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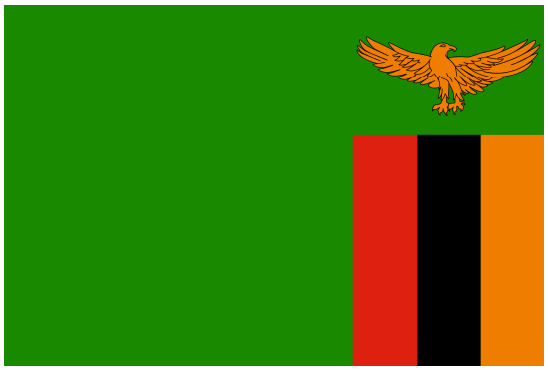

"Strategic Environmental Assessment (SEA) of the Sugar Sector in Zambia"

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SEA Study

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Strategic Environmental Assessment (SEA) of the Sugar Sector in Zambia

SEA Study

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Acronyms and Abbreviations

µg	Microgram
ACP	Africa, Caribbean, Pacific
ADC	Area Development Committee
AIDS	Acquired Immune Deficiency Syndrome
ALRI	Acute Lower Respiratory Infection
AMS	Accompanying Measures for Sugar
ART	Anti-Retroviral Therapy
BCH	Burnt Cane Harvesting
BHC	Benzene Hexa Chloride
BOD	Biochemical Oxygen Demand
CATF	Community AIDS Task Force
CCJDP	Catholic Centre for Justice, Development and Peace
CDM	Clean Development Mechanism
CEEEZ	Centre for Energy Environment and Engineering of Zambia
CEP	Country Environmental Profile
CF	Consolidated Farming Limited
cm	Centimetre
CMS	Concentrated Molasses Solids
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
COPD	Chronic Obstructive Pulmonary Disease
CSO	Civil Society Organisation
CSO	Central Statistics Office
DAC	Development Assistance Committee
DACO	District Agriculture Coordinator
DALY	Disability-Adjusted Life Year
DATF	District AIDS Task Force
DDCC	District Development Coordinating Committee
DDT	Dichlorodiphenyltrichloroethane
DoE	Department of Energy
DRC	Democratic Republic of Congo
DWA	Department of Water Affairs
EC	European Commission
ECAZ	Environmental Conservation Association of Zambia
ECZ	Environmental Council of Zambia

EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
ENR	Environment and Natural Resources
ENRMMP	Environment and Natural Resources Management and Mainstreaming Programme
ERB	Energy Regulation Board
ESMU	Environmental and Social Management Unit
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FBO	Faith Based Organisation
FLO	Fairtrade Labelling Organizations International
FNDP	Fifth National Development Plan
g	Gramme
GCH	Green Cane Harvesting
GDI	Gender Development Index
GDP	Gross Domestic Product
GHz	Gigahertz
GIDD	Gender in Development Department
GIS	Geographical Information System
GMA	Game Management Area
GMO	Genetically Modified Organism
GRZ	Government of the Republic of Zambia
GWh	Gigawatt Hour
ha	Hectare
HCB	Hexachlorobenzene
HIV	Human Immunity Virus
IAIA	International Association for Impact Assessment
ILUA	Integrated Land Use Assessment
IPP	Independent Power Production
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
JICA	Japan International Cooperation Agency
K	Potassium
K_2O	Potassium Oxide
KASCOL	Kaleya Smallholder Company Limited

KE	Kalungwishi Estates
kg	Kilogramme
km^2	Squared kilometre
KST	Kaleya Smallholder Trust
kV	Kilovolt
kWh	Kilowatt Hour
LDC	Least Developed Countries
LPG	Liquefied Petroleum Gas
LRP	Lead Replacement Petrol
m^3	Cubic metre
MACO	Ministry of Agriculture and Co-operatives
MCDSS	Ministry of Community Development and Social Services
MCGA	Magobbo Cane Growers Association
MCT	Ministry of Communications and Transport
MCTI	Ministry of Commerce Trade and Industry
MDG	Millennium Development Goal
MEWD	Ministry of Energy and Water Development
mg	Milligramme
MJ	Mega Joule
Ml	Million litres
MMT	Methylcyclopentadienyl manganese tricarbonyl
MOH	Ministry of Health
MOL	Ministry of Lands
MTBE	Methyl Tert-Butyl Ether
MTENR	Ministry of Tourism Environment and Natural Resources
MW	Mega Watt
MWUA	Manyonyo Water Users Association
N	Nitrogen
N_2O	Nitrous oxide
NAC	Zambian National AIDS Council
NAO	National Authorising Office
NAPA	National Adaptation Programme of Action
NASF	National AIDS Strategic Framework
NBSAP	National Biodiversity Strategy and Action Plan
NIP	National Implementation Plan
NGO	Non Governmental Organisation
NO_2	Nitrogen dioxide

NO_x	Nitrogen oxides
NPK	Nitrogen, Phosphorous, Potassium
OECD	Organisation for Economic Cooperation and Development
OPPPI	Office for Promoting Private Power Investment
P	Phosphorous
P_20_5	Phosphorous Oxide
PATF	Provincial AIDS Task Force
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzofurans
PDCC	Provincial Development Coordinating Committee
PELUM	Participatory Ecological Land Use Management
pH	Hydrogen Potential
PM	Particulate Matter
POP	Persistent Organic Pollutant
PRSP	Poverty Reduction Strategy Paper
RDA	Road Development Agency
RES	Renewable Energy Sources
ROADSIP II	Road Sector Investment Programme II
RPTES	Regional Programme for the Traditional Energy Sector
RSD	Ratoon Stunting Disease
RSZ	Railway Systems of Zambia
RV	Recoverable Value
s	Second
SA	Social Accountability
SADC	Southern African Development Community
SADFSP	Support to Agriculture Diversification and Food Security Programme in Western and North Western Provinces
SAI	Social Accountability International
SEA	Strategic Environmental Assessment
SI	Statutory Instrument
SO_2	Sulphur dioxide
SO_x	Sulphur oxides
SRS	Shree Renuka Sugar Ltd
SSIP	Small Scale Irrigation Project
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
t	Tonne

TAZARA	Tanzania Zambia Railways Authority
TB	Tuberculosis
tc	Tonnes of cane
TEQ	Toxic Equivalent
THPAZ	Traditional Health Practitioners' Association of Zambia
ToR	Terms of Reference
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US$	United States Dollar
US EPA	United States Environmental Protection Agency
USA	United States of America
VOC	Volatile Organic Compound
WCSZ	Wildlife Conservation Society of Zambia
WFC	Women for Change
WHO	World Health Organisation
WRM	Water Resource Management
wt%	Weight Percentage
WTO	World Trade Organisation
WWF	World Wide Fund for Nature
yr	Year
ZABS	Zambia Bureau of Standards
ZARI	Zambia Agriculture Research Institute
ZAWA	Zambia Wildlife Authority
ZDA	Zambia Development Agency
ZDHS	Zambia Demographic and Health Survey
ZFAP	Zambia Forest Action Plan
ZMK	Zambian Kwacha
ZNAN	Zambia National AIDS Network
ZNFU	Zambia National Farmers Union
ZNSS	Zambian National Sugar Strategy
ZS	Zambia Sugar Plc
ZS	Zambian Standard

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0. Executive Summary

Zambia has benefited from the provisions of the EU/ACP Sugar Protocol, allowing it to export a quota of sugar to the EU market at a guaranteed price. In 2006, the EU common organisation of the markets in the sugar sector was reformed. This reform has involved a reduction of the EU sugar prices by 36% by 2009, which is reflected in the price obtained by ACP Sugar Protocol countries. As a consequence, the EU has denounced the Sugar Protocol with effect from 1/10/2009. The European Commission has proposed an assistance scheme to help the Sugar Protocol countries, who depend on the EU market, to adapt to the new situation.

In this context, the European Commission (EC) has provided support to Zambia in implementing the Zambian National Sugar Strategy (ZNSS) through its Multi-annual Indicative Programme for the Accompanying Measures for Sugar (AMS).

The ZNSS contains four general components: (1) Expansion of sugar production through out-grower schemes; (2) Diversification strategy, in turn consisting of: ethanol production for fuel blending, ethanol production for fuel gel, co-generation of electricity and production of refined sugar; (3) Improvement of the transport network and services; and (4) Development of a national sugar trade policy.

The AMS is providing support to three main areas: (1) Establishment and expansion of outgrower schemes in sugar-production areas; (2) Improvement of competitiveness of Zambia's sugar products by reduced transport costs; (3) Implementation of policies and regulatory environment related to sugar sector strategy.

As the implementation of the ZNSS may have impacts on the environment, the GRZ and the EC have foreseen to carry out a Strategic Environmental Assessment (SEA), which will provide recommendations both to the EC and the GRZ on how to enhance the environmental performance of the ZNSS.

The first part of the SEA was the Scoping Study, where key aspects were identified. These were subsequently validated and adapted accordingly through a stakeholders' workshop. Key aspects are categorised as High-, Medium- and Low-priority.

The SEA Study assessed the key aspects in further detail. An environmental baseline was established; potential impacts identified and assessed, under the assumption of no implementation of the ZNSS ('zero alternative') and expected impacts with ZNSS implementation; finally recommendations are made to address key aspects and optimise environmental performance of the ZNSS.

The SEA was based primarily on: a comprehensive literature review; bi-lateral and multi-lateral semi-structured interviews with key actors; a stakeholders' workshop using the 'world café' format; use of Leopold-type matrices; site visits; and expert judgement. Furthermore opportunities were given to stakeholders to have an input at key stages of the SEA: findings of the scoping phase were presented in a ZNSS Steering Committee meeting; the scoping and SEA Study reports were circulated to key stakeholders for comments; and the findings of the SEA Study were presented to a selected number of key stakeholders (MCTI, ECZ and EC).

High Priority Aspects

1. Water availability in the lower Kafue River basin

- The lower Kafue River basin is becoming a water stressed area, due to the multiple water users and the regulation of flows at the Itezhi-Tezhi dam.
- There are indications that the water rights already allocated to ZESCO and the sugar estates (Zambia Sugar and Consolidated Farming) may be exceeding future water availability.

- There are important knowledge gaps with regards to water use, demand and availability. These are meant to be addressed by a water balance study of the Kafue River basin. Meanwhile a moratorium has been set on the granting of further water rights.
- Simplified water balances show a possibility of further water availability for either irrigated agriculture or expansion of hydropower (but not both). These results need confirmation.
- The (Zambia Sugar) Nakambala sugar estate is already expanding and the (Consolidated Farming) Kafue Sugar estate has plans to expand. Both companies have sufficient water rights allocated to cover their expansion water needs. These expansions will add to any water stress in the Kafue River.
- Climate change is expected to result in lower rainfall and a reduction of the rainy season in Zambia, leading to increased pressure on scarce water resources.
- The most common irrigation system in the sugar estates is furrow irrigation, but also the least water-efficient. Nevertheless both ZS and Consolidated Farming are shifting to centre-pivot irrigation.
- A policy promoting further expansion of sugar cane production must address water availability.
- The Water Resources Management Bill foresees important institutional changes to address water management in an integrated manner. These changes will necessitate of appropriate capacity building and training to ensure their effective implementation.

2. Regulatory framework for vinasse management

- The production of bioethanol generates a highly polluting waste product, vinasse in large quantities (approximately 12-18 litres of vinasse per litre of ethanol produced).
- Worldwide vinasse is managed in several ways, ranging from being directly discharged into the aquatic environment, bio-digested for energy generation, or disposed of on-land as fertiliser.
- If vinasse is to be discharged – directly or indirectly - to the aquatic environment, it falls under Zambia's water discharge regulations.
- As ethanol production is being promoted under the Energy Policy, further ethanol distilleries may be set up outside the sugar sector, increasing total potential production of vinasse.
- There are currently limited capacities in Zambia, especially within the environmental regulatory bodies, to adequately assess applications for vinasse management (e.g. reviewing EIA reports, establishing safeguards and conditions). Nor does a (explicit or implicit) policy for vinasse management exist. This situation constitutes a risk of ending up with highly polluting disposal of vinasse in Zambia.

3. Minimising the risk for increased risk of HIV/AIDS associated to new sugar cane cultivation areas

- Increase in incomes, especially of men involved in out-grower schemes and living within poor communities, increases their ability to buy sex while the vulnerable women within these communities would be too willing to trade money and/or goods for sex in order to make ends meet. This creates conditions for increasing the HIV/AIDS rates.
- Men will normally leave their families to go and work in the new sugar plantations/factories and out-grower schemes making them more vulnerable. These workers will have more money in their pockets, but their spouses would have been left behind while a number of vulnerable women from poor households in the surrounding communities will be willing to trade sex for money. This creates conditions conducive to the spread of HIV/AIDS.

- Housing and related facilities when provided for would enable migrant workers move with their families and minimise opportunities to engage in risky social behaviour.
- HIV/AIDS sensitisation and protection measures at the work place would also help minimise the risk of infection.
- Addressing impacts of HIV/AIDS usually concentrates on health ones neglecting the non-health impacts, which are also critical in curbing the spread of the pandemic. Livelihood empowering of the vulnerable groups including female headed households and orphans within sugar production areas and in surrounding communities would reduce tendency by women to trade for sex (addressing non-health aspects of the pandemic).

4. Enhancing the opportunities that the sugar industry has to increase gender balance in their operations

- Sugar estates and factories tend to employ largely men compared to women. Women, when employed are meant to mostly weed the sugar plantations at which time they also need to work in their own fields (November to March). Gender imbalances are also found with respect to decision-making powers; women being under-represented in Sugar Cane Growers Associations and in leadership positions.
- Out-grower schemes have been reported to increase gender inequality as women spend more time working in the fields than men.
- Proper mainstreaming of gender, (going beyond increasing the number of women taking part in particular activities alongside men), taking into account the inter-linkages between HIV/AIDS, poverty and gender inequality provides excellent equitable and sustainable improvements of rural livelihoods. It also addresses issues of access to, use and control of resources and benefits.

Medium Priority Aspects

5. Securing a sound policy for ethanol, fuel blending and gel fuel that will optimise the positive effects on the environment

- Ethanol production for fuel blending has potential positive impacts, mainly the reduction of fuel dependency, but also a reduction of carbon emissions and contributing to reduce MTBE and MMT as additives.
- For these benefits to be optimised, an adequate policy and regulatory framework must be in place to ensure ethanol will be produced in sufficient quantities and that it will be used for purposes of fuel blending.
- Fuel blending ratios are currently being discussed in the GRZ, but no commitments yet made.
- The sugar industry currently has the potential (based on the production of molasses) to satisfy E5 and E10 blending ratios by 2015 and 2020. However these need to be confirmed based on expected increases in the consumption of petrol, statistics and forecasts for which are currently lacking in Zambia.
- The Energy Policy already promotes ethanol production and fuel blending, but an appropriate regulatory framework, which offers incentives to potential producers in the sugar sector, and guarantees both to potential producers and the GRZ, is still pending.
- Deforestation is currently one of the key environmental concerns in Zambia, which is partly due to the demand for fuel-wood and charcoal for domestic use. Deforestation is also associated to urban centres and road axes. Gel fuel has the potential to reduce pressure on wood resources.
- Gel fuel also has the potential to reduce the high incidence of indoor air pollution associated to the burning of fuel-wood and charcoal in the households.

- Gel fuel is promoted under the ZNSS and the Energy Policy as a measure to reduce pressure on forest resources, but it requires an adequate framework to ensure it will be produced, is socially accepted and consumed in place of fuel wood and/or charcoal.

6. Securing an environmentally integrated strategy for roads upgrading/construction and for upgrading/expansion of the railway system

- The upgrading of roads, construction of new roads and expansion of the railway system - all considered in the ZNSS – have a potential to exacerbate deforestation (by the effect of inducing human settlements) and other environmental impacts associated to linear infrastructure projects.
- Currently discussions on environmental implications of expansion are addressed primarily at the project level. Opportunities should be explored to address them at a strategic level (i.e. Transport Policy) through the consolidation of Strategic Environmental Assessment, a tool on whose development ECZ is currently working on.
- The EIA system is the main tool currently available in Zambia to address potential environmental impacts of transport infrastructure projects. However there are indications that the EIA system might currently not be as effective as it could be, and thus there could be an opportunity for improvement.

Low Priority Aspects

7. Exploring the implications of the POPs Convention for the regulation of sugar cane burning

- Cane burning is a source of certain POPs regulated by the Stockholm Convention on POPs.
- Sugar cane burning is an important source of unintended generation of POPs, which is currently not addressed in Zambia's National Implementation Plan (NIP) for the Stockholm Convention.
- The NIP should establish a plan to reduce generation of POPs by sugar cane burning, but any such strategy should address the potential socio-economic effect of shifting from sugar cane burning to green cane harvesting.

8. Securing co-generation policy that optimises efficient use of bagasse from the sugar sector

- Bagasse is a by-product of sugar production, currently burned for power generation to satisfy power needs in the sugar factories
- Opportunities exist to increase power production surplus which could be sold to the national power grid, resulting in more efficient use of existing energy sources
- An adequate regulatory framework is necessary to allow the sale of this electricity.

Recommendations are made to address the key aspects, as well as other associated issues. These are summarised below.

Recommendations

Addressing high-priority aspects

Water efficiency in the lower Kafue River Basin

- The GRZ needs to conduct a comprehensive Water Balance study of the whole Kafue River Basin to establish a realistic estimate of water availability for any increase in agricultural production under irrigation.
- The **moratorium on the allocation of water rights** in the Kafue Flats should be maintained until completion of the water balance study.
- **Development of additional hydropower capacity** should be sought in other places other than the present Kafue Gorge hydropower station.

- **Institutional and capacity building** programmes need to be developed and implemented for the new natural water resources monitoring programme.
- **Institutional and capacity building** should be undertaken to ensure effective implementation and operation of the new structures foreseen under the coming National Water Policy.

Vinasse management

- **Capacities within ECZ** need to be developed in order to ensure they can effectively carry out their functions as executive agency with regards to the challenges posed by a new industrial process in Zambia (alcohol distilleries), and its main waste product (vinasse).
- **Training and capacity building** for ECZ needs to be undertaken on knowledge of the ethanol production process and vinasse. Study tours could be organised where sound vinasse management by the sugar industry is being carried out in the region.
- The MTENR should have a policy stance on biofuels, including aspects related to vinasse management, up-take of land and sound environmental practices.
- Establish basic guidance on vinasse management, to be used for evaluation of applications, quality of EIA reports and determining conditions to be attached to development consents.

HIV/AIDS

- There is need for the GRZ to amplify through the NAC, ZNAN and other stakeholders the need for responses to non-health impacts of HIV/AIDS in the strategic framework for the multi-sectoral responses to the pandemic, in order to elevate their importance and hence attract more allocation of resources for activities addressing these impacts.
- The GRZ should encourage sugar companies and other employers within the sugar sector to mainstream HIV/AIDS activities taking into account non-health impacts as well as the normal health ones through the existing NASF.
- The EC support to the development of out-grower schemes should be on condition that enhanced HIV/AIDS mainstreaming taking account of non-health impacts is part of the core activities in the implementation process.

Gender

- There is need for the GRZ to increase awareness through the GIDD and other stakeholders that gender is much more than level of participation of men and women in particular activities, as it includes important issues such as decision making, use and control of resources and sharing of benefits from productive activities amongst others.
- The GRZ should encourage sugar companies and other employers within the sugar sector to mainstream gender going beyond the proportion of women employed to sensitising their employees on pertinent gender issues using existing institutions specialising in gender activities.
- The EC support to the development of out-grower schemes should be on condition that gender is properly mainstreamed going beyond the number of women out-growers or scheme committee members.

<u>Addressing medium-priority aspects</u>

Ethanol production, fuel blending and gel fuel

- The GRZ should make a firm commitment towards the **mandatory blending** of petrol with ethanol.

- The **legal and institutional framework** should be developed soonest for the national fuel-blending sub-sector, to enhance the interest from potential ethanol producers and the fuel blender(s) and guarantee the market.
- ***In situ* fuel blending** options (decentralised) should be given consideration, to encourage ethanol production destined to fuel-blending and which is not in the proximities of the Indeni refinery.
- A study should be carried out to establish the **acceptability of gel fuel** as a substitute of wood-fuel and charcoal, particularly in the rural and low-income urban areas.
- A **policy framework** is developed to support investment in the gel fuel production through appropriate incentives, standards and research. **Study tours** where gel fuel has been introduced (e.g. Malawi) could be organised.
- Any production and commercialisation of gel fuel should address the **potential socio-economic impacts** on the people engaged in producing and commercialising charcoal, giving them stakes in the gel fuel sub-sector.

