulfill all the roles (e.g., research-extension role)  No budget line for environmental research  Extension model is insufficient to the needs
Mills	√ Environmental and social management	1. √ Most mills have skilled staff, but some mills have appointed some staff without adequate managerial skills.			Many financial issues and debt, hampering the privatization process

Institution	Policy (mandate, regulatory instruments, guidelines)	Human resources (skills and hardware)			Institutional (finances, network, organisational mechanism)
		1. Skilled staff	2. # of staff	3. Hardware (database, equipment)	
	<p>roles are not explicit enough</p> <p>Mills do not have explicit environmental policies</p>	<p>2. ✓ Most mills have an adequate number of staff. Not all mills have a <i>trained</i> Environmental and Social Management Officer, to conduct the environmental and social management monitoring</p> <p>3. No environmental management and monitoring system</p>			<p>No environmental management and monitoring budget line</p> <p>No environmental contact within key stakeholder institutions</p>
Outgrowers' Organisations	<p>Outgrowers' organisations do not have an explicit mandate to safeguard the environment, and that role could be made more explicit in the next revisions to the Sugar Act</p>	<p>1. Most outgrowers' organisations do not have enough skilled personnel</p> <p>2. Most outgrowers' organisations do not have an adequate number of personnel.</p>			<p>Financial resources are inadequate for most outgrowers' organisations, mainly due to shortcomings in their management and lack of support from millers and other stakeholders</p> <p>Some outgrowers' organisations continue to operate in a satisfactory manner, but others are facing serious challenges to their existence</p> <p>The organisational model is insufficient to the needs</p>
Sugarcane Farmer	<p>The role of farmers (including environmental role), as well as the benefits from growing sugarcane (and its by-products) are not clearly outlined; the contracts between farmers and millers seem to benefit the miller more than the farmer</p>	<p>1. There are an estimated 300,000 smallholders</p> <p>2. Some farmers have insufficient skills, while the extension services are inadequate</p> <p>3. Insufficient equipment and services</p> <p>4. Extension modules do not fully cover environmental and social management topics</p>			<p>Farmers have insufficient access to finances;</p> <p>Organisational models fail to serve the interests of farmers</p>



## 8. Mitigation or Optimizing Measures and Indicators

Mitigation measures and optimizing measures are mentioned throughout the SEA report. This chapter compiles the mitigation and optimizing measures covering the ten key SEA objectives, proposes specific activities to implement the mitigation measures, and also proposes indicators to assist with monitoring the environmental and social management impacts. **Table 27** presents the whole in a convenient layout. Table 27 can be considered the SEA's environmental management and monitoring plan (EMMP).

**Table 27: Environmental Management and Monitoring Plan (EMMP) (with Indicators)**

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<b>GENERAL RECOMMENDATION:</b>		
<p><b>Mitigation Measure:</b> <u>All projects normally requiring an EIA must complete a stand-alone EIA report, which also incorporates the SEA mitigation measures</u></p> <p>All projects stemming from or supporting sugar sector activities that normally require an EIA continue to require an EIA. Such projects include, but are not limited to: new mills; significant expansion of mills; irrigation works and significant water storage works; major road works (or a programme of road works; and road works in sensitive habits), and new processing activities (e.g., ethanol, co-generation).</p>	Mills, KSB	EIA reports completed for projects subject to EIA regulation
<b>BIOLOGICAL</b>		
<p><b>Habitats</b></p> <p><b>Mitigation Measure:</b> <u>Protect sensitive habitats: avoid wetlands, fish spawning areas, forests, and avoid cutting down trees when growing sugarcane.</u></p> <p><b>Relevant Activities (wetlands):</b></p> <ul style="list-style-type: none"> <li>Have local specialists/NEMA/landowners/sugar mills demarcate wetlands in their specific area;</li> <li>Demarcate and protect fish breeding areas (fish tend to breed in sheltered areas, and are vulnerable to effluents);</li> <li>Mills with adequate land could set aside land for wildlife conservancies and generate income through tourism (KWS to provide necessary permits and technical assistance).</li> </ul> <p><b>Relevant Activities (forests):</b></p> <ul style="list-style-type: none"> <li>Ensure that all forests are correctly demarcated (most are already, e.g., Kakamega);</li> <li>Forest Department to make recommendations on what to plant and where to plant trees, and provide the seedlings;</li> <li>Plant indigenous trees and have local professionals periodically implement action plans for tree planting.</li> </ul> <p><b>Relevant Activities (Payment for Environmental Services):</b></p> <ul style="list-style-type: none"> <li>Introduce a cess for Environmental Services, which can be publicized by each County/Municipality (e.g., review the experience with the plastic-bag-action plan to minimize implementation costs).</li> </ul>	<p>NEMA Land Owner Min of Forestry Sugar Mills County Government KSB KWS</p>	<p>Encroachment into wetlands and fish spawning areas</p> <p>Change in forest cover Amount of re-forestation activity</p> <p>Existence of cess for environmental services</p>
<b>PHYSICAL</b>		
<p><b>Soil Erosion and Land Degradation:</b> N.B. It was noted that during harvesting operations, tractor/trailers cross the cane rows, causing bad regrowth of ratoons due to compaction of soil and damage to the cane stubble. Due to the poor condition of most rural roads, accessing the farmers' cane can be difficult, and it would be difficult to re-organize the farmers' fields.</p> <p><b>Mitigation Measure:</b> <u>Minimize soil erosion and soil compaction</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Promote manual loading, where feasible, as it is done in West Kenya, to minimize soil compaction and damage;</li> <li>Otherwise, mills to stop crushing during the main rainy season (to avoid harvesting on wet soils and damaging the ratoons).</li> </ul> <p><b>Mitigation Measure:</b> <u>Improve drainage system</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Assist small farmers with drainage: install infield drains; improve field drainage and secondary/collection drainage system;</li> <li>Ministry of Water to develop drainage systems in the rural areas;</li> <li>County government to install and maintain collection drains, including concrete structures for drainage;</li> <li>Protect large-scale projects located along rivers or flat lands;</li> <li>Ensure that quarry and burrow pits used in road works are rehabilitated correctly.</li> </ul>	<p>Mills KSB KESREF NEMA</p> <p>Farmer MWI Mills KESREF KSB</p>	<p>Soil erosion and compaction in the field</p> <p>Loading practice (manual vs. mechanical)</p> <p>Calendar of cane-crushing activities at the mills</p> <p>(Adequacy of) drainage systems Change in frequency and intensity of floods (farm level and estate level) Borrow pit rehabilitation</p>
<p><b>Soil Quality:</b> Farmers should not just apply a certain # of bags of fertilizer per ha, as this may not be suitable for the on-site soil condition. Soil needs to be analyzed.</p>		