Environmentally integrated roads and railways policy

- The whole **EIA process in Zambia should be evaluated**, through a stock-taking exercise, in order to strengthen it.
- The *Procedures Manual for Environmental and Social Management in the Roads Sector in Zambia*, prepared by the RDA should be more accessible. It should be freely available on-line through key institutional web sites.
- Based on the above revision, **capacity-building and training needs** should be defined for both the ECZ and the ESMU.
- The **curricula of university degrees** in engineering and social sciences should be appraised in order to identify opportunities to introduce elements on EIA.
- The above elements could be considered as part of the upcoming **SEA of ROADSIP II**, which will be financed by the EC.
- **Strategic Environmental Assessment** should be promoted at the Transport Policy level within the MCT, with a view to apply it in the context of the next revision of the policy.
- The **transport policy-making and planning system** should be revised to ensure the environmental stakeholders (especially the ECZ) play an active role in it, ideally through SEA processes carried out in an integrated manner to the policy-making and planning processes in the transport sector.

<u>Addressing low-priority aspects</u>

POPs

- Zambia's National Implementation Plan (NIP) of the Stockholm Convention should **acknowledge the unintended production of POPs from the burning of sugar cane**, and explicitly include its contribution to the generation of POPs.
- The ZNSS should **promote Green Cane Harvesting** (GCH); but any strategy to reduce sugar cane burning must ensure it does not result in significant socio-economic impacts of farmers and cane cutters.
- 'Cool burning' practices should be encouraged as a way to reduce emission of particulate matter.

Co-generation

- The **legal and institutional framework** should be developed soonest for co-generation, to enhance the interest from potential electricity producers in the sugar sector and guarantee the market.
- A **framework of incentives** should be developed to attract potential investment into electricity production from biomass.

Recommendations of a general nature

Environmental and Social Management Systems

- The development of an **Environmental and Social Management Code of Practice** in the sugar sector should be promoted, to be prepared jointly by all key stakeholders. Implementation of the Code of Practice should be voluntary and in no way undermine the role of legislation or of the regulatory authorities.
- The MTENR (canalised through the ECZ) should promote the implementation of **environmental and social management systems**, such as ISO 14001:2004 and SA8000, as well as Fair Trade certification, as a way to improve the environmental performance of the sector.

Environmental capacity-building for new out-growers

- It should be ensured that the training and **capacity-building of farmers in the new out-grower schemes** include elements of good environmental and social management practices.

Promotion of sound environmental and management practices of farmers and the general population surrounding sugar cane developments

- Promote, as part of new out-grower schemes and new sugar developments sound agricultural practices, as well as the use of gel fuel as a charcoal and fire-wood substitute (where and when available).

Waste water discharges and atmospheric emissions licensing process

- The ECZ should **review the waste water and atmospheric emission permitting process**, ensuring all producers hold a license and are submitting the required reports in a timely manner. Any non-compliances should be tackled immediately.

Water balance study for the Luena Farming Block

- Water balance studies should be carried out to determine **water availability for the Luena Farming Block** and potential impacts of the five dams proposed, *before* proceeding with authorisation for works.

Fleshing-out and wording of the ZNSS

- The **Zambia National Sugar Strategy** (ZNSS) must be taken beyond its current "Core Elements" phase, fleshing it out; defining a Logical Framework with clear objectives, strategies, actions, resources and responsibilities; and leading to official endorsement of all stakeholders involved.
- The wording of the ZNSS should be environmentally mainstreamed. Environmental sustainability should be an integral component of the ZNSS; the environment as a cross-cutting issue should not be limited to describing the potential environmental impacts of each ZNSS component.
    - The **Introduction to the ZNSS** should establish that the adaptation of the sugar sector should take place in the context of sustainable development. Moreover the introduction section should clearly recognise that performance of the sugar sector is closely related to the environment and to social development, and thus

that environmental protection and socio-economic development are integral components of the ZNSS.

- The **recommendations made in this SEA Study should be clearly reflected in the text** of the ZNSS and its associated logical framework.
- The logical framework should state any environmental assumptions and risks made (e.g. in relation to the effects of climate change).
- The logical framework for the ZNSS should define environmentally sound indicators.

Use of the SEA findings and SEA follow-up

- This SEA report should be distributed to all key stakeholders, taking the original list of invitees to the Stakeholders' Workshop as an indication of stakeholders;
- This SEA report should be made publicly available and published in the web sites of *at least* the following organisations: Ministry of Commerce, Trade and Industry; Environmental Council of Zambia; European Commission (Zambia Delegation).
- The MCTI and the EC should ensure that the findings of this SEA are properly discussed in the ZNSS Steering Committee, and decisions/commitments made on how its finding will be implemented. These decisions and commitments should be recorded.
- It is recommended for the GRZ and the EC to carry out a **follow-up on the effectiveness of this SEA process**; this could take place around 6 to 12 months after its completion.
- The results of the follow-up study should be used to draw lessons useful for the development of an SEA system in Zambia, as well as for future SEAs financed by the EC. Experiences could be shared in the region and internationally also as a way to trigger discussions with experts in the area that could be useful for improvement. This would also raise visibility of GRZ and EC efforts to effectively mainstream the environment in the policies, plans and programmes.

PART I INTRODUCTION AND BACKGROUND

1. Background

Zambia has benefited from the European Union/ACP Sugar Protocol, allowing it to export a quota of sugar to the EU market at a guaranteed price. In 2006, the EU Common Organisation of the markets in the sugar sector was reformed. Main features of the reform are: (a) a significant reduction in the price of sugar (36%) over four years beginning 2006/07; (b) voluntary reduction in the production quota through a high-incentive restructuring scheme; (c) introduction of a decoupled payment for sugar beet producers; and (d) new quota system and simplified quota management to ensure market balance in each marketing year.

The reform involves a reduction of the EU sugar prices, reflected in the price obtained by ACP Sugar Protocol countries. The European Commission (EC) proposed a scheme to help Sugar Protocol countries that depend on the EU market to adapt to the new situation. From 1 October 2009, the Sugar Protocol has been denounced and LDC ACP countries benefiting from the 'Everything But Arms' (EBA) initiative, such as Zambia, will have access to the EU market. An automatic volume safeguard clause will also be applied to ACP non-LDCs, allowing for a substantial increase of export levels. In the case of Zambia the adaptation strategy for the sugar sector is reflected in the **Zambian National Sugar Strategy** (ZNSS).

In 2006 the Ministry of Finance and Planning commissioned a study to explore the effects of the reform of the European sugar regime on the Zambian sugar sector. In parallel, Zambia Sugar Ltd also commissioned a study to examine effects on its own operations. The recommendations from these studies formed the basis for the ZNSS, "Core Elements" of which were defined in June 2006 through a stakeholders' consultative process, revised in 2008, and are to be further adapted based on the results of a stakeholders' workshop held in March 2009. The ZNSS will be supported by the EC through its Multi-annual Indicative Programme for the Accompanying Measures for Sugar (AMS), which has three main components and an allocation of 6 M€: (1) implementation of small-scale out-grower schemes; (2) improvement of the transport network; (3) implementation of the sector strategy and associated policies.

As the implementation of the ZNSS may have impacts on the environment, the GRZ and the EC have also foreseen to carry out a Strategic Environmental Assessment (SEA) with the following specific objectives:*"…to describe, identify and assess the likely significant effects that the ZNSS may have on the environment…also assess the degree to which the ZNSS addresses the major environmental sustainability challenges in the sector."* The SEA will provide recommendations to the EC and the GRZ on how to enhance the environmental performance of the ZNSS.

It should be highlighted that the ZNSS was prepared in 2006. **The fact that the SEA is not done concurrently with ZNSS preparation inevitably limits the potential to influence its contents. Nevertheless there are still opportunities to enhance the environmental performance of ZNSS implementation if the GRZ and the EC have the willingness to study and integrate recommendations that this SEA may make.** This is especially the case as the ZNSS is currently being reviewed.

The sugar sector in Zambia is described below. A general overview of the sugar production process (field and factory operations) is presented in Appendix 2.

2. The sugar sector in Zambia

2.1. Introduction

The sugar sector makes a strong contribution to Zambia's Gross Domestic Product (GDP), accounting for around 3-4% of the national income. It makes an even larger contribution to the national export earnings, corresponding to around 6% over the last few years.

The sugar industry provides employment for around 11,000 workers, with a total of dependents probably exceeding 75,000. Although not all of employed rely on the sugar industry as their

sole source of income, the sector remains one of the key sources of formal, waged employment in the country, particularly in rural areas. A significant amount of indirect employment and local development is generated from the sugar industry. For example the town of Mazabuka has developed alongside the Nakambala estate. Much of the social infrastructure in the region has been developed, improved and maintained by sugar sector revenues. Sectors such as engineering, banking and transportation have developed in response to the needs of the industry. The impact of poverty (about 50% of Zambia's population lives below the poverty threshold of US$2 per day) is offset in the sugar growing regions by the relatively high level of agricultural wages provided by the sugar sector, twice the national average agricultural wage.

Zambia's sugar industry has one of the world's lowest production costs. Agro-climatic conditions in the cane growing regions are excellent for sugarcane under irrigated conditions. Despite this the size of the industry is constrained due to two major weaknesses: (1) the country's landlocked location - when coupled with poor transport infrastructure, it makes it very expensive to access export markets; and (2) the high initial cost of land development, owing to the need to develop bulk water capacity and in-field irrigation and drainage infrastructure.

These weaknesses have prevented the industry from expanding beyond the size of its domestic, regional and preferential export markets. However the EU's EBA initiative will present new market opportunities from 2009, albeit at greatly reduced prices. Although sugar prices in the EU will, on average, offer producers a better return than the world sugar market, the reduction in prices presents a considerable challenge if the industry is to exploit fully its potential: (i) it will reduce the profitability of current operations, which derive around 11% of their revenue from sales to the EU; (ii) the industry incurs considerable social costs associated with provision of education, health and other basic amenities to the employees and the local community; (iii) high cost of land development and accessing export markets means that financial returns from expansion projects are modest in relation to the risks associated with making investments.

In order to maximise the potential of the Zambian sugar sector, the industry has developed a strategic development plan, the ZNSS, to be implemented over the next five to ten years.

2.2. Current situation of the Zambia Sugar Industry

Sugar is currently produced in three areas. The largest producer is Zambia Sugar Plc (ZS) (part of the Illovo Sugar group), who own the Nakambala estate and a mill in Mazabuka District, with approximately 89.6% of total production. The second producer is Consolidated Farming Ltd (CF), who own an estate and mill in the Kafue flats, Kafue District, contributing about 9.8% of national production. Finally Kalungwishi Estates Limited (KE), located in the Kasama District (Northern Province), produces approximately 0.60% of the total. Table 1 below provides basic information on sugar production in Zambia[1].

Table 1. Basic information on sugar production in Zambia

Company	Location	ha under sugar cane (estate)	ha under sugar cane (smallholders)	Cane production (t/ha)	Sugar output (t/yr)
Zambia Sugar[2]	Mazabuka	16,500	7,724	132.8[3]	357,000
Consolidated Farming	Kafue	7,430[4]	N/A	85	23,000
Kalungwishi Estates	Kasama	400[5]	N/A	80	1,400

2.3. Outgrower and Smallholder Schemes

ZS currently sources approximately one-third of its cane supply from local out-growers. There is one smallholder sugar cane scheme currently operating, Kaleya Smallholder Trust (KST).

[1] 2008 figures (source: Struyf and Chuba, 2009), except as otherwise specified.
[2] 2009/10 figures. Source: (Tony King – Zambia Sugar, Personal Communication, November 2009).
[3] This output is unusually high due to carry over cane; yields are expected to be on average 121.5 t/ha after expansion (Tony King – Zambia Sugar, Personal Communication, November 2009).
[4] Agricultural Manager CF, Personal communication during field visit, September 2009
[5] Mr Vedad Alavian – Kalungwishi Estates, Personal Communication, October 2009).

With ZS's expansion two other schemes are being set up: Manyonyo and Magobbo. The three schemes are thus: (1) Kaleya Smallholder Trust (KST), operational since the 1980s; (2) Magobbo Cane Growers Association (MCGA), under development (irrigation works to be constructed 2009/2010); (3) Manyonyo Water Users Association (MWUA), under MACO (Small-Scale Irrigation Project, irrigation works currently under construction).

Table 2. Basic information on smallholder schemes (source: various ZS reports)

Name	ha of sugar cane	Number of smallholders	% women	Average ha/farmer	Yield (t/ha)	Annual income (million ZMK)
Kaleya	1,040	160	22.5	6.5	120	30-40
Magobbo	380	76	17.0	5.0	0	projected, 25
Manyonyo	555	136	6.0	4.0	0	projected, 20

Kaleya Smallholder out-grower scheme

The Kaleya Smallholder out-grower scheme was initiated in 1981 by four shareholders as a poverty alleviation strategy and an expansion strategy by ZS. The land was provided by the GRZ and the shareholders formed a holding company, the Kaleya Smallholder Company Limited (KASCOL). The Company selected around 160 farmers, who underwent a six-month agronomic training. Those successful in the training were allocated a 4 ha plot to manage along with an associated irrigation system and 0.5 ha for a home and to grow subsistence crops for consumption. The costs and profits became the responsibility of each farmer.

The KASCOL scheme comprises 2,167 hectares of irrigated cane land. A nucleus estate accounts for close to 60% of the total and is managed by the Kaleya Management Company. The remaining 1,040 ha is farmed by smallholders on plots averaging just over 4 ha each. There are three major institutions operating the Kaleya Smallholder Scheme: (1) sugar mill company (ZS); (2) management Company (KASCOL); and (3) farmers organization (Kaleya Smallholder Trust-KST), formed by the 160 small-scale farmers, including 38 women.

ZS as a milling company provides a ready market for all the cane the smallholders grow. ZS also offers services such as: water supply to the scheme through its canal and pipeline system; maintenance of the head work/intake canal up to the holding dams; research on the right varieties of cane; and provision of seed cane to the out-grower scheme. KASCOL, who run the nucleus estate, provide inputs, haulage and management services for the smallholders. Payments for cane are made by ZS at the same division of proceeds as all out-growers (64.8% of sugar and molasses proceeds). Any deductions for outstanding loans are made at source by ZS. Water is provided to the KASCOL development by ZS, for which a charge is levied.

These institutional arrangements have provided a strong management to the scheme and guarantees to creditors. Moreover cane replanting and sustainable crop practices are insisted upon by KASCOL for participating small growers. The success of the practices can be measured by the very high yields achieved, even higher than on the Nakambala estate in 2005.

Over time, the proportion of the cane land farmed by the nucleus estate has reduced to 50%, with the smallholder area increasing proportionally. Smallholder plots now average around 6 ha. Another development has been the transfer of ownership of the nucleus estate, now run as a single private entity, owned by the Mazabuka Small Growers' Trust (the original ZS shareholding), KASCOL, smallholders, and independent Zambian entrepreneurs.

KASCOL is Fair Trade certified. This certification implies compliance with a series of standards aimed at ensuring the implementation of good environmental and social practices, e.g. in relation to social and environmental policy and planning, child labour, remuneration of workers, use of agrochemical products, etc. The main motivation for KASCOL to go for Fair Trade certification was the premiums of 60 US$/tonne of sugar received from Fair Trade, and which has to be used for community projects.

Generally speaking the scheme has enabled the KST members to improve their livelihoods in terms of: (i) improved income - average net income according to KASCOL is around 40-50

million ZMK/yr, which is over 10 fold the average rural household income in Mazabuka; (ii) improved housing; (iii) improved education for the children of the KST members; (iv) access to potable water; and (v) clinic services.

Mazabuka Small Growers' Trust

The original ZS investment in KASCOL was for the purpose of developing and enhancing the capacity of Zambian small cane growers. To further pursue this objective, ZS donated its shareholding to a registered trust — Mazabuka Small Growers' Trust — in January 2005. The trust is designed to facilitate the development of future small and medium size cane growers. The income of the trust, represented by dividends received from KASCOL, will be distributed to eligible small and medium size cane grower projects.

Manyonyo Outgrower Scheme

The Manyonyo scheme, situated East of Nega Nega, is a MACO scheme (co-funded by the African Development Bank) currently under development. Cultivation of sugar cane is expected to commence in 2009 and mobilisation of farmers started in 2006. The irrigation system was initially meant for a multi-purpose scheme of various crops. With ZS expansion, farmers saw an opportunity for growing a high value crop with secured markets and have committed to producing sugar cane, whilst ZS has committed to buy the cane crop. The scheme is expected to have 555 hectares under sugar cane once it becomes fully operational.

The following institutions are playing or expected to play a key role in the scheme: (1) sugar mill company (ZS) responsible for provision of the market and providing seed cane; (2) Manyonyo Water Users Association (MWUA), formed by the farmers participating in the scheme and which represents them in all matters pertaining to its development; (3) MWUA is currently negotiating with KASCOL to be the management company; and (4) MACO Small Scale Irrigation Project (SSIP), which has been fulfilling a key role in facilitating the development of the scheme, including farmer organization development and training.

Land tenure at the scheme is a combination of customary land and individuals[6] with title deeds. The scheme will operate without major disturbances to the current land tenure system. MWUA doesn't have a block title deed to the land. Farmers who don't have individual title deeds have been advised to acquire these, but for practical reasons, acquiring individual title deeds by all is not realistic in the foreseeable future. The absence of a block title will make crop establishment and crop seasonal cost financing difficult and is seen as a strategic weakness.

Farmers that were in the catchment area of the irrigation project were picked by nature of their location, and there is general agreement that they will need plenty of training in technical (sugar cane, irrigation management) and in farmer organisation development areas (e.g. management). The MWUA have their own water rights and irrigation system, including the water head works and intake canals. This makes them potentially independent from supplying cane to ZS.

At the moment the average member of the MWUA lives the life of a typical subsistence farmer with production of maize, mainly for their own consumption, while cash income is derived from a number of sources such as cotton (through the Dunavant out-grower scheme), other crops, occasional sale of goat or cow and cash transfers from relatives in town. The expected current income is around ZMK 3.6 million/household (CSO figures). MWUA members hope that the scheme will enable them to improve their livelihoods through improvements in: education for children; housing; food security/nutrition; and more money to improve their lives generally.

Magobbo Smallholder Scheme

The Magobbo Smallholder Scheme falls within the area of the ZS expansion. ZS approached the farmers to be part of the sugar outgrower scheme based on its location. ZS will be the mill company and will provide a guaranteed market for sugar cane produced.

[6] Around 30 % of the participating farmers have acquired title deeds; the remaining 70 % farm their land under customary arrangements.

The Magobbo land was a mixture of customary and titled land. The farmers under the scheme have agreed to give up individual titles and apply for a block title. One farmer has refused to give up his individual title and will not be part of the scheme; this has caused delays and an access road for this particular farmer had to be created. Currently farmers practice subsistence farming, (seasonal) work at the sugar estates and cash transfers from relatives in towns.

Farmers have organised themselves in the Magobbo Cane Growers Association (MCGA). The Mazabuka Cane Growers Trust has facilitated a technical feasibility study and is applying for grant funding for irrigation development. As the KASCOL scheme provides a successful model for smallholder development programmes, it is likely the system will be replicated. MCGA members have been at KASCOL to learn from the people there; however they feel they need plenty of training in sugar cane production and management, and don't know yet which organisation can assist them. The Magobbo farmers were given water rights through ZS who will supply them with water under a contract arrangement between MCGA and ZS.

The MCGA members are exited about the project and hope that it will improve their livelihoods, through: improving their incomes; establishment of a clinic; and improved education for their children. Currently there is no clear plan with regards to the development of social services around the Magobbo smallholder scheme, and the MCGA doesn't seem to have clear plans on how they will lobby for the development of the social services.

Consolidated Farming also has plans for expansion and for setting up a smallholder scheme at Mogoba. These plans are still in a preliminary stage; the area is some 500 ha which would be put under a centre-pivot irrigation regime. The scheme would benefit some 80 farming families. It is intended to practice green cane harvesting. However the area lacks infrastructure.

Kalungwishi Estates Limited has no immediate plans for expansion or out-grower schemes.

2.4. The Zambia National Sugar Strategy (ZNSS)

At the moment a detailed sugar strategy has not been produced, only a document containing the "core elements". As this is the only existing document, we refer to it as the ZNSS.

The ZNSS contains four general components:

1. Expansion of sugar production through out-grower schemes;
2. Diversification strategy, consisting of: (a) ethanol production for fuel blending, (b) ethanol production for fuel gel, (c) co-generation of electricity, and (d) production of refined sugar;
3. Improvement of the transport network and services; and
4. Development of a national sugar trade policy.

Based on the March 2009 stakeholders workshop to revise the strategy, it was decided the trade policy component was no longer relevant. ZNSS components are described in

Table 3 below.

Table 3. ZNSS components

Component/Description	Observations
<u>Expansion of sugar production through outgrower schemes</u> Sugar protocol countries will be able to export sugar quota-free and duty-free to the EU at a price which, albeit considerably lower than in the past, would still be higher than the world market price. In spite of higher competition (as all other Least Developed Countries – LDCs – will benefit from this), as Zambia has one of the lowest	ZNSS makes reference to the need to identify similar schemes for the expansion of KE, but KE does not currently have an interest to increase production. Although not mentioned, there are references to other areas targeted for sugar cane growth[7]: Chief Manachingwala area, Mazabuka; Kafue flats; Lisutu River area,

[7] As referred to in Struyf and Chuba (2009).

production costs for sugar in the world, expansion represents an opportunity for Zambia. Growing resistance to the provision of land for commercial activity without the involvement of local communities has been identified. Thus expansion based on out-grower schemes, which have been successful in the Mazabuka District, is proposed as the way forward. ZS has already begun the expansion of their sugar production at Nakambala (foreseen a 70% increase in sugar production). This is to be done both through increasing milling capacity and increase of land under sugar cane by out-growers. The small-scale sugar cane growers of ZS, organised under KASCOL, have the capacity to expand their area under cultivation by an additional 560 ha. Apart from Kaleya Smallholder Trust (KST, managed by KASCOL) currently working with ZS, two other out-grower schemes are being established: Manyonyo out-grower scheme organised under the Manyonyo Water Users Association (MWUA) and the Magobbo smallholder scheme, organised under the Magobbo Cane Growers Association (MCGA). CF also has firm plans for expansion of estate lands under sugar cane as well as the establishment of at least one out-grower scheme (Magoba).	Siavonga District; Luena farming block, Kawambwa District; Manshya farming block, Mpika District; and Nansanga farming block, Serenje District. Mazabuka has been identified by the Indian company Shree Renuka Sugar, interested in establishing a sugar estate and mill, but guarantee of water rights is pending. Expansion in Kafue Flats is considered by a consortium of 4 commercial farmers currently developing a 1,700 ha irrigation scheme (Chinaga water development project) which could include sugar cane, and could supply it to CF. 400 ha have been earmarked for smallholder development. For the other sites concerns have been shown either because they lack optimal growing conditions (Lisutu river area), or basic infrastructure (Luena and Manshya). Moreover, for the GRZ development of Luena farming block remains second priority after Nansanga Farming Block. As for Mpika (Manshya and Mupamazi farming blocks), there seems to be interest by investors to develop up to 70,000 ha, which would in principle include sugar cane, a sugar factory and an ethanol distillery. The ToR for this SEA also mentions the Kariba shoreline as a potential expansion area, but it does not seem to be a priority for the GRZ nor pointed out as an area where investors have expressed an interest.
Ethanol production for fuel blending In light of a reduction of export opportunities and/or increase production of sugar, ethanol production will be encouraged. Also in the context of reducing Zambia's dependency on fuel imports, the GRZ may mandate blending of gasoline with 10% ethanol. An adequate regulatory framework will be required.	ZS has plans to build an ethanol plant at Nakambala, which would supply Indeni Petroleum Refinery. It is expected for the plant to produce 25 million litres per year. Date when production will start is not know. CF also has plans to build an ethanol plant with capacity of 32,000 litres ethanol/day.
Ethanol production for gel fuel Wood fuel remains the main source of energy (almost 80% of total consumption), and contributes to deforestation. An opportunity was identified to produce gel fuel, to be promoted for use in households.	
Improvement of the transport network and services A key constraining factor to competitiveness in the sugar sector is the high transport costs. Measures are foreseen to enhance transport links through roads and railway. For roads the ZNSS refers to rehabilitation of major road links; this is addressed under the Road Sector Investment Programme II. For enhancement of railway links reference is made to the Chipata/Mchinji rail link (connecting to Malawi), a part of the Nacala Corridor, and the pending Kasama/Mpulungu rail link (connecting to Tanzania). The	The ZNSS document does not make any reference to new potential areas for sugar cane cultivation. Some of these potential areas would need the building of basic infrastructure before attracting investors. In 2008, the EC was asked by the Sugar Accompanying Measures Steering Committee to fund an identification study for the construction of the Kawamba-Mushota-Luwingu road, which would

Beira Corridor through Zimbabwe (road) and the opening of the Nacala Corridor for rail transport (the latter stretching from the Port of Nacala in Mozambique via Malawi to Lusaka), are of particular interest.	improve access to the Luena farming block in the Northern Province. The identification study is currently ongoing, and includes environmental expertise within the team.
Development of a National Sugar Trade Policy Various factors interact to produce complex trade issues with regards to the sugar market. The ZNSS had thus identified a need to develop a sugar trade policy.	The March 2009 ZNSS revision workshop concluded this component was no longer relevant, and suggested it be taken out.
Private sector diversification strategy: co-generation of electricity and production of refined sugar Sugar estates produce electricity but still require 20MW from the national grid. This component encourages mills to improve their generation capacity, and maybe sell surplus electricity to the national grid, contributing to matching the increasing energy demand in the country. As well, as part of the diversification options, an opportunity exists for industry to add value to its sugar product by increasing production of refined and direct mill white sugars.	

2.5. Key Stakeholders

The main institutional actors relevant to the ZNSS include the following (their functions and relevance to the ZNSS are described in more detail in Appendix 3).

- Ministry of Tourism Environment and Natural Resources
- Ministry of Agriculture and Co-operatives
- Ministry of Community Development and Social Services
- Ministry of Communications and Transport
- Ministry of Commerce Trade and Industry
- Gender in Development Department
- Ministry of Health
- Environmental Council of Zambia
- Road Development Agency
- Water Board
- Zambia Development Agency
- Zambia Wildlife Authority
- Ministry of Lands
- National AIDS Council

Apart from the key institutional actors described above, other stakeholders relevant to the ZNSS include outgrower organisations, commercial sugar companies, sugar cane commercial farms, professional organisations and unions, NGOs, research institutes, and international development organisations and donors. These are described in detail in Appendix 3.

2.6. Main policies, plans and programmes relevant to the ZNSS

The main government policies, plans and programmes relevant to the ZNSS are as follows (described in more detail in Appendix 4):

- Zambia Vision 2030
- Fifth National Development Plan 2006-2010
- National Adaptation Programme of Action (NAPA)
- Biodiversity Policy
- National Biodiversity Strategy and Action Plan
- National Forest Policy and Action Plan
- Irrigation Policy and Strategy
- National Energy Policy
- National Agricultural Policy
- National Water Policy
- National Transport Policy
- Road Sector Investment Programme II
- National Gender Policy
- National HIV/AIDS/STI/TB Policy
- National Implementation Plans for the Management of Persistent Organic Pollutants in Zambia
- Environmental and Natural Resources Management and Mainstreaming Programme

2.7. Legislative framework relevant to the ZNSS

The environmental legislation most relevant to the ZNSS is (described in Appendix 4):

- Environmental Protection and Pollution Control Act
- Water Pollution Control (Effluent and Waste Water) Regulations
- Air Pollution Control (Licencing and Emission Standards) Regulations
- Electricity Act
- Forest Act
- Lands Act

- Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations
- Hazardous Waste Management Regulations
- Pesticides and Toxic Substances Regulations
- Water Act
- Energy Regulation Act
- Wildlife Act
- The Local Government Act
- Council By-Laws
- Societies Act
- Agricultural Credit Act

2.8. Methodology and tools

This SEA makes use of a combination of tools. The Scoping phase was aimed at identifying the key environmental aspects relevant to the SEA, addressed in further detail in the SEA Study. Identification of key environmental aspects was based on: (1) comprehensive literature review, including: relevant policies, plans, programmes, regulations, consultants' reports, and professional and academic publications; (2) bilateral interviews with the main key stakeholders (see Appendix 2); (3) one site visit to a sugar cane estate and sugar factory (CF); and (4) expert judgement. Key stakeholders were given an opportunity to comment on the scoping report.

As for the SEA Study phase, the following mechanisms and tools were used for impact identification, impact evaluation and preparation of recommendations: (1) literature review complementary to that carried out during scoping; (2) bilateral interviews with key stakeholders (see Appendix 2); (3) focused bilateral interviews to explore specific issues arising from the scoping phase; (4) site visits to: sugar cane estates and sugar factories (CF); out-grower schemes (Manyonyo, Magobbo); (5) stakeholders' workshop to validate preliminary findings and explore potential ways to address the key aspects (see Appendixes 3 and 4); (6) use of Leopold-type matrices for identification and assessment of potential impacts; and (7) expert judgement.

2.9. Key environmental aspects

The scoping stage identified the key issues of concern. These are categorised as 'High Priority', 'Medium Priority' and 'Low Priority'.

High Priority Aspects

Key Aspect 1. Water availability in the lower Kafue River basin

Key Aspect 2. Regulatory framework and capacities for vinasse management

Key Aspect 3. Minimising the risk for HIV/AIDS associated to new out-grower schemes and new sugar cultivation areas

Key Aspect 4. Enhancing opportunities of the sugar industry to increase gender balance

Medium Priority Aspects

Key Aspect 5. Securing a sound policy for ethanol production, fuel blending and gel fuel that will optimise the positive effects on the environment

Key Aspect 6. Securing an environmentally integrated strategy for roads upgrading/construction and for upgrading/expansion of the railway system

Low Priority Aspects

Key Aspect 7. Exploring implications of POPs Convention for regulation of cane burning

Key Aspect 8. Securing a co-generation policy that will optimise efficient use of existing raw material (bagasse) from the sugar sector

2.10. Non-issues

Key aspects identified in scoping were validated in the stakeholders' workshop, leading to some changes.

Deforestation, associated to the sugar sector, was discarded as a key issue. Key arguments are: (i) new sugarcane developments are most likely in areas designated as farming blocks; (ii)

firewood collection is not a key cause of deforestation; (iii) charcoal is not likely to be a main fuel in new settlements; (iv) sugar cane expansion beyond that around existing sugar estates does not seem feasible in the short- or medium-term; (v) sugar cane expansion may have a positive effect on deforestation if it substitutes lands under slash-and-burn agriculture.

HIV/AIDS and gender issues were raised from medium priority to high priority. The relevance and importance of these aspects as associated to the ZNSS was confirmed. A high priority is also consistent with the urgency of these aspects at national level.

Food security was not identified as a key issue associated to the sugar strategy. Although food security is an issue in Zambia, farmers shift to sugar cane mainly because it helps them attain food security, met by purchasing food with the income obtained from the sale of sugar cane.

The **regulation of atmospheric emissions** was initially identified as a key aspect as the current regulations do not set emission standards for bagasse-fired combustion units. However ECZ has confirmed that a new approach has been developed whereas emission standards will be independent of the type of industry or of combustion unit, and new Regulations (due for signature by Cabinet) have already been prepared. Thus this is no longer an issue.

Potential **conflicts over land** and impacts associated to general poverty issues were taken out as key issues, as not significant in the context of the sugar strategy.

Other potential environmental impacts of the sector, although opportunities may exist to improve performance, were not identified as key aspects: These include: (i) water contamination associated to use of agrochemicals and factory waste water - basic treatment systems are in place and, although there have been incidents of pollution into the Kafue river, the situation has much improved in the recent years after interventions from the ECZ; (ii) atmospheric emissions from boilers in the sugar factories; (iii) contamination associated with use of fertilisers and agrochemical products; and (iv) waste management, e.g. associated to fly ash disposal.

2.11. Assumptions, uncertainties and constraints of the SEA

There were no major factors that hindered the SEA process. The main shortcomings were related to ownership of the process by the GRZ and the access to certain information.

Participation of certain Government institutions in key phases of the SEA process fell short of expectations, e.g.: (i) participation to the meeting where the findings of the scoping phase were presented, and to which all ZNSS Steering Committee members were invited, was very poor; (ii) none of the ZNSS Steering Committee members, or any representative of GRZ institutions, provided feedback to the Scoping Report; (iii) some key actors did not send any representatives to the stakeholders workshop, which was a key opportunity to contribute to the process.

It was also not possible to obtain some information, which would have being of help for analysis. The information either did not exist, was confidential, or could not be secured. Examples of information that could not be obtained included: new policies and regulations which were being discussed in Cabinet; ToR for the Kafue River Basin water balance study; final report on the pilot introduction of gel fuel in Zambia; reliable projections for petrol consumption; reports of water discharges and atmospheric emissions from sugar companies.

3. State of the environment in Zambia[8]

Situation, climate, rainfall and main agro-ecological zones. Zambia is a landlocked country situated on the great Plateau of Central Africa, lying between latitudes 8º and 18º S and longitudes 22º and 34º E. It has an extension of 752,612 km^2 and altitudes that range between 350 and 2,164 metres above sea level. The four major biomes present in Zambia are: forest, woodland, grassland and aquatic systems. Climate is sub-tropical, characterised by a cool dry season (May to August), a hot dry season (August to November) and a rainy season (November

[8] This section is based mainly on: Environmental Council of Zambia (2001), Pope (2006), the National Policy on Environment and the National Adaptation Programme of Action. It is not the purpose of this section to provide a detailed description of the state of the environment, which is covered by, e.g. the above documents.

to April). Annual rainfall varies from an average of 1,000 mm in the northern parts of the country to 600 mm in the South. Mean annual temperatures range between 18 and 20ºC, with a highest of 32ºC and a lowest annual of 4ºC.

Zambia is divided into three major agro-ecological zones, as shown in **Figure 4** (Appendix 1).

Zone I covering the valleys of Gwembe, Lunsemfwa and Luangwa, and also including the southern parts of Western and Southern provinces. Zone I has the harshest climatic conditions, with rainfall under 800 mm and a short growing season of between 80 and 120 days.

Zone II covers the Sandveld Plateau of Central, Eastern, Lusaka and Southern provinces, as well as the Kalahari sand plateau and the Zambezi Flood Plains of the Western Province. 87% of this zone could be used for agriculture purposes, but only 50% is accessible, the rest being set aside for national parks, game management areas and forests. Zone II is characterised by an annual rainfall ranging from 800 to 1,000 mm and a growing season of between 100 and 140 days.

Zone III includes part of the Central African Plateau covering Northern, Luapula, Copperbelt and North-western provinces, as well as parts of Serenje and Mkushi districts. Only 52.7% of the land is suitable for cultivation due to soils being highly leached. It has an annual average rainfall of 1,000 mm and a growing season of 120 to 150 days.

Hydrogeography. Zambia has two major river basins: the Zambezi and the Congo. Zambia has extensive and diverse wetlands of local and international importance, covering about 14% of the surface area. Main wetlands are shown in

Figure 5 (Appendix 1).

Biodiversity. Zambia lies within the Zambezian Regional Centre of Endemism. Zambia is divided into sixteen ecosystems, 14 of which are terrestrial, one aquatic and one anthropic land cover type. Eco-regions of Zambia are shown in **Figure 6** (Appendix 1).

Forests and vegetation. The predominant type of vegetation is Miombo woodland, followed by grasslands, closed forest types and, finally termitaria bush group type. According to a recent study (Kalinda, 2008) forest cover is estimated at approximately 49.9 million ha, i.e. 66% of the total land area. The main forest types are semi-evergreen forests, which account for more than 45% of the total land area and 68% of the total forest area; the second main type are deciduous forests, with nearly 20% of total land area and 30% of total forest areas. The Provinces with largest forest cover are the Northwestern Province (20.1%), the Western Province (16.5%), the Central Province (15.8%) and the Northern Province (14.4%). Those with the lowest forest cover are the Copperbelt (3.2%), Lusaka (3.3%) and Luapula (6.9%). In the intermediate range we find the Eastern Province (10.3%) and the Southern Province (9.3%).

Climate change. Over several decades Zambia has experienced a number of climatic hazards, including drought, seasonal floods, flash floods, extreme temperatures and dry spells. According to the National Adaptation Programme of Action droughts and floods have increased in frequency, intensity and magnitude over the last two decades and have adversely impacted on food and water security, water quality, energy and sustainable livelihoods of rural communities.

Climate forecasts predict that Regions I and II will have lower average rainfall, whereas Region III is expected to increase its average rainfall. Mean temperatures are expected to increase in all Regions in about 2ºC in the 2010-2070 period. These changes are expected to result in increased frequency of warm spells and heat waves; warmer and more frequent hot days and nights; increased frequency of heavy precipitation events and increased area affected by droughts.

Climate change may also influence efficiency of the sugar sector[9]. Sugar cane is a water-intensive crop and its growth is directly related to rainfall, temperature and water availability. Sugar cane in Zambia is under irrigation, reducing vulnerability to climate change, but exerting

[9] The climate dependencies of sugar cane production and potential effects of climate change is based on the document: Enabling Activities for the Preparation of Jamaica's Second National Communication to the UNFCCC, Vulnerability and Adaptation Assessments Work Package 2: Water Resources and Agriculture, Final Report.

further pressure in water stressed areas. Also growth is closely related to temperature: optimum temperature for sprouting of stem cuttings is 32-38ºC, slowing down below 25ºC, reaching plateau level at 30-34ºC, reduced above 35ºC and practically stopping above 38ºC. However, for ripening temperatures between 12-14ºC are desirable, as it influences the reduction of vegetative growth rate and enrichment of sucrose in cane; at higher temperatures reversion of sucrose into fructose and glucose may occur, leading to less accumulation of sugars.

Presence of pests and changes in their patterns will also change with temperature. For example, smut initiation and spread is high when ambient temperatures are in the range of 25-30ºC; the spread of red not disease is high in the temperature range of 37-40ºC (other conditions being similar); rust incidence is high when minimum temperatures are reduced. Insect pest activity could also be similarly affected by changes in temperature and humidity. Sugar cane productivity and juice quality are influenced by weather conditions during the crop-growth sub-periods. Sugar recovery is highest with low humidity, bright sunshine hours, cooler nights with wide diurnal variations and very little rainfall during the ripening period. Presence of pests and changes in their patterns will also change with temperature.

Key environmental challenges. The progress report on the Millennium Development Goals (MDG) show an improvement in all MDGs, with the exception of MDG7 on environmental sustainability. The National Environmental Policy identifies the following key challenges: (i) deforestation; (ii) land degradation; (iii) wildlife depletion, especially in the protected areas; (iv) soil erosion; (v) loss of productivity; (vi) inadequate sanitation; and (vii) air and water pollution.

The EC's Country Environmental Profile (CEP) refers to the key environmental issues identified during the FNDP stakeholder analysis. Some are widespread at national level: (i) deforestation –particularly evident adjacent to headwater catchments, major urban areas and trunk road systems; (ii) wildlife depletion; (iii) fish stock depletion; (iv) loss and degradation of wetlands, especially in the Kafue River basin; (v) loss of biodiversity; and (vi) avoidance of future contamination and increased, appropriate, handling of hazardous and radioactive wastes. Other issues are more localised: (i) land degradation and dereliction – mainly in mining areas, but increasingly also in peri-urban and highly settled and drought-prone areas; (ii) surface and groundwater pollution – in mining, urban and major agricultural areas; (iii) localised air pollution – mainly in mining and major urban areas.