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<p><b>Mitigation Measure:</b> <u>Minimize soil erosion, minimize soil pollution, and correctly use inputs, such as fertilizer</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Enhance farmers' awareness on correct fertilizer application and control of fertilizers;</li> <li>Analyze soils, before applying fertilizer; and return the soil analysis results to farmers; Consider regular soil testing;</li> <li>Provide farmers a means to check the fertility of their plots and to fertilize them accordingly;</li> <li>Disseminate the results of previous fertilizer and soil fertility tests already conducted by Mumias, KESREF, and KARI;</li> <li>Provide larger-scale soil analysis laboratory services (e.g., through KESREF or another laboratory);</li> <li>Develop an <i>Association for Sugar Technologists</i> and support its annual meetings to discuss 'soil issues'.</li> </ul>	<p>Farmer Zonal Manager Miller Outgrowers' organisations KESREF KSB</p>	<p>Water quality of nearby water sources, related to NPK standards</p> <p>Soil test results disseminated and use of soil test results when applying fertilizers</p>
<p><b>Land Use:</b> Competition for land could kill the sugar industry. Sugar should be grown where it is well suited.</p> <p><b>Mitigation Measure:</b> <u>Reduce land use competition by developing a sugar-sector land use plan</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Calculate the minimum area needed to achieve a set sugar-output target (e.g., 900,000 tonnes/year by 2015);</li> <li>Develop a sugar sector land use plan and land use policy, to clarify where to locate new sugar areas (e.g., outline which areas are for rice, pastoralism, ... and focus on areas where sugar has a comparative advantage;</li> <li>Seriously consider that a lot more land could be brought under sugar cultivation with large-scale irrigation projects.</li> </ul>	<p>KSB NEMA Land Owners Ministry of Lands MWI MOA</p>	<p>Compliance of the location of sugarcane fields to the land use policy for sugarcane</p>
<p><b>Watershed (Water Quantity)</b></p> <p><b>Mitigation Measure:</b> <u>Protect watersheds and conserve and store water</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Promote a culture of water conservation;</li> <li>Conserve and store more water for sugarcane;</li> <li>Avoid excessive run-off by using bunds/pans in the field;</li> <li>Drain excessive infield water into a central drain.</li> </ul> <p>N.B. Irrigation could improve cane production per ha. The capital investment is high, meaning that it is probably not economic to install irrigation in areas to just supplement rainfall.</p> <p><b>Mitigation Measure:</b> <u>Include 'water scarcity' and 'value of water to be consumed' (and climate change) in the sugar-sector feasibility studies</u></p> <p><b>Relevant Activities related to Irrigation:</b></p> <ul style="list-style-type: none"> <li>Assess the cost of the water permit and water price (if water is metered, agriculture could be difficult);</li> <li>Adjust the cane growing area to reflect water scarcity and the cost of water.</li> </ul>	<p>MWI MoA Miller Land owner/farmer NEMA KESREF KSB</p> <p>Farm Owner Sugar Mills MWI KSB NEMA</p>	<p>River water flows (ratio of Qmax and Qmin)</p> <p># of water storage initiatives for sugarcane</p> <p>Water use per unit of production Water costs</p>
<p><b>Water Quality</b></p> <p><b>Mitigation Measure:</b> <u>Minimize soil erosion, minimize water pollution, and optimize the use of agrochemicals</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Increase people's awareness about how excess water carries away the top soil, which contains important minerals/nutrients;</li> <li>Improve awareness about minimum tillage; in areas with slopes, strongly discourage the growth of annual crops, unless the slopes are correctly terraced to accommodate excessive water;</li> <li>Adopt Cleaner Production;</li> <li>Construct artificial wetlands to filtrate mill effluents before discharge;</li> </ul>	<p>MoA NEMA KESREF Sugar Mills KSB</p>	<p>Water quality (NPK, TSS; TDS, chemical content) of water bodies near sugarcane growing areas</p> <p>Water quality of sugar mill effluents</p> <p>Awareness training in agrochemicals</p> <p>Certificates in fertilizer application</p> <p>Water management practices (to minimize use of larvicides)</p>