PART II ENVIRONMENTAL IMPACTS OF THE ZNSS

4. Introduction

The sections below explore in more detail the environmental baseline associated to the key environmental aspects identified, including cause-effect relationships, trends, expected state of the environment in absence of the ZNSS (where relevant) and expected effects of the ZNSS on the key environmental aspects. These analyses are the bases for identifying recommendations to enhance the environmental performance of the ZNSS. Figures 1, 2 and 3 (Appendix 1) present a synthesis of the environmental performance of the three sugar estates as well as the potential environmental impacts of implementing the ZNSS.

5. Key aspect 1: Water resources in the lower Kafue River basin (high priority)

5.1. Current state

Description of the area

The Kafue Flats are located in the flat country below the Itezhi-Tezhi Dam downstream up to the Kafue Gorge Dam; it is a wetland area with about 7,000 - 15,000 km^2, and a highly valuable environmental system. ZS and out-growers on the southern banks close to Mazabuka are the largest producers of sugarcane in Zambia. CF is on the northern banks.

The Kafue flats flood annually and attenuate flood flows into the Kafue Gorge reservoir, this results in considerable surface evaporation. The water regime has been altered due to the Itezhi-Tezhi and Kafue Gorge dams, constructed for the production of hydropower.

Increases in water use from agriculture, industry, and demand for energy in Zambia, coupled with the need for continued environmental sustainability, mean that the Kafue River is being placed under competing water demands and increasing water stress.

The Kafue River hydrological dynamics have been covered by numerous studies. Most have focused on individual matters such as improved environmental flows or development of new hydropower schemes[10], but a few make a more comprehensive system analysis addressing agricultural and hydropower developments. All of the mentioned studies refer to the large complexity of the river basin and the poor availability of data. The hydraulic characteristics of the Kafue Flats make both measurements and water balance calculations difficult. Uncertainty in hydrological monitoring data is referred to in most of these studies; this is the main reason for the different results obtained and the uncertainties around on water availability.

The water use in the Kafue Flats can be categorised into four areas:

1. Consumptive use for domestic water supply. Most of the domestic water use is for the Lusaka Water and Sewage Company, but also other small villages take their water from the Kafue River. Return flows from domestic use is insignificant since Lusaka Water and Sewage Company releases its treated sewage water to another river basin.
2. Consumptive use of water for irrigation. The majority of the irrigation is for sugar cane, but it is also used for wheat, maize and other crops. The two major sugar cane estates, ZS and CF abstract water from the Kafue River through canals upstream of the Kafue Gorge Reservoir. Almost all irrigated water is lost through evapotranspiration but a small portion is drained back to the river through drainage canals or groundwater flow.
3. Non-consumptive use of water for hydropower production. The existing hydropower plant at Kafue Gorge has a capacity of 900 MW and is used for both base load and peak power production. During the last decade the Kafue Gorge has had problems of running at full capacity, but an on-going rehabilitation by ZESCO will soon make the power plant operational for 900 MW. Future plans exist for installing a 120 MW power station at the outflow of the Itezhi-Tezhi reservoir and for a 600-750 MW power station at Kafue Lower, 65 km upstream the confluence with the Zambezi River (MWH, 2008).
4. Non-consumptive use for environmental conservation. To preserve some of the natural flooding variation of the Flats, ZESCO's water right for Itezhi-Tezhi is linked to a condition of releasing a "freshet" of 300 m^3/s for four weeks during the end of the wet season. Furthermore the water right stipulates a minimum flow of 25 m^3/s downstream the Itezhi-Tezhi reservoir, which is also necessary to ensure stability of the aquatic ecosystems.

The main source for current water use is the Water Rights record[11]; however the use of this as a base for water use is problematic. Water rights are not fully up to date because users have failed to report changes or reapply for extension, and because the Water Board does not have the capacity to fully monitor water use. Also it is still difficult to identify the exact location of the water abstraction points from the water rights records (the Water Board is transferring the water rights to a GIS database, which will tremendously improve information). The water right only gives maximum daily abstraction as m^3/day. Because of general lack of capacity, measurements of water use are scarce and information on actual use is therefore not available; however for seasonal users such as irrigators, total use can be assumed to be considerably lower on an annual basis then the total water rights allocated.

[10] The most recent reports are: Institute of Hydrology (1994); JICA (1995); Scott Wilson Piésold (2003); WWF and ZESCO (2004); Department of Water Affairs (2007); World Bank (2008); and Ministry of Energy and Water Development (2009).
[11] Information provided by the Water Board 09 Nov 2009.

Estimated water rights in the Kafue flats (2009) are 253 m^3/s (including consumptive and non-consumptive water use) and 38 m^3/s for consumptive use. Water users and their water rights/requirement are: 215 m^3/s for hydropower; 35 m^3/s for agriculture (irrigation); 3 m^3/s for local communities & industry; and 25 m^3/s for environmental services. For sugar cane in the Kafue Flats the water rights record differs slightly from the values above, especially for out-growers. It is also observed that some of the water rights stated by ZS for the sugar cane out-growers are reported as other crops in the Water Board record.

Actual water use is furthermore different because of irrigators using less water during the rainy season. Records of pumped water from ZS reveal that during the seasons 2006-2008, only about 50-60% of water rights were used on an annual basis. Furthermore even during September and October, when demand was close to the water right, not more than 60-65% was used. The reason, according to verbal communication from ZS, is that the capacity of the canal and pumping scheme could not accommodate the water demand. A visit to CF indicated the same situation. Both sugar estates are therefore at the moment investing in more pumping capacity.

Water Allocations System in Zambia

The Water Board considers all applications for water rights; in deciding over an application it has wide discretionary powers to issue and attach the conditions in its opinion are suitable. The decision is based upon advice of the Department of Water Affairs. Most water rights are issued for a renewable period of five years, but applicants can request rights for longer periods.

Irrigated agriculture has gained prominence in the basin where, apart from sugar cane, other crops have been introduced and grown commercially. This development has given rise to increased demand for water. Furthermore, water crises caused by the increasing population demanding more and more water, as well as the changing climatic conditions coupled with poor management of the basin, have brought about an imbalance between supply and demand.

The need for good water resource management of the Kafue Flats becomes more urgent at the present moment as all developments, current and planned require adequate water supplies. In this regard, as a first step in the granting of water rights, an assessment of the surface water resources supply becomes essential to maintain equity in the distribution of the resource.

Water balance (according to available information)

The following formula is used to get a rough estimated water balance for the Kafue Flats basin:

$$Q = (p + q_1 + q_2 + q_3 + q_4) - (a_1 + a_2 + a_3 + a_4); \text{ where:}$$

Q = available surface water allocation
p = rainfall contribution from the catchment
q_1 = releases from the Itezhi-Tezhi dam spillway gates
q_2 = contributions from the gauged rivers/streams in the sub-basin
q_3 = contribution from ungauged streams
q_4 = estimated return flows
a_1 = environmental flows
a_2 = existing water rights by other water users (other than ZESCO) in the sub basin
a_3 = evaporation losses
a_4 = ZESCO rights at Kafue Gorge

The variables were calculated and are summarised in the following table (Water Board, 2009).

Table 4. Summary of water balance variables for the Kafue Flats area

Variable	Description of variable	m^3/s
q_1	Releases from Itezhi-Tezhi into Kafue Natural Channel	206
P	Rainfall Contributions from the inundated sub-basin	96
q_2+q_3	Contributions from gauged and ungauged tributaries	66
q_4	Return flow	0.5
a_1	Environmental flows	25
a_2	Water rights granted (excl. Zesco)	38
a_3	Evaporation losses	59
a_4	Zesco Water right	215
Q	**Balance**	**31.5**

The water balance shows a surplus of 31.5 m^3/s in the Kafue Flats at this very moment (2009). This would be sufficient to support the development of additional agricultural activity on about 31,500 ha, using the 1 litre/s/ha as suggested by Stephens, 2008 (cited in MEWD, 2009).

Water rights allocated

At present (2009) the following water rights have been allocated to the sugar cane producers. The distribution of areas under furrow and centre-pivot irrigation is presented in Table 6.

Table 5. Water rights allocated in the sugar sector

Water User		Water Rights allocated	
		m^3/day	m^3/s
Zambia Sugar	Estate	1,246,428	14.4
	Outgrowers	575,540	6.7
Consolidated Farming	Estate	515,000	6.0
	Outgrowers	0	0
TOTAL		**2,336,968**	**27.1**

Table 6. Areas under centre-pivot and furrow irrigation in the sugar sector

Name of Sugar Company		Area (ha) under sugar cane	Area (ha) under furrow irrigation	Area (ha) under centre-pivot
Zambia Sugar	Estate	16,500	10,916	5,584
	Outgrowers	7,724	3,126	4,598
Consolidate Farming	Estate	7,430	4,532	2,898
	Outgrowers	0	0	0
Kalungwishi Estate	Estate	400	0	400
	Outgrowers	0	0	0
Total		**32,054**	**18,574**	**13,480**

A little over half of the total area planted to cane is currently under furrow irrigation, which is the least efficient system of water use. Only about 70 % of applied water is effectively available to the plant and the remainder is lost in surface run off and evaporation. Centre-pivot irrigation is more efficient, at 80% efficiency. Here the remainder is lost as evaporation and some surface run off. The most efficient application system is drip irrigation, where water is applied through perforated plastic pipes, buried some 20 cm, and the water is applied directly to the rooting zone of the sugar cane with virtually no water loss, only some loss through percolation.

Figures on water consumptive use by the two different irrigation systems at ZS do not show the above trend, as under the furrow irrigation system the full crop water demand cannot be met. This is said to be because water abstraction from the Kafue cannot satisfy the requirement.

Besides the water consumptive efficiency, other factors influence the choice of irrigation systems. Furrow irrigation is relatively easy to manage and virtually unskilled workers can operate the in-field system. The programming of the main water distribution is the hardest part; this is one of the reasons furrow irrigation is often selected for smallholder schemes. The disadvantage is that the land has to be formed in a constant slope, to make a uniform application of water over the whole length of the field. Initial land preparation costs are therefore very high.

Centre-pivot irrigation does not require this land forming, but the investment costs of the centre-pivot and its installation are high. Also its operation costs are higher than the furrow system. Furthermore, this system needs skilled workers to operate it. Drip irrigation is expensive from an investment point of view as perforated tubes have a limited life, one whole crop cycle (6-8 years). Furthermore the pre-application equipment (e.g. pumps, filters, fertiliser application) is sophisticated and the operation requires highly skilled workers.

DWA is charged with collecting data on surface and groundwater; however its information management system is not up to date and requires improvement in data collection, data exchange and processing as well as in monitoring and reporting. With inadequate capacity to monitor water rights issued, water abstraction by users is not effectively controlled. With an insufficient monitoring mechanism the level of metering is currently unknown, although

installed metering is a requirement for every water abstraction. There is the ongoing development of creating a new water resources information system with focus on the collection, exchange, processing, monitoring and reporting of all data.

Due to the lack of accurate figures on the actual use of water in the Kafue Flats, the Water Board has put a moratorium on the allocation of new Water Rights as from 2008. The DWA recognizes the need for a detailed water balance through of the entire Kafue River basin. This includes detailed assessments of all major sectors affecting the river runoff, e.g. mining, agriculture, hydropower and domestic water supply. Present and future scenarios should be considered. It should, contrary to previous studies, consider the whole of Kafue River basin for the system analysis. Terms of Reference for this study have been prepared.

5.2. Expected impacts in absence of the ZNSS

Future water use is very difficult to predict. On a 5-year horizon it is not anticipated that much will happen more than that the water rights will be sorted out for the actual demand, and that canal and pumping capacities are upgraded to fully utilise allocated water rights.

The Lusaka Water and Sewage Company will probably start implementing their plans for changing their source from groundwater to surface water by increasing the treatment plant capacity at the intake from Kafue River. It is judged feasible that part of the expansion is possible to 2015 and that the abstraction is doubled from the present 95,000 m^3/day. This will result in an actual water use of close to 42 m^3/s during the dry months for the Kafue Flats by 2015. On the longer term (10-20 years), Lusaka Water is anticipated to grow further. According to the present Water Supply Master Plan being developed, this would represent an abstraction from Kafue River of 460,000 m^3/day (5.3 m^3/s).

CF still has capacity in its sugar factory and is planning expansion of 2,000 ha through out-grower schemes (Struyf and Chuba, 2009). ZS's factory has capacity for another 400 ha. These expansion plans would lead to some 36,000 ha for sugar cane irrigation. Assuming a 20% increase in other irrigation, and taking into account the growth of Lusaka, this would give a total water demand in the Kafue Flats in the dry months of 48 m^3/s, or 4.1 million m^3/day in the long-term perspective. Table 7 below summarises the projection of water demand in the Kafue Flats.

Table 7. Water demand projections in the Kafue Flats

Type of use	Water demand in driest months (m^3/s)		
	Present	**2015**	**2020-2030**
Sugar cane irrigation	31	34	36
Other irrigation	4.5	4.5	5.2
Domestic and industrial use in Lusaka	2.8	3.6	6.6
Total	**38**	**42**	**48**

Water Right quantity *vs* actual water requirements in the case of sugar cane cultivation

Sugar cane requires an average of 1 l/s per hectare. However, during its development the sugar cane plant doesn't need the full amount of water; during the first 2-3 months the requirement is about 75%, then when the cane is actively growing the full amount is required; but one month before harvest a drying off of the cane is required to enhance sucrose formation.

One could argue that during the driest months, September and October, when the harvest is in full swing, about 1/3 of the cane area is not requiring the full amount of water. The moment the whole area requires the full amount would be about two months after the last cane is harvested, which is in the middle of the rainy season. At this time rainfall will supply most of the required water, supplemented with some irrigation; again the full Water Right will not be used.

The only period when the full demand is required would be just after the rainy season and at the beginning of the harvest. This is the time with lower temperatures and consequently lower evapotranspiration of the sugar cane plant. It is therefore felt that the water quantities allowed under the Water Rights are on the comfortable side and there might be more water available in the water balance than calculated according to the water rights allocated. During the assessment

of a water rights application the aspect of crop water requirement at different periods in the year should be taken into consideration in establishing the value of the water right.

Present and future hydropower needs

ZESCO currently has four major schemes that supply power: Kafue Gorge (900 MW capacity); Kariba North Bank (600 MW capacity); Victoria Falls (108 MW capacity); and Lumsemfwe & Mulungushi (28 MW capacity). Kafue Gorge is the largest producer with 430 MW firm power. Electricity production capacity in Zambia has historically been well above demand, although peaking capacity has been missing during times when the plants have not been fully operational. Relatively poor high-voltage transmission lines have further prevented large exports.

The FNDP states that hydropower generation is one of the priority development objectives and ZESCO judges that power demand is projected to increase by 100 MW per year (World Bank, 2008). The power demand is very much linked to the mining industry (59% of the electricity was used by the mining sector in 2007). Considering the present downturn of the mining sector due to the global economy, power demand projections are at the moment very uncertain.

However, during recent years electricity demand in southern and eastern Africa has generally increased and on a regional scale electricity demand will probably continue to increase despite the current global economic downturn. There are extensive plans to rehabilitate the regional grid for transmission; in Zambia rehabilitation projects aimed at increasing capacity of transmission lines and the three large power schemes have been on for some years. The rehabilitation of Kafue Gorge is to finalise by 2009, making the power plant operational for 990 MW.

The general need for power in the region and the increasing transmission capacity, nationally and regionally, has made ZESCO predict the need for extended power production, and new power schemes are planned. The two most immediate projects are the Kafue Gorge Lower and Itezhi-Tezhi. Future demand for extended power production in Zambia will depend on how the regional, now deregulated, market and the global economy develop. If investments occur for a regional transmission grid, the high hydropower potential in Zambia will be of large interest for South Africa and countries in East Africa. The other perspective is where investments in regional grids do not occur in the near future and mining production demand remains low. Electricity production will then focus on providing electricity for services (mainly domestic). Under this scenario growth is moderate and the immediate need mainly for peaking power.

Conflict situation

The water balance analysis of the Kafue Flats over the past years has shown no real conflict between irrigation and hydropower. The reason is that power demand has historically not been very high and that both the Kafue Gorge and the major sugar cane estates have had limitations in their technical capacity, preventing both users from fully utilising their water rights.

A water balance analysis of the Kafue Flats under future conditions has confirmed a potential conflict between hydropower production and sugar cane production. In a MEWD report (2009) a limited modelling exercise was carried, using two scenarios for hydropower development:

1) No increase in power demand at Kafue Gorge or, if expansion occurs in hydropower, to be made in places other than the Kafue Gorge. This means that the Kafue Gorge has a demand for 430 MW firm power (or 3,767 GWh/year) and an average of 6,150 GWh/year.

2) An increased in power demand at Kafue Gorge to run at its maximum capacity, through increased releases from the Itezhi-Tezhi dam of 170 m^3/s - the highest continuous release that can be made without the dam failing over the 28-year period of analysis.

Four different levels of sugarcane agriculture development were introduced:

- Water rights prior to approval of the expansion at Zambia Sugar and out-growers, corresponding roughly to the 2008 situation.

- Present water rights, including new expansion, corresponding to the 2009/2010 situation.
- The 2015 scenario with more or less present water demand fully utilised and legalised, and a limited expansion of Lusaka water supply demand.
- A future long-term scenario (10-20 years) with expansion to meet the factory production capacities at ZS and CF. This scenario assumes 20% increase in irrigated crops other than sugar and a high increase in water demand from Kafue River for Lusaka (460,000 m^3/day).

For all model simulations environmental flow releases were included as a minimum flow of 25 m^3/s and a freshet of 300 m^3/s during March.

Results of Scenario 1, simulation of irrigation development, assuming no additional demand for hydropower production at Kafue Gorge shows that the firm power of 430 MW could be generated at 100% reliability with future sugar cane development with the current operation of Itezhi-Tezhi. To test the limits of the system the sugar cane area was increased to a level when the 430 MW firm power cannot be met. The results show that up to approximately 38,000 ha of sugar cane can be developed in the Kafue Flats without effects on the firm power generation.

The results of the second scenario (simulation of maximum power production at Kafue Gorge under different alternative developments of irrigation) showed that the firm power available decreases as more sugarcane area is irrigated, in the order of 1.5 % or 79 GWh from the pre-expansion situation to the present sugar cane level; less than 1% or 42 GWh from the present to 2015; and another 1.5% or 89 GWh from the 2015 to the 2020-2030 development level. The total decrease from 2008 to the future long-term scenario is from 525 MW to 495 MW firm power. On the other hand, the average annual energy is still above the 6,150 GWh/year level, which was assumed for the design of the power scheme.

Economic value of water in the Kafue Flats: hydropower vs (sugar cane) irrigation

If water is seen as a commodity, its economic value could be established for competitive use. The MEWD (2009) study calculated the estimated economic value of water for different uses in the Kafue catchment. The economic value of consumptive raw water use for hydropower is significantly larger than for extracted water for irrigated sugar cane production.

For hydropower the economic price variation has been estimated of 0.56-1.33 US$/$m^3$ depending on the economic value of electricity (0.07-0.11 US$/KWh), compared to an estimated value for sugar cane production of 0.03 US$/$m^3$. Thus in a case of water scarcity and competition between hydropower generation and irrigated sugar cane production the economic value of water would favour hydropower. However it is important to stress that the economic value of water should not be the only factor to consider. A comprehensive analysis would need to be made where factors such as the overall importance of hydropower for economic development, the export value of sugar, employment generation and provision of social services in the sugar sector are also taken into account. Furthermore possibilities to save water from the sugar sector by introducing more efficient irrigation technology should be taken into account prior to a possible decision to transfer water from irrigated agriculture to the hydropower.

Updated and sound economic values of water need to be prepared in a possible situation of water scarcity and competition between the two sectors. Decisions on water allocation should be framed in a context of sustainable development, i.e. addressing the economic, social and environmental dimensions, rather than exclusively on economic grounds.

Expected pressures on water resources from climate change

Climate change is one part of the uncertainty of the water availability studies. UNDP/GEF (2007) (cited in MEWD, 2009) reports on the expected effects. Projections to 2070 show a slight increase in average rainfall but also a larger inter-annual variability. This would mean that dry years will occur more often, even if rainfall generally increases. Also, an increase in average temperatures of about 2ºC for 2010-2070 is expected. The increase in temperatures will be

followed by increased evapotranspiration, which will generally decrease water resources.

The combined effects of climate change will probably be less river flows during extreme dry years, which determine the firm power and safe yield of dams. However, modellings refered to in the NAPA concluded no significant effects on existing or future proposed reservoir yields.

For a time period of 5-10 or even 20 years the effects of climate change is relatively small compared to the natural variation in river flows. The trends reported, however, further accentuate the potential water availability conflict in the Kafue River and give further motivation of leaving extra margins when allocating water.

5.3. Expected impacts with implementation of the ZNSS

As a result of the water balance estimate (2020/2030 situation), additional sugarcane production can top a maximum of 21,500 ha (1 litre/s = 1 ha), using the whole balance of water for sugar cane. In concrete terms it would mean that an additional sugar complex with an area planted to cane of some 10,000 ha, as nucleus estate with out-grower schemes, would be feasible. This mill could produce some 100,000 tonnes of sugar and 30,000 tonnes of molasses, which could be turned into 8 million litres of ethanol for fuel blending.

This scenario would imply the development of hydropower at sites other than the Kafue Gorge. If however ZESCO would increase its capacity at the Kafue Gorge then part or all of this surplus available water would be absorbed. The GRZ or its regulatory body the Water Resource Management Authority should arbitrate on the final use of the surplus water available.

Adequacy of policy, institutional and regulatory framework

Zambia is currently moving towards the institutionalisation of integrated water resource management (IWRM). A water resources management (WRM) Bill has been under preparation and discussion since 2003, and is now in Cabinet. The WRM Bill is intended to provide a new institutional and legal framework for WRM that is consistent with the government's decentralisation policy. The Bill will establish a new National Water Resources Management Authority with catchment and sub-catchment bodies that recognise the role of Water Users Associations. A water charge system will be established to ensure the sustainability of the new institutional setup. Furthermore the water rights and permitting system will be revised. The Bill provides for a five-year transition period during which existing government agencies will shift their roles and new capacity will be developed to begin full implementation of the roles, functions, and responsibilities established by the Bill.

The system of water resources management described in the Bill will, if implemented accordingly, be focusing on a number of key areas, including:

- The use of water shall maximise the social and economic benefits to the community;
- Water may be used for a number of purposes including domestic, environmental, training & research, municipal, agricultural, industrial, hydro-electric, mining, navigational, and supply of water in bulk;
- Prioritisation of the process of allocating water for various purposes shall commence at the sub-catchment level and the Sub-catchment Council shall submit its recommendations to the Catchment Council, which shall submit a proposal in form of an allocation plan to the Board of the Water Resources Management Authority;
- Subject to the National Water Resources Strategy and Plan and a Catchment Management Plan the Board of The Water Resources Management Authority shall determine the quantity of water to be allocated for the various uses of water taking into account the water available and required for the reserve, any regional and international obligations, municipal, agricultural, mining, hydroelectric and industrial purposes;

- The Minister may, based on recommendation of the Water Resources Management Authority and a catchment concerned, prescribe the manner of allocating water between users who have competing needs for water.

As described above the Bill is clearly envisaging a situation of competition for scarce water resources between competing water uses. As described in the preceding sections, tools such as the assessment of water availability, preparation of a water balance and the preparation of an economic price of water should be made available for the Water Resources Management Authority in allocating scarce water between competing sectors.

The establishment of The Water Resources Management Authority will also change the role of existing water resource institutions. A capacity building programme is envisaged for the different institutions to ensure that the planned functions can be effectively implemented. With an effective capacity building programme coupled with sufficient resources available to install, maintain and develop the new institutional and legal framework for IWRM the enacted Bill appears to provide for sufficiently detailed policy guidelines to optimise water management and utilisation in the catchments of the country.

Water availability in other potential sugar cane production expansion areas

Luena Sugar Cane Scheme - The Kalungwishi River

The Kalungwishi River flows west in northern Zambia into Lake Mweru. It forms part of the boundary between the Northern and Luapula Provinces. Several waterfalls are located in the downstream part of the river. According to the water rights record water use in Kalungwishi is very low, and most water rights refer to small-scale irrigation. Two major potential schemes are however identified; one for hydropower development in the Kabwelume Falls area in Kalungwishi and one for sugar cane production at the Luena/Pambashe tributary.

The Luena Sugar Cane Scheme was identified already in the 1970s. A feasibility study was further made by the Stockholm Environment Institute (2000). The proposed agricultural area covers 6,650 ha in the Luena and Lufubu River area with possible future expansion of 10,000 ha in the Luongo River basin to the south. For the 6,650 ha, water for irrigation is planned to be taken through a canal from the Lufubu River and by constructing a dam on the Pambashe River.

A study on the development of hydroelectric power on Kalungwishi River in the 1970's found that it was feasible to develop a scheme using the heads of Lumangwe, Kabwelume and Chimpempe falls. A cascade arrangement would give a generation capacity of 110 MW. The Office for Promoting Private Power Investment (OPPPI) is currently driving a project to develop a 210 MW scheme (MEWD, 2009). If this hydropower project would go ahead there might be a potential conflict between with the planned Luena sugar scheme.

Kalungwishi Estates - the Chambeshi River

The Chambeshi River originates in the NE part of Zambia in the Mbala Highlands. It flows to the SE and joins the Luapula River that discharges into Lake Mweru. Major tributaries in the upper part are the Kalungu, Lubu, Mansha and Lukulu. The river catchment at the Mpika-Kasama Road (Chambeshi Old Pontoon) is 37,745 km^2. Just downstream the bridge the Lukulu River, with a catchment area of 8,550 km^2 joins the Chambeshi River.

The water rights record shows a variety of water users for domestic, agricultural and hydropower purposes in the Chambeshi River basin. The water rights, however, indicate a generally low level of water utilisation. The only existing sugar cane producer is KE, in the upper Lupombwe River. KE abstracts water from a dam to irrigate four centre-pivot areas of a total of 400 ha.

One medium scale hydropower scheme exists in the Luombe River at the Chishimba Fall, a 6 MW power scheme linked to the national grid, with basically no storage and working as a run-of-the-river scheme. As it is located in the Luombe River before it joins the Lukulu River there is no conflict with existing sugar cane production. The Chambeshi and Kalungwishi River

basins have abundant water and are, from a water availability perspective, good options for development. Both have the potential to sustain large expansions in irrigation and several sites in the Kalungwishi have been identified for their hydropower potential.

5.4. Options to address the Key Aspect

Water availability in the Kafue Flats

Up to now there has been no real conflict between irrigation and hydropower in the Kafue Flats. The reason is that power demand has historically not been very high and that both the Kafue Gorge and the major sugar cane estates in the area have had limitations in their technical capacities to abstract water. This has prevented both users from fully utilising their water rights.

The water balance analysis of the Kafue Flats has, however, confirmed a potential conflict between hydropower and sugar cane production. If power demand grows nationally and internationally, and necessary investments are made in transboundary transmission lines, expansion of sugar cane in the Kafue Flats will limit the increase of average energy and firm power production of the Kafue Gorge, or visa-versa. On the other hand, Kafue Gorge is not the only alternative for future growth in hydropower production in Zambia and the increased power demand is associated with considerable lead times for improvements of the transmission lines.

The water balance analysis indicated that a further limited expansion of irrigated sugar cane in the Kafue Flats is possible without significantly reducing the present energy production at the Kafue Gorge and maintaining the level of production it was originally designed for.

The key to optimise development and avoid conflicts on the local scale is a long-term strategic plan for water resources development and building institutional capacity for associated water resources management to implement the strategy. The long-term strategic plan may include a review of existing water rights in the Kafue Flats, requiring negotiations with major water users. During the review of the water rights allocated the aspect of crop water requirements at different periods in the year should be considered to establish the value of the new water right.

The Water Resources Management Bill is envisaging a situation of competition for scarce water resources. It is recommended that tools such as the assessment of water availability, preparation of a water balance and an assessment of the value of water (including social, environmental and economic aspects) be made available for the Water Resources Management Authority in allocating scarce water between competing sectors.

To allow correct planning and policy making it is essential that a detailed water balance through a complete system analysis of the entire Kafue River basin be conducted. This should include assessments of major sectors affecting the river runoff, e.g. mining, agriculture, hydropower and domestic water supply (including identification and quantification of illegal and unregulated water abstractions). Present and future scenarios should be considered. Detailed system analysis modelling should be applied to assess safe yields and assurance of supply for major water users.

Monitoring of water resources by DWA

The current DWA information system is outdated and is not a good basis for decisions on water resources. It is highly recommended to support the ongoing development of creating a new information system with focus on collection, exchange, processing, monitoring and reporting of data. Information should include data on hydrogeology, hydrology, water quality, meteorology, water use and the links between water resource utilisation, the economy and the environment.

Integrated Water Resource Management

The Water Resources Management Bill envisages a Water Resources Management Authority, which will change the role of existing water resource institutions. A capacity building programme is envisaged for different institutions to ensure planned functions can be effectively implemented. With an effective capacity building coupled with sufficient resources to install, maintain and develop the new framework for IWRM the Bill seems to provide adequate policy guidelines to optimise water management and utilisation in the catchments of the country.

6. Key aspect 2: Regulatory framework and capacities for vinasse management (high priority)

6.1. Current state

Vinasse is a residual substance from the sugar cane distillation process. It is a thick acid liquid containing a mixture of water and organic and inorganic compounds, and a very large BOD in the order of 30,000 – 40,000 mg/l. When distillation is produced from molasses, total solids are around 5-10%, and organic solids are in the 4-8% range. Other parameters include: potassium (0,48-1,2 wt%); phosphorous (0.0001-1.5 wt%); nitrogen (0.015-1.2 wt%); calcium (0.014-0.2 wt%); magnesium (0.006-0.15 wt%) and ash (1.5-5 wt%) (Cortez and Brossard Pérez, 1997). Vinasse is highly polluting and therefore requires proper management and regulation.

Currently vinasse is not produced in Zambia, as there are no distillery operations. In terms of environmental regulation, being a liquid waste, regulation of vinasse falls under the *Water Pollution Control (Effluent and Waste Water) Regulations, 1993*. Vinasse disposal, be it disposed of directly or indirectly to the aquatic environment is considered under the Regulations as an "effluent"[12] and thus subject to a license. Discharges have to conform to the standards for effluent and waste water, and additional conditions may be attached. Other treatment options may be subject to EIA and other conditions additional to the regulation of any effluents produced. There is currently no statement or policy from ECZ on whether vinasse produced should be subject to specific conditions for disposal.

Licenses issued by ECZ for effluents require agricultural run-off to be collected in a common reservoir prior to discharge, canalised via drainage channels. License holders are obliged to take monthly samples of specified parameters and submit bi-annual reports. Compliance with regular reporting, and enforcement by ECZ, seems to be currently very limited, with only few license-holders submitting regular reports. This hypothesis cannot be fully ascertained in this SEA Study, but there are strong indications that this is so. In the best case, monitoring reports are not being systematically and adequately filed by ECZ for their consultation; in the worst case companies are not carrying out the monitoring, and no consequent enforcement is taking place.

6.2. Expected impacts in absence of the ZNSS

Although the ZNSS promotes biofuels, they are also promoted under the Energy Policy. Thus production of ethanol by sugar companies will be independent of how the ZNSS may be shaped.

6.3. Expected impacts with implementation of the ZNSS

The blending percentages are not yet determined, and will depend on a study currently being carried out by the Department of Energy. However pre-draft blending ratios are available (Sinkala, nd), and can be used as an initial estimate. These ratios range from a 5% blend (E5) up to 2015 and an E10 blend to be implemented between 2015 and 2020.

Currently petrol consumption is in the order of 200 million l/yr. Ethanol requirements to satisfy fuel blending are in the range of 12-24 million l/yr for the E5 and E10 scenarios respectively. Considering a production of vinasse in the order of 12-18 l vinasse/l ethanol produced, production of vinasse may range between 120 and 500 million l/yr.

Table 8. Ethanol requirements and associated generation of vinasse

Year/Blend ratio	Petrol consumption (million litres/yr)	Ethanol requirements for blending (million litres/yr)	Vinasse generated (million litres/yr)
2009/E5	200	10	120-180
2015/E5	239	11.95	143-215
2020/E10	277	27.7	332-499

[12] According to the Regulations "effluent means waste water or other fluid of domestic, agricultural, trade or industrial origin, treated or untreated and discharged directly or indirectly into the aquatic environment".

There are no reliable projections for petrol consumption (see Key Aspect 5); projections made here correspond to a 2009 expected consumption of 200 million litres and a 3% annual increase. Under this scenario, vinasse generation would be 120-499 million l/yr. However foreseen distillery capacity is about 32.9 million l/yr, generating 395-592 million litres of vinasse.

Considering that approximately 10 litres of ethanol can be produced with 1 tonne of sugar cane, and considering the current and expected sugar cane being crushed at the three sugar factories, we can obtain the potential production of ethanol considering that all molasses are employed in its production. The question that concerns us in this section is what is the impact of this production of vinasse, the environmental risks and the options to manage it.

Table 9 below summarises the typical composition of vinasse from molasses (for some key physical-chemical parameters), and compares it to the standards for effluents and waste water in the Zambian regulations. Although precise figures may vary according to sources, Table 9 gives an idea of the magnitude of the contaminant load of vinasse.

Table 9. Vinasse composition and effluent standards

Parameter	Typical composition of vinasse	Standards for Effluents
Temperature	65 – 105 ºC[13]	40ºC at point of entry
Total Suspended Solids	1,500-14,000 mg/l[14]	100 mg/l
pH	4.0 – 4.5	6.0 – 9.0
COD	20,000 – 60,000 mg/l[15]	90 mg/l
BOD	25,000 – 50,000 mg/l[16]	50 mg/l
Nitrates	55-600 mg/l[17]	50 mg/l (water course)
Nitrite	3650 mg/l[18]	2 mg/l
Phosphorous (total, as phosphates)	100-500 mg/l[19]	6 mg/l
Sulphates	3,000-16,000 mg/l	1500 mg/l

Taking just BOD as a reference, if vinasse were to be treated, the treatment system would require an efficiency in the order of 99.8 - 99.9% to be compliant with the discharge limits. Such efficiencies are not possible with standard water treatment processes, not to mention settling ponds, which are the most common treatment systems in sugar mills.

ZS and CF have plans for building ethanol plants with production capacities of 25 million l/yr[20] and 8 million l/yr[21] respectively (although no projects have been submitted for approval). KE also considers producing ethanol if the regulatory framework developed allows them to do their own blending. Vinasse management at both ZS and CF is not yet determined.

6.4. Options to address the Key Aspect

Various alternatives are available for the treatment/disposal of vinasse. Advantages and disadvantages of some of these methods are summarised in Table 10 below.

Table 10. Strengths, opportunities, weaknesses and threats - vinasse management

Strengths and Opportunities	Weaknesses and Threats
Use of vinasse for fertigation	
• More environmentally sound method of disposal than discharge to the aquatic system • May require basic prior treatment only (e.g. lined settling ponds)	• Production of vinasse should be close to fields for method to be feasible • Risk of water contamination runoff and leaching, especially during rain events

[13] Baez-Smith (2006).
[14] Driessen *et al* (1994).
[15] Baez-Smith (2006).
[16] Cheesman (2005).
[17] Driessen *et al* (1994).
[18] *idem*
[19] *idem*
[20] Kaizen Consulting International (2006).
[21] Consolidated Farming, pers. comm. Figure based on 32,000 l/day with 250 days/yr effective production.

• Reduction in application of synthetic fertilisers • It is very likely that there is sufficient land in the sugar estates for all vinasse to be applied	• May imply distillery operations cannot take place during rain events • ECZ needs to ensure capacities to assess license applications • Materials for transport of vinasse must adequately deal with acidity
Aerobic treatment of vinasse using activated sludge	
• Technically can bring down load of contaminants to comply with standards • Allows year-round operation of distillery	• Standard waste water treatment plants would not suffice • Very high energy costs
Anaerobic treatment of vinasse (biodigestors)	
• If well designed can reduce load of contaminants to comply with standards (normally followed by aerobic treatment or lagooning) • Energy recovery (biogas) • Sludge can be used as fertiliser • Opportunity to generate carbon credits through the CDM[22]	• Expensive to implement • Even efficient treatment may be insufficient to bring levels to comply with standards, so follow-up treatment (aerobic treatment or lagooning) may be needed
Concentration of vinasse by evaporation	
• Allows recovery of water, which may be used in the factory • Yields concentrated syrup (CMS) which can be used as fertiliser, animal feed, or fuel	• Production of CMS involves additional costs to factory • High energy costs

Fertigation with vinasse seems to be the most likely option producers may opt for, due to the lowest costs implied[23] and the benefit of acting as partial substitute of fertilisers. Environmental implications of this option are thus explored in further detail. The main constraint, from an environmental point of view, is to ensure that vinasse is applied in quantities that match crop uptake of nutrients, minimising run-off into the aquatic system. Impacts on the aquatic environment associated to fertigation with vinasse can be important[24], and in some cases has led to restrictions such as prohibiting the generation of vinasse (and thus, distillery operations) during rain events, e.g. in Jamaica (Palerm and Burgess, 2009).

Rates of application will vary according to crops and soil types. An average application of vinasse would be in the order of 50-80 m^3/ha. Taking a maximum estimated production of 592 million l vinasse/yr for the long-term in Zambia (based on a maximum foreseeable production of ethanol in the medium-term from the three existing sugar companies), and an average of 2-3 applications of vinasse per year, this gives us an area between 2,500 ha (3 applications of 80 m^3/ha) and 5,900 ha (2 applications of 50 m^3/ha) that can be fertigated. Considering the lands under centre-pivot irrigation (the irrigation system through which fertigation can be applied) at ZS and CF, all vinasse may be applied through fertigation. See Table 11 below.

Table 11. Maximum production of vinasse

Sugar Estate	ha under centre-pivot (after expansion)	Production of vinasse (Ml/yr)	Area fertigated at 50 m^3/ha (ha) Number of applications		Area fertigated at 80 m^3/ha (ha) Number of applications	
			2	3	2	3
ZS	6,084	300 - 450	3,000- 4,500	2,000-3,000	1,875-2,813	1,250-1,875
CF	5,000 (50% of total)	96 - 144	960 - 1,440	640 - 960	600 - 900	400 - 600
KE	400	0.47-0.70	4.7-7.0	3.1-4.6	2.9-4.4	1.9-2.9
Total	**11,484**	**396–595**	**3,965 -5,947**	**2,643-3,965**	**2,478-3,717**	**1,652-2,478**

[22] Only one CDM project has been registered for anaerobic treatment of vinasse in Nicaragua (Viansse Anaerobic Treatment Project – Compañía Licorera de Nicaragua S.A.) where vinasse will be treated in two biodigestors whose energy output will be used in the factory operations. Output of the biodigestors is expected to generate about 119,589 tonnes of CO_2 equivalent in emissions reductions annually.

[23] However costs are not negligible, and should consider appropriate materials for the transport of the acid substance.

[24] See Gunkel *et al* (2007); Cheesman (2004); Barber *et al*, 2008; Water Resources Authority, Jamaica (2003, 2004).

Whatever the method of treatment/disposal selected, the regulating authorities will require the capacities to technically assess applications in order to evaluate environmental feasibility and establish appropriate safeguards. These capacities, including understanding of vinasse physical-chemical characteristics and options for disposal/treatment are currently absent in the ECZ.

To be able to respond to the environmental challenges posed by the production of vinasse associated to ethanol production, recommendations of this SEA focus on the development of appropriate environmental safeguards for vinasse disposal as well as capacities within the ECZ. It should be nevertheless be reminded that the onus is on the private sector, who must ensure the disposal/treatment measures foreseen are compliant with applicable regulations.

7. Key aspect 3: Minimisation of increased risk of HIV/AIDS associated to new sugar cane cultivation areas (high priority)

7.1. Current state

State of HIV/AIDS and awareness in Zambia in general, and in sugar areas in particular

The Sub Saharan African region in which Zambia is located is the worst affected by the HIV/AIDS pandemic. It is well known that the pandemic is posing a serious threat to Zambia's social and economic development. According to the 2007 Zambia Demographic and Health Survey (ZDHS) the adult HIV prevalence (among women and men 15 to 49 years old) is 14%; the prevalence was 16% among women and 12% among men. The prevalence rate stood at 16% in the 2001/2002 ZDHS. HIV prevalence in the urban areas is twice that in rural areas (20 and 10% respectively). Southern and Lusaka provinces in which 2 of the 3 sugar estates are situated are among those that have HIV prevalence rates above the national average (15 and 18% respectively). Northern Province, where the other sugar estate is situated, has together with North-Western Province the lowest rate at 7% while that of Luapula, where there are plans to open new sugar estates falls within the national average.