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<ul style="list-style-type: none"> <li>Encourage recycling of wastes around factories;</li> <li>Develop a registration system for farm chemicals;</li> <li>Improve fertilizer use: use agrochemicals, as prescribed (i.e., do not use agrochemicals to kill fish or water weeds, and do not dump them anywhere);</li> <li>Certify people that are able to spray agrochemicals;</li> <li>Reduce the amount of larvicides used to control mosquitoes, through good water management practices.</li> </ul>		
<p><b>Climate Change:</b> N.B. Farmers say that rains are delayed and then more intensive, and that the dry season is longer.</p> <p><b>Mitigation Measure:</b> <u>Support appropriate water management (including irrigation systems) and water conservation in wet and dry season</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Emphasize irrigation (where economically feasible) to mitigate climate change and variability. One risk is that land that is irrigated will be used to cultivate other, higher-value crops (e.g., e.g., rice);</li> <li>Include climate as a serious constraint in feasibility studies;</li> <li>Assess the effect of climate change and variability on sugarcane;</li> <li>Monitor meteorology forecasts, and advise stakeholders as needed.</li> </ul> <p>N.B. Some millers and some farmers burn their cane at time of harvest, but mostly, fires are accidental or malicious. Otherwise, air quality issues can occur at mill sites, especially at the chimneystacks.</p> <p><b>Mitigation Measure:</b> <u>Control air emissions</u></p> <p><b>Relevant Activities:</b> Adhere to NEMA rules regarding air emissions of factory chimneys; ensure good performance of factory soot scrubbers and air quality equipment.</p>	<p>MoA MWI Farm Owner KSB Mills KESREF</p> <p>Miller/NEMA/KSB</p>	<p>Adequacy of flood control during wet season</p> <p>Availability of water to grow sugarcane in dry season (by county)</p> <p>Air quality emissions from sugar mill chimney stacks</p>
<b>SOCIAL CULTURAL</b>		
<p><b>Governance and Equity</b></p> <p>There are some governance issues in the sugar sector leading to complaints of inadequate transparency in sugar imports and high consumer prices for sugar, while at the same time farmers complain about the low <i>producer</i> prices.</p> <p><b>Mitigation Measure:</b> <u>Develop a fair system to share the costs and benefits in the sugarcane industry</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Promote competition in the sugar industry;</li> <li>Promote participation in equity sharing/privatization by sugarcane growers by allocating mill shares to Farmers' Organisations, rather than to individual farmers;</li> <li>Develop a cost-benefit sharing structure between farmers and millers.</li> </ul>	<p>Mills KSB</p>	<p>Consumer price of sugar</p> <p>Allocation of costs and benefits in sugar sector</p>
<p><b>Gender</b></p> <p><b>Mitigation:</b> <u>Increase the participation of women in the sugar sector</u></p> <p><b>Relevant Activities:</b> Target women specifically to comply with 30% of the labour force (in skilled and unskilled work).</p>	<p>Miller KSB Farmers' Organisations</p>	<p>% of women in sugar-sector workforce; % of women participating in training</p>
<p><b>Children:</b> Children are generally not engaged as labour at sugar mills, but they can assist their parents at the farm level.</p> <p><b>Mitigation:</b> <u>Educate children and sugarcane farming families about accident risks</u></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Inform farmers and children about the dangers of taking cane stalks from cane carts and risks associated with farm chemicals;</li> </ul>	<p>Mills (nucleus estate) Farm owners KSB</p>	<p># accidents in sugar sector involving children</p>