The proportion of HIV positive individuals, among respondents tested during the 2007 ZDHS, increases with age from 5% among the teenagers to 24% in the 35-39 years age-group, before falling slightly among those in the 40 years age-group (Figure 7– Appendix 1).

The pandemic has left an estimated one million orphaned children and more than 200,000 people in need of anti-retroviral therapy (ART)[25]. The accompanying human, social and economic consequences make HIV/AIDS one of the most crucial development challenges. The human toll of AIDS is a tragic reality being experienced by families, communities and the nation at large, with no aspect of life not directly or indirectly being negatively influenced.

However HIV awareness according to the 2007 ZDHS findings is almost universal, with little or no differences based on socio-economic characteristics. Figure 8 (Appendix 1) shows that people's knowledge of HIV infection prevention methods have generally been increasing especially in rural areas over the years. The figure compares the level of knowledge for some HIV infection prevention methods captured in previous surveys and in the 2007 ZDHS.

Impact of sugar estates on HIV/AIDS and awareness

There are no official statistics on the prevalence of HIV/AIDS in sugar estates in Zambia. However, Struyf and Chuba (2009) indicated that HIV/AIDS infections and/or mortality related to HIV/AIDS are high at Kaleya Smallholder Scheme and the ZS estate. They reported as having been established the fact that the 30% mortality among the KST scheme members is related to HIV/AIDS, and that 75% of the deaths at the ZS estate are AIDS related. A number of explanations to the high incidence of deaths at the Kaleya scheme were suggested as:

- It is culturally acceptable for men to have more than one regular partner, and high frequency of change of sexual partners and multiple sexual partners has been observed;

[25] www.netherlandsembassy.org.zm/en/development-cooperation/hiv-AIDS.html

- The relatively high income of the scheme members makes them more vulnerable to contracting HIV/AIDS as many women have sex with a "boyfriend" for money;
- Women are dependant on men and have limited ability to control the terms under which they have sex, including whether a condom is used and whether their partner is faithful;
- Sugar production involves use of hired migrated labour for seasonal work such as cane cutting. Migration with long separations and breakdown in family patterns contribute to a rise in prostitution and high incidences of STDs and AIDS;
- There is no structural HIV/AIDS prevention/education programme in place at the scheme.

All the sugar estates have reported activities to raise HIV/AIDS awareness and sensitisation on preventative measures among either employees or scheme members. However, the impacts of these activities cannot be ascertained at this point in time.

HIV/AIDS policy and institutional framework….also in the sugar companies

In responding to the devastating personal, social and economic impacts of the pandemic, Zambia has formulated the National AIDS Strategic Framework (NASF) 2006-2010 which is multi-sectoral and is coordinated by the Zambian National AIDS Council (NAC) and has actors at macro, sector, civil society and private sector levels. At the macro level the Government has put in place a number of national support structures as follows:

- A high level Cabinet Committee of Ministers on HIV and AIDS, which provides policy direction and supervises and monitors the implementation of HIV and AIDS programmes;
- A Partnership Forum established to include high level representation of different stakeholders in the Zambian multi-sectoral HIV response;
- The NAC is a broad-based corporate body with government, private sector and civil society representation. It is the national mechanism to coordinate and support the development, monitoring and evaluation of a multi-sectoral national response to HIV and AIDS whose overall mission is the prevention and combating of the spread of HIV and AIDS and reduction of the personal, social and economic impacts of the HIV and AIDS epidemic;
- The National HIV/AIDS/STI/TB Policy provides direction and mandate for the national response.

At lower levels, provincial, district and community HIV and AIDS Task Forces (PATFs, DATFs and CATFs) have been established to operate as sub-committees of the decentralised development coordinating structures, the Provincial Development Coordinating Committees (PDCCs), the District Development Coordinating Committees (DDCCs) and the Area Development Committees (ADCs) respectively.

At the sectoral level there is an HIV/AIDS focal person in each Government ministry. Civil society is considered an important stakeholder and plays a significant role in strengthening the multi-sectoral response to HIV/AIDS, TB and STIs. Civil Society Organizations (CSOs) are frequently key role-players in developing and implementing innovative, culturally-sensitive approaches that include elements of mainstreaming, decentralisation, outreach and community participation. The role of traditional health practitioners in strengthening the national response to HIV/AIDS, TB and STIs is increasingly acknowledged. The Traditional Health Practitioners' Association of Zambia (THPAZ) has also been active in natural remedies research and income generating activities, such as crop production and processing and community-based catering.

The private sector accounts for an estimated 58.5 percent of the formally employed work force in Zambia. The design and implementation of HIV and AIDS work place programmes in companies and businesses have been largely supported by the private sector. The sugar companies have also been undertaking HIV/AIDS awareness and sensitisation activities. KE has designated AIDS counsellors within the estate who also work with outside organisations on a

number of activities addressing various social issues. ZS as part of its social investments supports HIV/AIDS activities through (LMC International, 2006):

- Women groups who attend ante-natal classes receive HIV/AIDS sensitisation and HIV/AIDS awareness videos are periodically shown on the estate while continuous HIV/AIDS sensitisation material is available through markets and housing centres;
- Youth outreach programme, for sensitisation targeting young people at schools and churches as well as on the estate;
- Home based care. Zambia Sugar supports the Catholic Church home based care programmes in townships on the estate;
- Work place programme aimed at improving communication on and understanding of HIV and AIDS which are held sporadically in different departments, both during recruitment and as part of an on going programme targeting both permanent and seasonal employees;
- Condom distribution through different points across the estate;
- Voluntary Counselling and Testing centre at the clinic within the estate;
- Wellness programme for the HIV positive but well and the HIV positive and unwell.

The Kaleya smallholder scheme and the planned schemes at Magobbo and Manyonyo do not have structured programmes to integrate or mainstream HIV/AIDS in their activities, though *ad hoc* HIV/AIDS activities are being conducted and there are plans to increase the capacities of these schemes to mainstream HIV/AIDS.

7.2. Expected impacts in absence of the ZNSS

Expected inflow of workers and migration due to foreseen expansion plans at Zambia Sugar and Consolidated Farming, and new out-grower schemes

Sugar cane estates operations at ZS and CF have heavily relied on temporary migrant labour for especially cane harvesting. These are normally single men and, in any case, married men are usually not allowed to bring their families along; this can result in a high proportion of single men in the population, distorting the gender balance in the area. The situation is the same at the Kaleya smallholder scheme and will be adopted at the planned Magobbo and Manyonyo schemes. Such short-term labour force is usually not offered housing by the sugar estates though some rudimental structures in the so-called labour camps is provided by CF.

Apart from migrant workers, other individuals will also be attracted to live in and around out-grower schemes by the anticipated better income and livelihood opportunities. This will also be driven by extended family ties whereby migrants could be assisted in settling down by sitting relatives, while some migrants would literally join households participating in the out-grower schemes and thus increasing the household sizes. Due to the general increase in income levels in these areas, effective demand for goods and services would increase and attract more providers of such goods and services to satisfy the demand and hence increase population levels.

Expected impact on HIV/AIDS incidence and awareness with planned expansion of sugar cane areas and out-grower schemes

The influx of migrant labour will cause gender imbalances in communities as there will be more single men with more money, increasing the willingness and ability to engage in prostitution, and which can increase the spread of HIV/AIDS. Even farmers participating in the out-grower schemes (or providers of goods and services) will also have more income and their ability to engage in promiscuous behaviour would increase. On the other hand, vulnerable women living in these poor communities will now have opportunities to engage in prostitution in order to raise money to buy food and meet other household necessities.

Furthermore, it is culturally acceptable in these areas for men to have more than one regular partner and experience has shown that men tend to even marry more wives when their income increases. Women are dependant on men and have limited ability to control the terms under

which they have sex. The high mortality that would result from HIV/AIDS would sometimes lead to difficult farmer succession wrangles. Incidences of HIV/AIDS also have negative consequences for sugar cane estates operations such as loss of labour due to death, high morbidity resulting in high absenteeism, production losses due to labour shortage and high costs related to medical care and funerals. However, these could be mitigated through awareness and sensitisation activities though more could be done in most cases. That of the out-grower schemes could be mitigated with increased capacity to mainstream HIV/AIDS in their activities.

7.3. Expected impacts with implementation of the ZNSS

Expected inflow of labour to new sugar estates and mills

The areas in which the new sugar estates and mills are planned such as Luena and Mpika are located in sparsely populated and remote regions with poor infrastructure such as roads. These are some of the areas with the highest poverty levels. According to the CSO Living Conditions Monitoring Survey of 2004, the incidence of poverty in Northern and Luapula provinces is 74% and 79% respectively compared to a national incidence of 68%. Thus before these can be developed, the areas need to be opened up to be accessible. This would require significant investment in time and resources in construction works, which would attract more migrant workers. There is going to be more influx of migrant labour than in the existing sugar areas. Initial construction activities involving roads and other estate and mill related infrastructure will require labour, and most of it may not return after the construction works are completed.

Secondly, labour will be required for working in the estates and mills themselves. As in the case of existing sugar areas and out-grower schemes, an influx of people will be induced by increased business opportunities arising from increased demand for goods and services, due to increases in population and income at both construction and operational phases. There would be significant inducement of new settlements most probably with inadequate social infrastructure.

Expected impact on HIV/AIDS incidence and awareness with new sugar estates and induced settlements

Increased population and income levels during infrastructure development as well as operation of the new sugar estates amidst poor communities would increase irresponsible sexual behaviour and the spread of HIV. In fact, infrastructure development such as that of roads is closely related with the incidence of HIV/AIDS. Infection rates tend to be highest along the major lines of communication, a fact that is closely associated with increased economic activity and exposure of transiting individuals such as truckers. This implies that communities are exposed to greater risk of HIV/AIDS infection following the opening up of any remote area.

There would also be a more direct form of vulnerability to HIV infection through the nature and behaviour of labour force for construction works. These, like sugar estates seasonal workers, live away from their homes for extended periods, making them more susceptible to irresponsible behaviour. Rural communities with whom the construction workers interact are also vulnerable, since the former will most likely be higher economically and be in a position to use their economic status to engage in irresponsible sexual behaviour.

These impacts can, however, be mitigated if HIV/AIDS is mainstreamed during the implementation of the construction works and later during the functioning of estates and mills.

7.4. Options to address the Key Aspect

Options to address the key aspect are: first the developers of the sugar estates and out-grower schemes need to mainstream HIV/AIDS into their activities. This could be achieved within the NASF by working with NGOs and/or CBOs specializing in HIV/AIDS, through which linkages are established to the higher levels of the institutional arrangements in the multi-sectoral response to the pandemic. There are many such organisations operating country-wide and linking with one of them should be easy and may be achieved through district level stakeholders Another advantage is that the developer is not initiating anything new but is merely supporting/complementing what the experts are doing in this area.

Second, non-health impacts of HIV/AIDS could be more adequately addressed; this is cardinal in really empowering the vulnerable (women) in being tempted to engage in irresponsible behaviour in order to raise some money for food and other household necessities. This aspect is implied and not amplified in the National AIDS Policy, and consequently does not receive adequate attention and resources. Not addressing socio-economic impacts of HIV/AIDS could be a contributing factor to having very high HIV/AIDS awareness rates but still with high incidence of irresponsible sexual behaviour. Thus vulnerability community members need to be empowered, and of course inter-linkages between HIV/AIDS, poverty or food insecurity, and gender inequality need to be kept in mind during these interventions.

8. Key aspect 4: Enhancing opportunities in the sugar industry to enhance gender balance (high priority)

8.1. Current state

Gender policy and institutional framework….also in the sugar companies

The GRZ takes cognizance of the importance gender plays in socio-economic development. To ensure that both men and women participate fully in the development process, there is need for gender mainstreaming, which is the making of girls'/women's and boys'/men's issues an integral dimension of the design, budgeting, implementation, monitoring and evaluation processes. Although women constitute 51% of the population, they are underrepresented in many areas of socio-economic activities including sugar estates, mills and out grower schemes. Women have lower levels of education, limited access and control over resources of production, face a high maternal mortality rate compared to other countries and are the ones most affected by poverty and HIV/AIDS. Zambian women are on average poorer than men with 70% of the female-headed households being poor, compared to 63% from male-headed households. In fact the UNDP Gender Development Index (GDI), Zambia ranks 143 of 157 countries.

Related to the above, the Government adopted the National Gender Policy in 2000 and launched the Strategic Plan of Action in 2004. The National Gender Policy highlights a number of policy areas and takes into account the issues and concerns contained in strategic documents[26]. The GIDD is responsible for coordinating and implementing the National Gender Policy. The vision of Government on gender is to achieve full participation of both women and men in the development process at all levels in order to ensure sustainable development and attainment of equality and equity between sexes. In addition, there is the gender consultative forum established by Government in 2003 to advise Government on emerging gender issues and ensuring that policies being formulated and programmes being implemented are gender responsive. At the provincial and district level, there are gender sub-committees of the PDCCs and DDCCs respectively. These were established to ensure that gender issues are taken into account in the planning and implementation of development activities at these levels.

Mainstreaming of gender in the development programmes is challenging. Even though gender is mentioned in the FNDP, its importance in the development process still remains to be understood. Cooperating partners have been helpful in this regard through capacity building and requiring that all supported programmes mainstream gender.

General state of gender balance in sugar estates, mills and out-grower schemes, and trends

Gender participation in the sugar sector seems low at 15% to 30% (16% of the field workers at CF are women while it is 25% at KE[27]). The sugar estates do not seem to have any deliberate gender policy in place and the low level of women participation in their activities will continue unless deliberate policies to reverse this are developed and put in place.

[26] e.g. Convention on the Elimination of all forms of Discrimination Against Women (1979); Beijing Declaration and Platform for Action (1995); SADC Declaration on Gender and Development (1997); Millennium Declaration and Development Goals (2000).
[27] Personal communication with the Agriculture Manager and General Manager - Mr Vedad Alavian, respectively.

The level of participation in the out grower schemes is also modest. According to Struyf and Chuba (2009) only 6% of the smallholders at Manyonyo, 17% at Magobbo and 23% at Kaleya out grower schemes are women, while participation in leadership positions is even lower at Kaleya. Gender issues seem not be a major concern of the leadership of the schemes as they do not have the capacity to mainstream gender. However, scheme members are being sensitised and trained in gender issues as stand alone activities, and there are plans that their capacity to mainstream gender be increased by use of facilitating organisations. Actually women participation in the scheme committees at Magobbo and Manyonyo improved to about 40% (according to focus group discussions held during this SEA) after sensitisation.

8.2. Expected impacts in absence of the ZNSS

It has been noted that women participation in the existing sugar estates and planned and existing out grower schemes is low. This is expected to continue or even increase unless deliberate policies are put in place to increase employment of women as well as sensitize workers on gender issues which go beyond the numbers of men and women taking part in particular activities. Such issues, in addition to low women participation, are also not addressed in the out-grower schemes. In fact out-grower schemes in general have been reported by CCJDP (2005) to exacerbate gender inequality with women doing more work in the fields and men wielding more power over how income should be used. It is pleasing to note, however, that arrangements are in place to increase the capacity of the existing and new out-grower schemes to mainstream gender and thereby address existing gender imbalances. The existing sugar companies do not seem to have specific gender policies and it is thus envisaged that exiting gender imbalances will not be addressed without developing deliberate policies to address these.

8.3. Expected impacts with implementation of the ZNSS

Developing of new sugar estates has a gender dimension influenced by activities during infrastructure development and the actual operations of estates and mills. These activities will provide employment opportunities for both men and women, leading to increased income and wellbeing. Women are normally the poorest in communities and tend to engage in less rewarding income generating activities. Thus employing them not only gives them alternative sources of income, but also more lucrative business opportunities in terms of financial returns and subsequently poverty alleviation. On the negative side, gender imbalances would be exacerbated if such activities follow the status quo and largely employ more men than women.

8.4. Options to address the Key Aspect

Options to address this key issue are two fold: first developers for both infrastructure development and operation of sugar estates, mills and out-grower schemes need to as much as possible engage/employ/involve women alongside men. Second gender needs to be properly mainstreamed going beyond numbers of men and women involved in a particular activity, to include decision making, access and control of resources and sharing of benefits from productive activities at the household level. There are number of NGOs/CBOs across the country that specialise in gender issues and partnerships with these can be made by the sugar estates/out-grower schemes/constructing agencies to extend gender activities to their areas of operation. Normally district stakeholders would know which organisation is operating in which areas of the district. Sugar estate workers also need gender sensitisation for better decision-making, use and control of resources and sharing of productive benefits at the household level.

9. Key aspect 5: Securing a sound policy for ethanol production, fuel blending and gel fuel that will optimise the positive effects on the environment (medium priority)

9.1. Current state

This key aspect concerns securing an adequate policy and regulatory framework to ensure potential positive environmental impacts associated to ethanol, fuel blending and gel fuel (all

promoted as part of the ZNSS) can effectively materialise. The underlying environmental and socio-economic concerns which this key aspect addresses relate to energy security (ethanol and fuel blending and deforestation (gel fuel). These three aspects are covered below.

Energy dependency and positive impacts of fuel blending with ethanol

Advantages of fuel blending

Countries in the SADC region, with the exception of Malawi and Zimbabwe, have yet to embark on ethanol blending as a means of reducing the petroleum import bill. However, the ethanol policy option in the region is fast gaining ground. In comparing atmospheric emissions from an ethanol blend to those from petrol we can see that the benefits mainly relate to reduction in emissions of benzene and carbon monoxide (an ozone precursor), which have resulted in cleaner air in USA cities (Hulsey and Coleman, 2006). However there are indications that NO_x emissions may increase slightly.

Policy and institutional framework

The climate in Zambia, coupled with abundant water resources offers ideal conditions for growing biofuel crops. It has been shown that the integration of sweet sorghum with sugarcane can improve the length of the harvesting season thereby guaranteeing continuous ethanol production as well as electricity generation. Policy-wise therefore Zambia is a clear candidate for bio-ethanol production given the ideal climate for sugarcane.

The revised Energy Policy, together with the new Investment Act will become the framework documents under which Zambia's bio-fuel strategy will be implemented. The GRZ has already issued Statutory Instrument 42 of 2008, which legalizes biofuels. The MEWD is responsible for formulating policy on energy matters while the Department of Energy and the Energy Regulation Board undertake their implementation.

The MEWD is keen to consider petrol blending with ethanol and may consider subsidising the production of ethanol if the needed. Though reasonable, the MEWD feels that the Road Map for the implementation of the bio-fuels strategy may encounter hitches due to factors ranging from the government's limited financial resources vis-à-vis the need to provide equity, the need to review the Petroleum Act, Chapter 424 and lack of adequate monitoring mechanisms.

The Energy Regulation Board (ERB) supports the production of clean fuels to ameliorate environmental impacts. The concentration of lead in petrol was gradually reduced, leading to a complete phase-out of leaded fuel by 2008. The ERB has issued liquid biofuels standards to regulate the biofuels industry as follows: ZS 702 – Automotive Biodiesel – Specification; and ZS 706 – Denatured Fuel Ethanol For Blending with Gasoline.

The blending rations for bioethanol are still being discussed, although the following so-called 'pre-draft ratios' give an indication of intentions.

Table 12. Pre-draft blending ratios for bioethanol in petrol

Blending Ratio	Time-line	Condition
E5	2009-2011	Voluntary
E5	2011-2015	Mandatory
E10	2015-2020	Mandatory

It has been proven that fuel (petrol) can be blended up to 18% with ethanol without requiring changes to car engines. Blends above 18% are corrosive to injector engines.

Sugar Industry

All three commercial sugar companies in Zambia have the potential to produce ethanol on a commercial scale. Sugar cane grown at ZS is dedicated to sugar production for domestic consumption and export. Approximately 55,000 t of molasses are produced; 14,000 t were exported and the rest sold locally as animal feed and fertiliser input. Projected production for

2015 is around 100,000 t. ZS could hence produce about 25 million l ethanol/yr from its molasses. The company supports the bio-fuel policy subject to an enabling legislation being put in place and other relevant issues clarified. CF has an annual production of 18,000 t of molasses, which will increase to 25,000 by 2015. About 4 million l/yr of ethanol can be produced using all molasses. KE has an annual production of 1,100 t of molasses, and a potential to increase to 1,500 by 2015.