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<ul style="list-style-type: none"> <li>Sugarcane transporters should adopt transport vehicles that are less prone to cane spillage and pilferage;</li> <li>Encourage mills to arrange schooling and recreation facilities for children.</li> </ul>	KESREF	
<p><b>Health</b></p> <p><b>Mitigation: <u>Protect health and increase health awareness of sugar mill workers</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Train sugar mill workers in occupational health and safety and general health issues (including HIV/AIDS and malaria prevention);</li> <li>Assign the implementation and monitoring of NEMA conditions to the environment, health, and safety section of the factories;</li> <li>Set labour conditions in compliance with labour laws, rules, and regulations</li> <li>Provide a system for medical care (e.g., including on-site hospital or polyclinic, emergency units for medical transport);</li> <li>Provide necessary drugs for employees, in cooperation with government;</li> <li>Provide adequate housing for on-site sugarcane workforce, including the cane cutters;</li> <li>Where labour camps are constructed near the cane fields or housing is provided, provide potable domestic water.</li> </ul>	Miller KSB Ministry of Labour Ministry of Health Ministry of Housing	# and quality of health awareness campaigns health status/statistics of the sugarcane workers  Quality of labour-force housing Sugarcane workers' access to potable water and medical care
<p><b>Food Security and Diversified Nutrition:</b> N.B. Most sugar mills have thousands of workers, and thus attract good market and shopping opportunities.</p> <p><b>Mitigation: <u>Support food security and a diverse diet</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Promote via extension workers the need to diversify food crops (e.g., maize, cow peas, beans, rice, fish ponds, where relevant);</li> <li>In the case of large-scale sugar complexes, sugar mills to support some animal husbandry, e.g., cattle husbandry;</li> <li>Emphasize integrated farming;</li> <li>Ensure that contracted sugarcane growers allocate some of their land to food production (a third of the land).</li> </ul>	Miller KESREF KSB Ministry of Health Ministry of Special Programs	# and quality of training in integrated farming Allocation of food crops vs. sugar crop on land parcels
<p><b>Poverty, Income, and Livelihoods:</b> The sugar industry should expect that the cost of labour will increase, in line with other development sectors. Farmers are complaining in a general way about the excessive deductions paid to millers and low incomes.</p> <p><b>Mitigation: <u>Promote fair pay and profit sharing within the sugar sector</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Review the payment deductions made by millers to ensure that they are transparent and not excessive;</li> <li>Develop an improved cost and benefit sharing system for sugarcane farmers.</li> </ul>	KSB Miller	Incomes of sugarcane farmers and deductions in payments to sugarcane farmers
<p><b>Cane Payment System:</b> This system implicitly assumes that farmers will make more money under a sucrose-payment system. But sucrose content is affected by a number of factors, including where the cane is grown, the variety, and the time of harvest. This means that the farmer could be punished for things beyond his/her control and by the decisions made by others. Low sucrose content is usually associated with moist conditions and high temperatures and a small difference between day/night temperatures. In the Nyando zone, the Nandi hill farmers are likely to have higher sucrose content because of altitude, especially during the dry season. If forced to supply the sugar mill in the rainy season (i.e., lush growth season), they will lose this advantage. High sucrose content is often associated with low growth and low cane yields. In brief, each factory location, e.g., the coast, will have its own average potential sucrose content and the mill will have a certain capacity to extract the sugar. The real amount of sugar and the average sucrose content will only be known at the end of the season. The price calculation will need to be negotiated by the growers' representatives and the miller. The idea is that if a grower has cane with high sucrose, he/she will be paid for it. If the miller works efficiently (and achieves high extraction rates), the miller will be paid for this efficiency.</p> <p><b>Mitigation: <u>Develop a fair sucrose-based payment system</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Increase the awareness of farmers about the sucrose-based payment system before adoption; clarify who will represent the farmer on this issue; bring millers and cane growers together to negotiate on this issue;</li> </ul>	Mills KESREF KSB Sugarcane farmers Representatives of the	Farmers' knowledge about the new sucrose-based payment system  Pilot studies on equitable sucrose-based payments  Sucrose-based payment system adapted to each local growing situation.