Table 13. Annual production of molasses in the three sugar companies

Sugar Company	Present (tonnes)	2015 (expected) (tonnes)
Zambia Sugar	55,000	100,000
Consolidated Farming	18,000	25,000
Kalungwishi Estates	1,100	1,500
TOTAL	**74,100**	**126,500**

Source: personal communications from company representatives

Based on total molasses produced at present in Zambia, the potential ethanol availability is estimated at 19.3 million l/yr, which is sufficient to meet demand for petrol at a 7% blend. With the projected production of 126,500 t of molasses by 2015, 32.9 million litres could be produced, sufficient to meet 2015 demand for petrol at a 10% blend.

The Indeni Petroleum Company has embraced the idea of fuel blending and, if the Government decides that ethanol blending becomes their policy, Indeni has indicated that it will implement this strategy at no additional cost.

Fuel consumption in Zambia

Records from the ERB[28] show a petrol consumption in 2008 of around 180 million litres (including unleaded petrol, LRP and Premium). Figures from the same source indicate a consumption of about 100 million litres for the period January-June 2009. By extrapolation one could predict a total petrol consumption of around 200 million litres for 2009; representing an 11% increase with respect to 2008.

Projections on fuel consumption vary enormously. In the literature values for annual increase in petrol consumption range from 1.5% (Renewable Energy Committee, 2004), 2.0% (ROADSIP II document) and 4.0% (Macwani, 2004). For purposes of this SEA we have taken a progressive increase in petrol consumption of 3%. Applying this increase on the estimated 2009 petrol consumption of 200 million litres, we arrive at an estimated petrol consumption of 239 and 277 million litres by 2015 and 2020 respectively.

At present all fuel has to be imported under varying costs that fluctuate according to the international price of oil and the uncertainty of deliveries. The blending of petrol with locally produced ethanol, from a by-product of the local sugar industry, will reduce the dependency on the foreign currency importation bill and lead to savings.

Gel fuel and its links to deforestation and health issues

Gel fuel is a fuel produced from ethanol mixed with a starch. It offers environmental and health benefits in comparison with the burning of firewood and charcoal in the households, and has been promoted in Southern Africa as a way to reduce pressure on forests and address indoor air pollution health issues. Benefits and impacts of gel fuel are summarised in Table 14 below. The current situation with regards to deforestation and indoor air pollution are described below.

Table 14. Potential impacts and benefits of gel fuel

Activity	Impacts and Benefits	

[28] Petroleum Industry Statistics, available at: http://www.erb.org.zm

Economic	• Rural/agricultural development • Employment in the rural/agro-industrial sector • Reduction of imported oil-fuels	• Improvement of balance of payments • Private sector development • Stable energy markets • Qualifies for climate change funding
Social	• Employment in the rural/agro-industrial sector • "Energy poverty" reduction • Safe and easy usage for women and children; non-explosive/no spilling	• Adaptable to existing wood and kerosene stoves/cooking practices • Easy to use • Ideal substitute for paraffin and charcoal
Environment + health	• 100% renewable/organic • Zero deforestation impact • Safe/clean production process • Safe/clean distribution	• No "indoor pollution" • Lower CO_2 emissions • Instant heat and less wastage • Not poisonous

Source: RPTES (2000), cited in Kambeu and Macwani (2004).

Health benefits of burning gel fuel, can be seen from Table 16 below, where emission of all major pollutants are significantly lower than for other fuels. Although the cost of gel fuel for the household is relatively higher than charcoal (about 30%) (Kambeu and Macwani, 2004), social and economic benefits are very high.

The Energy Policy promotes the use of alternative energy fuels as a measure to contribute to curb deforestation. In 1998 a study jointly conducted by the GRZ and the Swedish International Development Agency recommended ethanol and gel fuel as charcoal substitutes in Zambia.

The World Bank launched the Millennium Gel Fuel Initiative as part of its RPTES (Regional Programme for the Traditional Energy Sector) programme between 2000 and 2003, to adapt and disseminate gel fuel for the African household sector. The Initiative piloted gel fuel in six countries: Ethiopia, Malawi, Mozambique, Senegal, South Africa and Zimbabwe. For example, in Malawi gel fuel has been well accepted and successful, but a recent tax on ethanol has resulted in charcoal becoming cheaper than gel fuel, and users have shifted back to charcoal.

A pilot study for the introduction of gel fuel in Zambia was planned (see Kambeu and Macwani, 2004). However at present there is no evidence of it ever having been carried out and, if it did, there is no institutional memory of it nor follow-up on the results.

Deforestation

Deforestation is reiteratively pointed out as one of the main environmental concerns in the country. According to the recent ILUA (Integrated Land Use Assessment) project (Zambia Forestry Department and FAO, nd) the area of forest land is estimated at 49.9 million ha, or 66% of the total land area of the country, whereas "other wooded land" accounts for an additional 6 million ha (8%).

Some forest areas enjoy protection status, measured by ILUA according to the understanding of forest users: forest reserve 6.5%; forests known to be designated as national parks 9.1%; designated as natural monuments 0.3%; designated for habitat management 5.5%; designated for multipurpose 16.9%; and designated for production 23.7%. Approximately 16% of natural forests could not be identified under any designation, and 21.8% unanswered for in terms of protection status. Forests were classified according to the degree of 'disturbance', ("the impact level of human activity in the forest or other wooded land"), using the following classifications:

- Not disturbed: all resources are conserved and there is no extraction of forest goods by humans;
- Slightly disturbed: there is some exploitation of forest goods and services;
- Moderately disturbed: where many products are collected without management plans and where sustainable forest management is endangered;

- Heavily disturbed: where there is high human pressure for forest products and services or encroachment of agriculture and where removal of forest products does not conform to management plans.

The distribution found by ILUA is as follows: not disturbed: 33.1%; slightly disturbed: 30.2%, moderately disturbed: 25.5%, heavily disturbed: 5.6% and 5.5% with disturbances not recorded. The majority of the not disturbed forests are semi-evergreen forest types normally isolated and located on difficult terrain.

Although ILUA does not venture rates of deforestation, it does state that the alarming deforestation rates reported based on small sample observation of utilization levels and stock inventories have tended to produce alarming statistics (over 500,00 ha annually) that are not supported by the results of ILUA. The National Environmental Policy estimates a deforestation rate of 250,000 to 300,000 ha per year. Whatever is the rate of deforestation, it is generally localised around the urban centres (most forests designated for fuel-wood and charcoal in urban areas have been depleted) as well as along infrastructure (road) axes.

The main uses of forests are as fuel-wood and for charcoal production. According to the Living Conditions Monitoring Survey of 2004 (quoted in Kalinda *et al*, 2008) over 83% of households in Zambia depend on wood resources (firewood and charcoal) for cooking and over 97% of rural households depend solely on fuel wood for cooking. Fuel-wood is mainly consumed by relatively poor households, with 86% of households being dependent directly on firewood and 14% on charcoal. In terms of urban households, 98% of low cost households heavily depend on charcoal (in turn these correspond to roughly 85% of urban population). Kalinda *et al* (2008) also provide interesting data on the economy of charcoal production: over 50,000 people earn their living from charcoal production, whilst a number of others are engaged in charcoal production, distribution and marketing on a part-time basis.

In spite of the large dependency of rural households on firewood, it is mostly dead wood that is collected, and does not seem to be a driving factor behind deforestation. Charcoal production has however, a more direct effect. It is estimated that about 73,000 ha of forest may be degraded due to charcoal production. Apart from charcoal production the other major driving force behind deforestation is slash-and-burn agriculture (see, e.g. Malambo and Syampungani, 1998), which takes place especially in the northern provinces of Zambia.

In terms of policy, forest policy is mainly defined in the Zambia Forest Policy, the Forest Act of 1999 and the Zambia Forest Action Plan (ZFAP) of 2000. There are important limitations in the current institutional and regulatory arrangements to adequately deal with forests. For a more detailed review of these shortcomings refer to the ZFAP or Kalinda *et al*, 2008.

Indoor air pollution

Exposure to indoor air pollution from solid fuels has been linked to many different diseases, including acute and chronic respiratory diseases, tuberculosis, asthma, cardiovascular disease and perinatal health outcomes. It has also been related to pneumonia and other acute lower respiratory infections (ALRI) among children under five, and chronic obstructive pulmonary disease (COPD) and lung cancer (in relation to coal use) among adults (WHO, 2007; WHO, 2006; WHO, 2002). Globally reliance on solid fuels is one of the ten most important threats to public health. Indoor air pollution disproportionately affects women and children who spend most time near the domestic hearth. The WHO burden of disease from indoor air pollution study gave the following figures for Zambia (Table 15). The measure used is the Disability-Adjusted Life Year (DALY), which combines years of life lost due to disability with the years of life lost due to death. It allows comparing disease or risk factors in terms of their public health impacts.

Table 15. Burden of disease from indoor air pollution in Zambia

% population using solid fuels	ALRI deaths attributable to solid fuel	COPD deaths attributable to solid fuel	Lung cancer deaths attributable	Total deaths attributable to solid fuel	Total DALYs attributable to solid fuel	% national burden of disease attributable

	use (<5 years)	use (≥30 years)	to coal use (≥30 years)	use	use	to solid fuel use
87	8,160	470	-	8,600	285,400	3.8

Gel fuel burns with a low carbon flame and is a good charcoal substitute. As well, low-cost and high efficiency stoves have been developed specifically for the gel fuel burner, which can be retrofitted into most improved traditional stoves. Table 16 below shows emissions using different fuels, where the advantages of alcohol fuels (gel fuel) are manifest.

Table 16. Stove emissions for various fuels

Fuel	Stove efficiency %	Emissions (g/MJ delivered energy)				
		CO_2	CO	Methane	Total non-methane organic compounds	N_2O
Alcohol Fuels	53.6	126	0.19	None	0.09	Negligible
LP Gas	53.6	126	0.61	Negligible	0.19	0.002
Biogas	57.4	144	0.19	0.10	0.09	0.002
Kerosene	49.5	138	1.9	0.03	0,79	0.002
Fuel-wood	22.8	395	11.4	1.47	3.13	0.018
Crop residue	14.6	565	36.1	4.13	8.99	0.028
Charcoal	14.1	710	64.0	2.37	5.60	0.018
Dung Cake	10.0	876	38.9	7.30	21.0	0.022

Source: US EPA data, adapted and cited by Kambeu and Macwani (2004).

9.2. Expected impacts in absence of the ZNSS

Energy dependency and positive impacts of fuel blending with ethanol

In a previous paragraph we extrapolated the fuel consumption for 2009 and arrived at an estimated figure of some 200 million litres of petrol. Taking a conservative progression of 3% we projected a petrol consumption of some 239 million litres foreseen by 2015 and 277 million litres by 2020. This would create an increase in fuel dependency of 10% by 2015, and 39% by 2020 with respect to the 2009 baseline. As no alternative GRZ projections for annual petrol consumption were available, these figures have been used in our analyses. Table 17 shows the ethanol required to satisfy projected petrol blend rates for various years.

Table 17. Estimated petrol and ethanol demand under different blending scenarios

Year	No blending	E5 (mandatory by 2015)		E10 (mandatory by 2020)		E15	
	Fuel demand (million l)	Ethanol demand (million l)	Petrol demand (million l)	Ethanol demand (million l)	Petrol demand (million l)	Ethanol demand (million l)	Petrol demand (million l)
2009	200						
2015	239	11.95	227.05	23.9	215.1	35.85	203.15
2020	277			27.7	249.3	41.55	235.45

Considering the sugar industry could produce 32.9 million l ethanol by 2015 based on transformation of all molasses, the ethanol required for the mandatory E5 blend and a voluntary E10 blend by 2015 could be met by the projected ethanol distilleries' productions. Also, the ethanol required for the mandatory E10 blend by 2020 could also be met easily by the projected distilleries' capacities. Only if an E15 or E18 blend were to be applied would additional raw materials and distillery capacity be necessary. The total presently projected distillery capacity of 32.9 million litres could produce a 12 % fuel blend by 2020.

However, a note of caution should be taken. These estimates are based on a conservative 3% annual increase in petrol consumption. Zambia already experienced a peak in fuel consumption at the end of the 1980's (reaching 500 million l for all fuels, as compared to a stabilised consumption of around 300 l at the early 2000's – ROADSIP II data), and current ERB data

suggest a recent annual increase of nearly 11%. For policy-making purposes trends should be studied in detail to ascertain availability of ethanol to meet the targeted fuel blending ratios.

Positive impacts of gel fuel use

Unless policies are successfully implemented fuel-wood and charcoal consumption will continue in Zambia, with its associated impacts on deforestation and indoor air pollution. Pressure on forests and health effects of indoor air pollution will depend on a series of factors. Pressure is due to decrease if envisaged policy measures foreseen in the FNDP (reflected in the Energy Policy)[29] are implemented, and which are expected to result in a reduction of fuel wood consumption of 10% per year. But, as clearly stated by Kalinda *et al* (2008), this will largely depend on effective implementation and financing by government, the private sector and other stakeholders. In any case positive effects are not likely to be noticed in the short-term.

On the negative side, the following factors are expected to increase pressure on forest resources: increase demand for energy sources associated to demographic growth; land clearing for agricultural expansion, also associated to demographic growth; and construction/upgrading of roads which would facilitate access to new forest areas and induce human settlements. Indoor air pollution is expected to increase in absolute terms, due to demographic growth, but not in relative terms, as it is unlikely that % of consumption of wood fuel will increase.

9.3. Expected impacts with implementation of the ZNSS

Energy dependency and positive impacts of fuel blending with ethanol

The introduction of an E5 blend by 2015 would reduce the increase of fuel dependency with respect to the 2009 baseline from 20% to 14%. With respect to the E10 blend by 2020, the reduction would be from 39% to 25%. These emission and dependency levels are still high and alternative policies will have to be developed. One measure would be to progressively increase the blending rate up to 15 or 18%, but ethanol from the sugar industry may not cover that, and would require other dedicated fuel crops and distilleries.

The positive impacts of fuel blending and the production of gel fuel are potentially there, but neither the ZNSS (nor the Energy Policy) yet offer the appropriate framework to ensure these effects will materialise. This is particularly the case of offering adequate security to the sugar companies to invest. There is the need to ensure that ethanol for fuel blending will be basically satisfied by the sugar industry, which offers more advantages. Production of ethanol by sugar factories uses a by-product of the sector and there is no need to taking additional land for crops.

Positive impacts of gel fuel use

The introduction of gel fuel has the potential to reduce indoor air pollution, as well as help reduce the pressure on deforestation. It is not possible to quantify the effects of gel fuel, as these will depend on a number of factors, including: amount of gel fuel that can be produced, market price of gel fuel, social acceptability, etc.

9.4. Options to address the Key Aspect

Energy dependency and positive impacts of fuel blending with ethanol

The benefits from ethanol production and fuel blending are significant but, for these to materialise, require measures be put in place beyond the good intentions in the Energy Policy.

Table 18. Strengths, opportunities, weaknesses and threats of options to address ethanol production and fuel blending

Strengths and Opportunities	Weaknesses and Threats
Fuel Blending	

[29] These include: increasing electrification of rural areas; promotion of efficient production and utilization of wood fuel and production of charcoal production manuals for dissemination to charcoal producers; and promotion of gel fuels and Liquefied Petroleum Gas (LPG) to provide alternative sources of energy.

• Potential production of some 32 million litres of ethanol for fuel blending from an existing/projected by-product of the sugar industry - molasses • Reduction in energy/fuel dependency • Reduction in forex bill • Valorisation of a by-product of the sugar manufacturing	• No firm commitment from GRZ on fuel blending • No regulatory framework between GRZ and ethanol producers, nor with the fuel blenders • No reliable statistics and projections on future fuel consumptions • Presently no distilleries to transform the molasses into ethanol

Table 18 shows the advantages of fuel blending by using a product, ethanol, derived from a locally produced source, molasses. By taking advantage of this opportunity there will be a reduction in fuel dependency on importation as well as a reduction in the forex bill. The sugar industry, disadvantaged by the changes in the price reductions in the export market, would have the opportunity to valorise one of their by-products, molasses, transforming it into ethanol.

To profit from the beneficial effects of fuel blending however, it is essential that the Government commits itself clearly to the policy of fuel blending. The potential ethanol producers require this GRZ commitment to invest in a guaranteed market. The introduction of a legal and regulatory framework for fuel blending has to be introduced soonest and be negotiated amongst the stakeholders concerned. Such a framework must inject security to the sugar companies in order to secure needed investments in distilleries and ensure a constant and sufficient production of ethanol destined to fuel blending.

Positive impacts of gel fuel use

For the positive impacts of gel fuel to materialise, a concrete strategy has to be prepared and implemented. Such a strategy must consider the following aspects:

- Who will produce the gel fuel?
- Will ethanol produced by sugar companies be available for gel fuel in sufficient quantities?
- What policy measures will be put in place to ensure the price of gel fuel is competitive in comparison with charcoal and fuel-wood?
- Accompany the introduction of gel fuel with an awareness raising campaign on the health advantages of using gel fuel as opposed to fuel-wood or charcoal;
- Pilot test the introduction of gel fuel to identify obstacles and fine-tune the strategy;
- Address the acceptability of gel fuel for household consumption;
- Address the socio-economic impact on people engaged in producing and commercialising charcoal, maybe by giving them a role in the commercialisation of gel fuel;
- Learn from experiences in other countries in the region, e.g. Malawi.

The findings of the pilot study for the introduction of gel fuel, which was designed in 2004 (see Kambeu and Macwani, 2004) should be identified and analysed. Otherwise the pilot study should be carried out, taking into account the above factors.

Besides the possibility of using ethanol produced by the distilleries attached to the sugar mills, the development of small-scale (e.g. one million litres/yr) ethanol plants could be promoted. These plants could be developed across the country to produce ethanol from cassava as an alternative to charcoal. There could be gel fuel plants attached to the ethanol plants, which could supply each district at lowest cost. In this rationale small-scale growers would not be forced to sell to the factory, but would rather take excess production after food requirements. This would promote production of biofuels and gel fuels without imperilling food security. It would also create an alternative income for the converted charcoal producers. However, adequate disposal of vinasse should be first sorted out before authorising each individual plant.

10. Key aspect 6: Securing an environmentally integrated strategy for roads upgrading/construction and upgrading/expansion of the railway system (medium priority)

10.1. Current state

Being a landlocked country, Zambia depends on its transport infrastructure to ensure international competitiveness of their products, which face high costs of transport. The competitive advantage of Zambia's sugar in terms of production costs is eroded by the poor condition and capacity of the transport infrastructure; for example, Zambia's fobbing costs are 5.5 times higher than the average world market exporter (LMC International, 2006).

Due to the poor infrastructure, road freight is expensive; even rail transport is inadequate due to limited wagon capacity and unpredictable availability. Transport to the southern DRC market cannot be met using railway due to insufficient capacity, and expensive road transport has to be used. Export to the EU market involves rail or road transport to Beira (Mozambique) via Zimbabwe, which is also costly and unpredictable. Sugar for local/regional consumption represents less of a problem, as well as for Kalugwishi Estates, whose clients from DRC and Tanzania pick up the sugar at factory gate.

New sugar cane expansions beyond the current areas of production also face constraints due to lack or limited transport infrastructure (e.g. Luena farming block).

Transport policy and planning

Transport policy is the remit of the Ministry of Communications and Transport, whereas planning, implementation and management of infrastructure falls on other instances. In the case of roads it is the Ministry of Works and Supply, whereas in the case of railways it is TAZARA (Tanzania Zambia Railways Authority) and Zambia Railways Limited.

The Zambia Transport Policy (2002) sets Goals, Policy Objectives and Strategies for the different modes of transport. Although environmental sustainability is one of the aspects considered, there is no provision for a dedicated analysis of the environmental aspects and implications of the policy, such as could be provided by an SEA. Curiously it is the *Procedures Manual for Environmental and Social Management in the Roads Sector in Zambia*, developed by the Ministry of Works and Supply as a guidance for EIAs of roads, that suggests the role of SEA for environmental integration at the policy, plan and programme level.