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<ul style="list-style-type: none"> <li>Conduct more research on sucrose-based payments and identify the other pre-requisites of this system before adoption; modify the sucrose payment system to reflect factory conditions and factory location;</li> <li>Implement a case study in Nyando on sucrose payment system, given that the Nyando belt in general has lower sucrose content (maybe because of climate condition).</li> </ul>	farmers	
<b>SOCIAL ECONOMIC</b>		
<p><b>Infrastructure, such as Roads:</b> KSB funds some road maintenance (through EU funds for now and through levees, over the long term). Mills expect to receive road funds in proportion to the amount of levees paid. KSB does not check that the roads are complying with road standards. Although it can be argued that some millers have capacity to follow road standards and that they liaise with other relevant stakeholders (e.g., KERRA) to do standard works, the road works should still be monitored.</p> <p><b>Mitigation: Ensure that road works are conducted to standard and that road maintenance works are associated with reduced sugarcane transport costs</b></p> <p><b>Relevant Activity:</b> KSB to monitor the quality of the road works funded through the NAS.</p>	Miller KSB, with KERRA and County	<p>Quality of road works funded by sugar sector</p> <p>Cost to transport sugarcane in areas receiving road works vs. cost to transport sugarcane in areas without road works</p>
<p><b>Productivity of Sugarcane Fields:</b> With increasing population pressure, there will be increasing pressure to plant higher-value/high-yield crops. If the sugar industry is to survive, it has to become higher yielding/higher value. The impression from the field is that the contract farmers don't feel ownership toward their cane field and mostly do not practice good husbandry on sugarcane. The farmers do not always want to take loans for fertilizer and weeding, as they are discouraged by the high deductions. Some farmers have the impression that going 'private' reduces growing costs (but the farmers may not yet understand that going private means that they will need to buy their own inputs). Another issue is that it would be difficult to introduce mechanised harvesting in western Kenya, given the often undulating terrain conditions. Very large-scale sugar estates are therefore unlikely. In the future, small farms will increasingly be uneconomical and are likely to disappear.</p> <p><b>Mitigation: Expand nucleus estates (longer term) and promote good husbandry on nucleus estate and on outgrowers' farms</b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Optimize the layout and husbandry practices of existing large farms, as the standards overall have gone down; achieve higher production through better management and better organisation and better returns for all;</li> <li>Expand the hectares under the nucleus estate;</li> <li>As an immediate and short-term measure, better supervise sugarcane contracts and supply fertilizers at cost;</li> <li>Evaluate the current system of contract farming to improve it;</li> <li>Prepare the sugar sector for larger-scale sugar mills in alternative locations (e.g., Coast).</li> </ul>	Miller KESREF KSB Farmers	<p>Sugarcane yields per hectare</p> <p>Price of fertilizer and distribution of fertilizer</p>
<p><b>Value Addition through Diversification:</b> N.B. Mills see cogeneration as attractive because it makes the factory process more efficient through energy savings (i.e., bagasse is burnt to generate extra steam to produce electricity). However, growing sugarcane to generate electricity will tend to steer the sugarcane system towards producing more biomass, and away from sugar production. Another issue is that there are allegations that sugarcane is being harvested prematurely and that trees are being cut to feed the boilers to generate energy for sale. This is poor environmental practice.</p> <p><b>Mitigation: Promote environmentally sound diversification and energy production</b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Evaluate the cost and benefits of moving from sugar as a main product to having 'power' as a main product;</li> <li>Ensure that the right sizing of cogeneration plants (to avoid a scramble for biomass and poor environmental practices);</li> <li>Ensure that there is a fuel policy for 'blending alcohol' in place and ensure that there is a market for ethanol <i>before</i> making ethanol plants;</li> <li>Ensure the correct sizing of waste treatments systems (e.g., vinasse treatment)</li> </ul> <p><b>Mitigation: Explore new avenues for diversification</b></p>	Mills KSB KESREF KENGEN	<p>Amount of power generated and sold to the electricity grid</p> <p>Environmental practices associated with using bagasse for generating electricity</p> <p>Size of cogeneration plant and waste treatment plant</p> <p># of other diversification activities</p>

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<b>Relevant Activities:</b> <ul style="list-style-type: none"> <li>Explore other opportunities to diversify sugarcane products (e.g., evaluate opportunities related to agro-tourism)</li> </ul>		
<p><b>Competition and Privatization:</b> N.B. The public mills have yet to be privatized; this issue is still slow moving, and time has been wasted. Government should promptly take the debts and sell off or invest in the sugar mills and get on with the process of privatization.</p> <p>N.B. Many assumptions are being made about the benefits of privatization, e.g., after privatization, the mills should be able to add value, be more competitive, and be more environmentally friendly. But, in practice, good environmental practice will not automatically happen with privatization.</p> <p><b>Mitigation: <u>Incorporate environmental management requirements into privatization schemes and processes</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Educate the private sector involved in the sugar sector on polluter pays principles;</li> <li>Highlight environmental management requirements, at time of privatization: Impose ‘Clean Development Mechanisms’, Adopt Cleaner Production (and waste minimization); Endorse, plan, and integrate <i>Corporate Social Responsibility</i>; and/or Adopt ISO 1401;</li> <li>Evaluate relevant economic instruments for the environmental management of the sugar sector and apply them: e.g., user charges or effluent charges.</li> </ul>	KSB Mills GOK NEMA	<p>The environmental policy of privatized mills</p> <p>Environmental management systems (at the sugar mills)</p> <p># and quality of cleaner production, CDM, CSR, ISO initiatives</p> <p>Economic instruments for environmental management</p>
<p><b>Competition, Privatization and Social Benefits:</b> Without privatization, it is likely that most sugar companies will collapse when they will have to compete against imported sugar. But privatization may result in staff lay offs.</p> <p><b>Mitigation: <u>Promote corporate social responsibility during privatization process and subsequent mill operation</u></b></p> <p><b>Relevant Activities: <u>With respect to laying off staff as a result of privatization:</u></b></p> <ul style="list-style-type: none"> <li>Provide a good severance package/a safety net for employees who are laid off (review the Mumias experience);</li> <li>Re-train the employees that have to be released (e.g., training in alternative livelihoods).</li> </ul> <p><b>During subsequent mill operation:</b></p> <p>Mandate mills to:</p> <ul style="list-style-type: none"> <li>Share profits/benefits more equitably with workers and the communities;</li> <li>Establish pension funds; Establish an HIV/AIDs policy;</li> <li>Adopt payment for by-products (e.g., bagasse, molasses);</li> <li>Provide for wide ownership (through wide shareholders) to share the benefits;</li> <li>Participate in research forums (to sustain research efforts).</li> </ul>	KSB Mills NEMA KESREF	<p>Quality of severance packages</p> <p># and type of alternative-livelihood training programs</p> <p>Benefit sharing arrangements and social benefits from sugarcane farming</p> <p>Amount and type of research supported by private mills</p>
<p><b>Expansion:</b> Rapid expansion can lead to competition for cane, harvesting under very rainy conditions, or premature harvesting, leading to various negative impacts. Expansion into new areas could lead to further habitat fragmentation or habitat destruction. Competition for land and increasing population pressure are key drivers.</p> <p><b>Mitigation: <u>Focus on the vertical expansion of the sugarcane fields, rather than on horizontal expansion (and use environmental permits when granting licenses)</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Use environmental criteria to strictly control the expansion rate and expansion plans of sugar mills: Permit expansion when:               <ul style="list-style-type: none"> <li>Higher production per hectare on existing land is documented;</li> <li>A mill already complies with environmental standards;</li> <li>Expansion plans are linked to modernization and enforcement of existing environmental standards.</li> </ul> </li> <li>Do not permit expansion into wetlands, forested areas, or areas prone to erosion.</li> </ul>	KSB NEMA Mills Farmers Ministry of Lands	<p>Env. performance and production statistics from mills requesting expansion permit</p> <p>Compliance to mill environmental management plans;</p> <p>Compliance to sugar-sector land use plan; hectares of land under sugarcane (over time)</p> <p>Habitat fragmentation</p> <p>Mill permits having environmental criteria</p>
<p><b>Sugarcane production:</b> Sugarcane production could be increased and sugarcane costs could be reduced by adopting best practices in agronomy (good quality seed cane, timely planting, weeding, and harvesting) and adequate soil fertility upkeep, even without changing cane varieties and without expanding the land</p>		<p>Sugarcane yield per unit of land</p>

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<p>under sugarcane.</p> <p><b>Mitigation: <u>Implement best practices in agronomy to increase production and to reduce the cost of growing sugarcane</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Enhance access to good extension services (hire and train more sugarcane extension staff, outgrower companies, and farmers on best-agronomy-practices for sugarcane);</li> <li>Reduce cost of fertilizer [e.g., provide financing for key inputs (fertilizer, herbicides); pool the purchases of key inputs to reduce the per unit cost (compare KTDA model in the tea industry; and the NCPB model in the cereals)];</li> <li>Analyze soils before applying fertilizer to identify the required type and amount of fertilizer.</li> </ul>	KSB KESREF Mills	<p># and quality of training on best agricultural practices</p> <p>Fertilizer use and cost of fertilizer</p>
<p><b>Promote General Economic Development (e.g., Tourism)</b></p> <p><b>Mitigation: <u>Diversify local economy to reduce vulnerability to economic shocks or climate change</u></b></p> <p><b>Relevant Activity:</b> EU to finance a feasibility study on agro tourism.</p>	KSB Other sectors	<p>Feasibility studies on diversification of the economy</p> <p>Regional Statistics (over time) on other County-level economic activities (e.g., agro-tourism)</p>
<b>INSTITUTIONAL</b>		
<p><b>Planning, Capacity, and Coordination</b></p> <p>The COMESA extensions have not truly helped the sugar sector become more competitive and efficient; the safety clauses have not resulted in an improved sugar industry. The sugar sector actors have to truly get ready for a more competitive future, which still maintains environmental safeguards.</p> <p><b>Mitigation: <u>Strengthen environment-friendly planning, capacity, and coordination</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Develop a sugar sector environmental policy framework and a sugar sector land use plan;</li> <li>Reform regulatory bodies, research institutions, and cooperatives into complementary and high performing entities;</li> <li>Add explicit objectives/sub-objectives in the next amendment to the NAS to more explicitly focus on: <ul style="list-style-type: none"> <li>Improving environmental management and sugar production in the factory by improving the extraction process;</li> <li>Improving factory efficiency so that more bagasse will be saved for energy sales;</li> <li>Strengthening leadership in outgrowers' organisations;</li> <li>Developing and supporting farmer associations or coops to allow farmers to speak with a stronger voice;</li> </ul> </li> <li>Ensure that mills have an environment (and health and safety) section with one staff focused on the biophysical environment;</li> <li>Provide a qualified environment officer at KSB to monitor the environmental performance and compliance of the sugar sector;</li> <li>Provide a trained environment desk officer at KSB county level;</li> <li>Give NEMA county level the capacity to enforce sugar sector environmental management plans.</li> </ul>	KSB Miller GOK NEMA	<p>Environmental and social management officer in position at each major sugar mill</p> <p>Environmental Unit and Environment Officer at KSB</p> <p>KSB-county level environmental desks, with officers</p>
<p><b>Sugar Sector Research</b></p> <p><b>Mitigation: <u>Expand and disseminate research and focus on field-relevant environmental management research</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>Publish and disseminate the findings of past research;</li> <li>Conduct research to provide evidence about poor environmental management practices, and the impacts on production and environment.</li> </ul>	KESREF <sup>71</sup>	<p># and quality of research activities on environmental management topics</p> <p>Dissemination of research results</p>

<sup>71</sup> N.B. KESREF is likely to be absorbed into the Research Ministry.



Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
<p><b>Extension Services:</b> Previous capacity development efforts have not yielded the intended benefits. Farmers need field relevant capacity development. To a certain extent, the NAS forgot the individual farmers/producers. It is time to find a way to specifically address farmers and to completely rethink the capacity building model. N.B. It is unclear who is responsible for improving the extension services: Is it the sugar mills, KESREF, and/or the outgrowers' organisations? MoA mostly has moved out of providing extension to commodities (tobacco, sugar, and tea), but MoA said that it could provide some extension services, upon request. Some stakeholders said that demand-driven extension services have resulted in no one doing the work.</p> <p><b>Mitigation: <u>Revise the extension model, strengthen extension services in general, and the extension services for environmental and social management</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>▪ Better organize farmers to receive information; support farmers to develop their own farmers' groups;</li> <li>▪ Evaluate other extension models for new ideas on extension within the sugar sector: <ul style="list-style-type: none"> <li>○ For instance, assess the farmers' field schools used by Green Africa Villages (farmers are organized by units);</li> <li>○ Evaluate the tea and coffee extension programs to search for new ideas;</li> </ul> </li> <li>▪ Collaborate/combine efforts for the benefit of the sugar sector (e.g., MoA, KESREF, and sugar mill extension workers and KSB could work together as a team);</li> <li>▪ Increase the number of extension workers: Second MoA extension workers; increase staff at KESREF;</li> <li>▪ Increase the budget for extension services;</li> <li>▪ Define standards for extension services and ensure that extension officers have an agricultural certificate (providing good extension services requires more than a high school certificate and it requires training in environmental management);</li> <li>▪ Integrate environmental and social management topics into the extension material.</li> </ul>	<p>KESREF Millers MOA KSB Outgrowers' Organisations Farmers</p>	<p>Revised extension model</p> <p>Expansion of extension services (# and quality of training sessions and # and quality of extension workers)</p> <p># and quality of extension services covering environmental management</p> <p>Evaluations of the provided extension services</p>
<p><b>Outgrowers' Organisations:</b> A number of the Outgrowers' organisations are not functioning well.</p> <p><b>Mitigation: <u>Strengthen some of the promising outgrowers' organisations and develop some new organisational models</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>▪ Build the capacity of outgrowers' organisations (and farmers) to deal with the private sector;</li> <li>▪ Assess the experience with other organisational models from other countries, to identify new ideas;</li> <li>▪ Pilot test different organisational models (e.g., cooperatives).</li> </ul>	<p>KSB Sugar Mills</p>	<p>Capacity of outgrowers' organisations to fulfill institutional roles</p> <p>New organisational models</p>
<p><b>Farmers:</b> N.B. Outgrowers do not have a distinct mandate to be good custodians of the environment. 'Contract' farming doesn't seem to work as well as 'private' farming due to ownership issues. Some farmers rent their land for KSh 30,000 for 3 years; the investors make money, while the farmers are frustrated. Farmers need to keep pressing government on needed changes.</p> <p><b>Mitigation: <u>Increase the benefits of the sugarcane producers, while maintaining environmental and social management safeguards</u></b></p> <p><b>Relevant Activities:</b></p> <ul style="list-style-type: none"> <li>▪ Clarify the role of sugarcane farmers with regards to environmental stewardship;</li> <li>▪ Strengthen farmers' ownership of the sugarcane crop by improving the relationship/the contract between the mills and the farmers;</li> <li>▪ Evaluate other types of contracts between millers and farmers to improve profit sharing (e.g., limit the contract to 'transport' and 'delivery' of harvest only).</li> </ul>	<p>KESREF KSB Mill Farmers</p>	<p>Capacity of farmers to take on new environmental and social management roles and functions; # and quality of environmental and social management training</p> <p>Field-level environmental conditions</p> <p>Farmers' income from sugarcane Revised contracts</p>
<p><b>Legal Requirement, Compliance, and Licenses:</b> KSB renews licenses, and thus, its licensing procedure provides an opportunity to enhance the environmental and social performance of mills through conditions attached to licenses.</p> <p><b>Mitigation: <u>Integrate environmental criteria into the sugar mill licensing procedure and approval process</u></b></p> <p><b>Relevant Activities:</b> Approve/renew a sugar license under the condition that the mill:</p> <ul style="list-style-type: none"> <li>▪ Currently complies with environmental standards (to be verified with NEMA records) and has shown good governance on environmental audits (i.e., zero</li> </ul>	<p>KSB</p>	<p>Integration of environmental criteria into licensing procedure</p>

Issues, Mitigation Measures, and Relevant Activities	Responsible Parties	Indicators to monitor
tolerance for corruption); <ul style="list-style-type: none"> <li>Has demonstrated an adequate cane supply (if there is no cane, a mill cannot register);</li> <li>Has adopted new, cleaner technology, shows an adequate environmental management systems (EMS or ISO 14001), and has sufficient wastewater treatment capacity (including capacity to treat the wastes produced through its expansion plan).</li> </ul>		
<b>Enforcement:</b> N.B. NEMA generally has an insufficient number of staff and resources.  <b>Mitigation: <u>Strengthen NEMA and publicize good environmental behavior</u></b> <b>Relevant Activities:</b> <ul style="list-style-type: none"> <li>Provide environmental sensitization to sugar sector stakeholders, including mills;</li> <li>Urge government to increase the number and the quality of NEMA staff;</li> <li>Provide environmental awards to sugar mills with 'good environmental performance' (e.g., to the cleanest sugar mill)</li> </ul>	KSB NEMA GoK	Capacity of NEMA to monitor sugar sector (# of NEMA county staff; # of NEMA mill audits conducted by NEMA)  Environmental awards
<b>Monitoring and Evaluation:</b> ASCU's 2008 assessment of the monitoring and evaluation (M&E) of the agricultural sector concluded that in general M&E is very weak due to inadequate funds and equipment. Routinely collected government data are often projected from past records, which were also projected (and therefore likely to be inaccurate) <sup>72</sup> .  <b>Mitigation: <u>Strengthen environmental monitoring within the sugar sector</u></b> <b>Relevant Activities:</b> <ul style="list-style-type: none"> <li>Mills to comply with environmental standards and to conduct their routine environmental monitoring (includes social aspects), using relevant professionals;</li> <li>NEMA to conduct periodic monitoring on the environmental and social management performance of sugar mills;</li> <li>Link the monitoring of the sugar sector to the National Integrated Monitoring and Evaluation System (NIMES);</li> <li>Empower communities to report on the environmental and social management performance of sugar mills (e.g., support Village Environmental Committees);</li> <li>Increase sugar-industry environmental and social monitoring staff and develop capacity to conduct M&amp;E (including developing environmental databases, environmental monitoring systems, and procuring monitoring equipment, and harmonize M&amp;E efforts);</li> <li>Assess how the tea and coffee industry conducts its M&amp;E;</li> <li><b>KSB</b> to establish an environmental unit to monitor all aspects related to environmental management, NEMA conditions, and the implementation of this SEA;</li> <li>County-level KSB offices to have Environmental Desk Officer.</li> </ul>	NEMA Miller KSB	NEMA Compliance Reports  Internal environmental audits (from mills)  Environmental and social monitoring system  Evaluations of the monitoring reports

<sup>72</sup> The ASCU website ([www.ascu.go.ke](http://www.ascu.go.ke)) says that there is actually a lot of agricultural monitoring data, but it is scattered all over the place (e.g., Central Bureau of Statistics), the Ministry of National Planning, sectoral line ministries (MoA, MoLD, MoFD, MoCDM), bilateral and multi-lateral agencies (e.g. UNEP, FAO), governmental and NGO projects; and national research institutions (e.g. Tegemeo, KIPPRA).

**Annex 1: Technical Annexes**

- Annex 1.1: Maps and Images**
- Annex 1.2: Matrices**
- Annex 1.3: Three (3) Provincial SEA Workshop Attendance Lists (Coast, Western, and Nyanza)**
- Annex 1.4: Stakeholder Records, Field Work**
- Annex 1.5: Attendance List for the National Workshop on the Draft SEA Document (July 24, 2012)**
- Annex 1.6: Attendance List to the July 26 EU Debriefing meeting**

**Annex 2: Administrative Annexes**

- Annex 2.1 Scoping Report May 2012 (includes TORs)**
- Annex 2.2 Itinerary and Calendar of Activities**
- Annex 2.3 List of Documents**
- Annex 2.4 Curriculum Vitae**