Road transport infrastructure

Zambia has 37,000 km of gazetted roads and 30,671 km of un-gazetted roads classified under feeder, national parks and estate roads. These roads fall under different jurisdictions: the Roads Department in the Ministry of Works and Supply (approximately 21,000 km of gazetted roads); City, Municipal and District Councils in the Ministry of Local Government and Housing, and the Department of National Parks and Wildlife in the Ministry of Tourism (Ministry of Communications and Transport, 2003). Figure 6 (Appendix 1) shows Zambia's road network.

The road network has, to a large extent, being upgraded with the assistance of the donor community. Road upgrading has taken place under the Road Sector Investment Programme (ROADSIP I) and now under the ROADSIP II.

ROADSIP II (2004-2013) addresses the following objectives, with regards to road upgrading, maintenance and construction: (i) rehabilitation/periodic and routine maintenance of the Core Road Network (40,113 km); improve road conditions for trunk, main, district, primary feeder roads, tourist roads and selected urban roads through full and accessibility improvements as per "need" and priorities. ROADSIP II also sets objectives with regards to improving Environmental Management by building capacity and addressing poverty and HIV/AIDS countrywide through PRSP and National Policy on HIV/AIDS.

ROADSIP II includes an environmental management component, which provides for the creation of an Environmental Management Unit (later renamed Environmental and Social Management Unit - ESMU); development of environmental tools (including EIA screening criteria, review criteria, monitoring system and development of an environmental contract clause); environmental assessments of projects under design; monitoring implementation of projects under construction; and capacity-building for environmental management in the roads sector. Furthermore it is envisaged to carry out an SEA of ROADSIP II as part of the support from the European Commission (in principle to take place early- to mid-2010).

The Road Development Agency (RDA) is responsible for the implementation of ROADSIP II. The ESMU has been established within the Planning and Design Division of the Roads Department and its responsibilities include: (i) facilitating the integration of environmental matters in the planning and implementation of projects in the roads sector; (ii) assisting key stakeholders/agencies in carrying out EIAs and monitoring implementation of Environmental Management Plans (EMPs); (iii) promoting involvement of and cooperation of all relevant institutions; (iv) preparing and revising technical standards/guidelines and regulations; and (v) conducting training in environmental management and preparing sensitisation material. The team consists of two environmentalists and one social scientist.

ESMU also monitors compliance with environmental and social measures during road maintenance, rehabilitation and construction. Activities include reviewing EIAs and monitoring road projects. There are discrepancies between stakeholders on the effectiveness of monitoring and the degree of compliance by contractors with standard environmental clauses and EMPs.

An environmental analysis of the Zambia ROADSIP I identified five main areas of environmental concern related to roads: (1) destruction of wildlife habitats and loss of biodiversity along road environments; (2) increased soil erosion during road works leading to siltation of rivers and streams; (3) soil and water contamination by chemical, oil and fuel spillage during road construction and use; (4) increased deforestation during road improvement, construction and use due to increased commercialisation of timber cutting, processing and haulage activities; and (5) disruption of traditional lifestyles, increased sexually transmitted diseases (STDs) and other health concerns among local communities and project workers.

In August 1997 the Ministry of Communications and Transport published the "*Environmental Guidelines for Road Rehabilitation and Maintenance Work*", to be used by those involved in the planning, design, implementation and monitoring of road works, so as to ensure proper integration of environmental concerns. However these guidelines are not available online and are difficult to get hold of. More recently the RDA produced a "*Procedures Manual for Environmental and Social Management in the Roads Sector in Zambia*"[30] with the purpose "*to outline the role of the ESMU, consultants…responsible for the design of road projects, contractors responsible for construction of roads and other stakeholders who may participate at the various levels of the EIA process*"; it is basically a guidance on EIA in the roads sector.

Under Zambian Regulations, the first step in the EIA process is to decide the level of assessment required (full EIA or not), which will depend on the length of the road and the sensitivity of the receiving environment. This is done through a screening process, synthesised in a *Project Brief*. If an EIA is not required then the *Standard Environmental Clause* (reproduced in Annex C of the Manual) is automatically integrated in the contractual documents for the project. Figure 10 (Appendix 1) shows the EIA screening process for roads. If an EIA is required then it goes through a rather standard process, where the ECZ plays a key role in ensuring quality of the process, aided by the ESMU for the case of road projects.

EIAs are carried out for road projects, but there are some indications that there might be important opportunities to improve the effectiveness of the EIA system, including implementation and monitoring of EMPs. In the framework of this SEA it was not possible to make a detailed assessment of the effectiveness of the EIA system, but due to its importance to

[30] Zambian Ministry of Works and Supply (2007).

guarantee the environmental sustainability of the roads sector further research is recommended in order to identify any opportunities that might exist to enhance the EIA system.

Rail transport infrastructure

The Zambian railway network consists of two main systems: Railway Systems of Zambia (RSZ) and the Tanzania Zambia Railways Authority (TAZARA). Other railway systems include the Mulobezi Railway and the Chipata-Mchinji Railway Project.

Zambia Railways has a total track length of about 1,266 km, running from the border with Zimbabwe in Livingstone in the South up to the border with the DRC, with branch lines on the Copperbelt. The TAZARA connects Zambia to Dar es Salaam in Tanzania, via a 1,861 km of track from Kapiri-Mposhi, where it connects to the Zambia Railways at Kapiri-Mposhi. The Mulobezi Railway line stretches from Livingstone to Mulobezi in the SW of the country. The line is managed by Zambia Railways on behalf of the Government. Finally the Chipata-Mchinki Railway Project aims at connecting Zambia to the seaport of Nacala in Mozambique, via Malawi. The line would connect either to Zambia Railways or to TAZARA.

According to the Transport Policy, the two main operational constraints of the railway system in Zambia are: poor track condition for Zambia Railways, and low availability of motive power and wagons in the case of TAZARA. These constraints have led to a reduction of the service capacity and reliability. In order to revitalise the rail system the Government concessioned Zambia Railways Ltd to Railway Systems of Zambia (RSZ) in 2003, and is currently studying the privatisation of TAZARA. Other projects are envisaged, such as the extension of the network through the Chipata-Mchinji rail link and the Kasama-Mpulungu.

From the point of view of the sugar sector, in order to increase competitiveness of exports, the expansions of most interest are the opening of the Nacala corridor, 604 km out of 774 from Lusaka, which at the moment are only accessible by the road link to Chipata in the Eastern Province. Figure 8 (Appendix 1) shows the railways network in Southern Africa.

10.2. Expected impacts in absence of the ZNSS

Although the ZNSS may promote the construction or rehabilitation of specific roads (e.g. the Kawambwa-Muhost-Luwingu road, that would service the Luena Farming Block) other actions for road and railway rehabilitation, upgrading and expansion will take place under sectoral planning processes, and thus pretty much independently of the ZNSS. Such is the case for the transport corridors to Beira and Nacala.

10.3. Expected impacts with implementation of the ZNSS

Environmental impacts that can be expected from upgrading and construction of roads and railways can be very varied. Impacts occur both during construction (e.g. land clearing, atmospheric emissions) and operation phases, and can be direct (e.g. cutting a biological corridor) or indirect (e.g. induced human settlements and associated deforestation, poaching). Impact significance will depend on a number of aspects, including sensitivity of the environment affected, socio-economic context in the area (e.g. unemployment, dominant agricultural techniques), etc. It is thus not possible to advance details as to potential environmental impacts that may result. However, environmental concerns associated to roads, identified in the analysis of ROADSIP, are most likely to remain unaltered under ROADSIP II.

10.4. Options to address the Key Aspect

From a strategic level point of view, the best way to ensure environmental sustainability of transport projects is, firstly, to ensure the policy and planning processes are environmentally integrated, e.g. through the application of SEA. An SEA at the policy and planning level would allow early consideration of environmental concerns, which will later have an incidence at the lower levels of planning. An SEA should be promoted for the next revision of the Transport Policy. Typical issues that need to the resolved at the policy level include, e.g. considerations of the best mix of transport modalities, including from an environmental point of view.

One of the shortcomings of the planning process is that the environmental authorities (i.e. ECZ) can only have an input at the project level, when it is too late to change more fundamental strategic decisions. The introduction of SEA at the policy (i.e. Transport Policy) and planning levels would address this issue, and allow better environmental integration.

An SEA is envisaged for ROADSIP II, with EC assistance. Although ideally this SEA should have been carried out at the same time as the planning process, the SEA can nevertheless be useful if there is willingness from the Government to integrate its findings. From the ZNSS point of view, the ROADSIP II SEA offers an opportunity to address in more depth the environmental implications of the ZNSS roads component. Thus the main output of this particular SEA will be to provide recommendations on the scope of the ROADSIP II SEA.

The main tool available to address environmental concerns for road projects is EIA, where ECZ and ESMU have key roles. As well other tools exist for environmental integration in cases where an EIA is not required, mainly in the form of standard environmental contractual clauses.

ECZ has a key role in overseeing the EIA process. As well it is responsible for reviewing the quality of the final EIA and EMP, and establishing any conditions necessary to obtain development consent. The ESMU also plays an important role in guaranteeing the quality of the EIA and ensuring adequate implementation of the EMP and any existing environmental clauses.

At the project level the right tools and mechanisms are in place. The concerns mainly relate to the capacities and resources of ECZ and ESMU to perform their functions effectively. In this particular SEA it has not been possible to determine adequacy of available capacities and resources of these institutions, although there are indications that these could be limited and that performance falls short of expectations. The capacities of ECZ to adequately implement and enforce regulations are currently referred to as an assumption in the ROADSIP II Environmental Management Plan (the Reformulated Management Plan of 2009) (see DANIDA, 2009). However such an assumption is too risky to be made, and instead capacities should be appraised and, if necessary, strengthened and developed.

The ROADSIP II SEA could look into these matters, including: (i) assessing quality of EIA screenings done by the ESMU (e.g. did road projects with potential significant environmental impacts by-pass an EIA?); (ii) assessing quality of road EIAs and EMPs; (iii) assessing appropriateness of ECZ response (e.g. observations to final reports and conditions imposed); (iv) appraising implementation of EMPs and environmental safeguards and conditions for road projects; (v) assessing capacities and resources at ECZ and ESMU for dealing with EIA (quality assurance, monitoring, follow-up); (vi) appraising training programmes available for different stakeholders; and (vii) appraising the degree to which capacities for EIA are integrated in relevant university curricula (e.g. engineering, natural sciences, social sciences).

In SEA processes the authority leading the process should be the competent sectoral authority (in this case the Ministry of Communications and Transport). However ECZ should play an important role as the key environmental authority, taking a role mainly in ensuring the quality of the SEA process and providing technical capacities in environmental matters throughout the SEA process. In this regards formulas should be explored to ensure ECZ has an active role in the development of the SEA; some considerations to explore includ providing key experts to the SEA team, and sitting in the transport planning team, at least during key stages in the policy-making and planning process as environmental advisors.

11. Key aspect 7: Implications of the POPs Convention for the regulation of sugar cane burning (low priority)

11.1. Current state

The Stockholm Convention on Persistent Organic Pollutants (POPs) aims to protect human health and the environment from POPs. Zambia has ratified the Stockholm Convention, and as part of its commitments has produced a National Implementation Plans (2007). POPs constitute

a class of organic compounds that are toxic, resist natural degradation, bioaccumulate and are transported through air, water and migratory species. They accumulate in the fatty tissues of living organisms and their concentrations increase higher in the food chain. Exposure to POPs has been associated with adverse health effects such as cancer, reproductive defects, immune system suppression, hormonal disruptions, etc.

Article 5 of the Convention relates to the control unintentional of the production of POPs, more specifically PCDD/PCDF (Polychlorinated dibenzo-p-dioxins and dibenzofurans), HCB (Hexachlorobenzene) and PCB (Polychlorinated biphenyls). Sources of PCDD/PCDF, HCB and PCB include open combustion. Countries have to take measures to reduce the total releases derived from anthropogenic sources on the chemicals listed in Annex C (i.e. PCDD/PCDF, HBC and PCB), *"with the goal of their continuing minimisation and, where feasible, ultimate elimination"*. To that effect Zambia should develop and implement an action plan.

Zambia's NIP identifies "uncontrolled combustion processes" as an important contributor of dioxins and furans to air, but does not specify particular sources, nor the contribution of sugar cane burning. Sugar cane burning is a source of unintended emission of POPs. For example, in Jamaica releases to air of dioxins and furans are dominated by burning of rubbish and sugar cane fields; in Mauritius sugar cane burning is also deemed a source of dioxins and furans and is an area where further research is focused. In both cases the corresponding NIPs call for a reduction, or even banning (in the case of Jamaica) of sugar cane burning. Other countries that have recognised the emission of POPs from sugar cane burning include Kenya. Needless to say, Jamaica and Mauritius are small island states where impact of sugar cane burning has a greater relative contribution to emission of POPs at a national level than in Zambia, but this difference of scale becomes less relevant when taking into account that sugar cane burning concentrates in a particular region of Zambia (Mazabuka and Kafue areas).

According to UNEP (2005) the emission into the air of PCDD/PCDF from open biomass burning is 0.5 µg TEQ/t of material burned, and 10 µg TEQ/t of material burned for releases onto land. For rough estimation purposes, and for the case of sugar cane burning, an estimate of 300 kg of biomass burned per tonne of sugar produced is suggested (UNEP, 2005). Considering the production of sugar at ZS and CF (KE practice Green Cane Harvesting), the PCDD/PCDF emissions can be estimated both prior and after expansion.

Table 19. Estimated emission of POPs from sugar cane burning at ZS and CF

Sugar Estate	Sugar production (t/yr)	Biomass burned (t)	g TEQ released to air	g TEQ released to land
Prior to expansion				
Zambia Sugar	357,000	107,100	53.55	1,071
Consolidated Farming	23,000	6,900	3.45	69
Total pre-expansion	**380,000**	**114,000**	**57**	**1,140**
After expansion				
Zambia Sugar	440,000	132,000	66	1,320
Consolidated Farming	38,000[31]	11,400	5.7	114
Total post-expansion	**478,000**	**143,400**	**71.7**	**1,434**

According to Zambia's NIP, the TEQ from uncontrolled combustion processes is 241.3 g TEQ/yr and 48.4 g TEQ/yr for releases to air and land respectively. Whereas the releases to air could account for those from sugar cane burning (in which case they would correspond to about 24% of the total), releases onto land do not match. If the total contribution of sugar cane burning is indeed around 24% of total unintended emission of POPs, this is a considerable percentage and any actions designed to reduce unintended emissions should tackle sugar cane burning. However the way the GRZ calculated unintended emissions from the burning of biomass should be reviewed.

[31] Rough estimate based on current production of 23,000 tons/year with 6,000 ha of sugar cane, and expected expansion of 4,000 ha.

11.2. Expected impacts in absence of the ZNSS

Since expansion of sugar cane cultivation in the surroundings of ZS and CF can be considered a *fait accompli*, it becomes irrelevant to envisage a 'zero alternative' scenario where such expansion does not take place.

11.3. Expected impacts with implementation of the ZNSS

Further expansion of sugar cane cultivation in other parts of the country will increase the emission of dioxins and furans proportionate to the extension of sugar cane burned.

Making a rough estimate, taking an average yield of 115 t/ha of sugar cane, and an average production of 0.13 t sugar per t sugar cane (based on ZS figures), we can envisage an approximate production of 15 t of sugar/ha. If 300 kg of biomass is burned per tonne of sugar produced, we have 4,500 t biomass burned per ha. Applying the emission factors described above we can envisage an increase of unintended emission of POPs per ha of sugar cane burned in the order of 1.35 g TEQ/ha and 45 g TEQ/ha of emissions to the air and to land respectively.

11.4. Options to address the Key Aspect

Zambia is obliged to reduce unintended emissions of POPs. Although the NIP estimated emissions from "uncontrolled combustion processes", it is not specific about sources, and does not seem to account for the contribution of sugar cane burning. One key step is for the GRZ to recognise the contribution of sugar cane burning to the emission of POPs. This will set the basis to develop a strategy for minimising such emissions, which should be part of the Action Plan required under Article 5 of the Convention, but referred to explicitly in the ZNSS.

Burnt Cane Harvesting (BCH) offers advantages over Green Cane Harvesting (GCH). BCH is normally practiced for its immediate economic benefits: harvesting is approximately 50% faster, allowing lower cost per tonne for manual reaping, having lower haulage costs (as less trash) and thus getting greater payloads into haulage vehicles. However BCH has adverse effects on the processing quality of cane, soil properties and the environment[32]. Heat opens longitudinal cracks in the bark that allow microbes to enter, hastening post harvest deterioration and increasing dextran formation. Unless cut within 48 hours, moisture absorption from soil increases weight by up to 8%, diluting juices, and internal stalk temperature increases to 80-98ºC, reducing sucrose and purity levels. As temperatures in the cane fires can approach 400ºC, impacts on soil can include: volatilisation and loss of nitrogen, sulphur and carbon to the atmosphere; heat destroys certain beneficial micro-organisms and earthworms in the surface layer; organic matter can be reduced resulting in a reduction in soil friability and porosity, reducing capacity of soil to hold nutrients in the root zone; and there can also be compaction, drying and susceptibility to erosion. Burned cane kept for more than 24 hrs affects processing, mainly through a higher susceptibility to *Leuconostoc* development, leading to rapid dextran development affecting process efficiency and sugar quality.

Environmentally speaking, key impacts have been reported to be: (i) release of POPs into the atmosphere, including certain dioxins and furans; (ii) health impacts through breathing of POPs and particles emitted as aerosol (e.g. boron, calcium, aluminium, silicon, manganese, potassium and sulphur) as well as carbon monoxide, ozone, particulate matter and volatile organic compounds (VOCs); (iii) smoke nuisance; (iv) exposure to high levels of dioxins could lead to: persistent acne, sarcoma, abnormality in children's teeth enamel and damage to the immune system. There is no epidemiological evidence that cane burning *per se* produces such dire consequences (Echavarria, 1996), but some effects on health have been identified, e.g. Cançado *et al* (2006) found that the increase in hospital admissions for respiratory affections in children and the elderly was directly related to cane burning practices in Piracicaba, Brazil. Apart from POPs, sugar cane burning produces other contaminants; emission factors have been calculated and are summarised below. GCH also allows mulching, which has the benefits of reducing weed growth and conserving soil moisture, thus reducing water requirements.

[32] Discussion on effects of BCH mainly based on Falloon (2009).

Table 20. Emission factors for cane burning (kg/tonne)

Pollutant		Darley *et al*, 1975[33]		Universidad Salle, 1992[34]	Jenkins, 1995[35]	US EPA, 1992[36]
		Whole cane	Trash			
Particulates	Average	3.60	2.70	2.80	5.60	
	Range	3.00-4.20	2.10-3.25	0.48-5.13		2.30-3.50
CO	Average	35.30	29.70		25.48	
	Range	30.00-40.60	23.90-35.60			30.00-41.00
VOC	Average				2.30	
	Range					2.60-2.80

Source: Echavaria (1996)

Mechanised harvesting would facilitate shift to GCH; however it is the government's policy to maintain manual harvesting as an employment generating activity. Thus for GCH to be attractive economic incentives must be in place for it to be profitable, and social awareness must be raised amongst farmers and sugar companies of the added benefits of GCH.

GCH requires more labour time than BCH, especially if hand-cut. In order to increase GCH farmers would need to receive capacity-building (e.g. preparation of the fields to accommodate harvesters if deemed an option, availability of upright self-trashing cane varieties). The retention of persons trained and willing to hand-cut green cane should also be given attention.

If GCH is to be promoted, a careful analysis must be made on the convenience of introducing mechanised harvesters (especially from a socio-economic point of view), as well as ensuring it does not represent an economic disadvantage to cane cutters. For example, trash could be sold to sugar estates to be used as combustion material for co-generation. GCH (either mechanised or manual) should only be pursued if it will not result in adverse socio-economic impacts.

Even if GCH cannot be attained under the present circumstances, an alternative to reduce polluting emissions is the use of controlled "cool burning". Cool burning implies burning in the early morning, when the wind is low and dew is usually present, which reduces emissions of particulate matter; for example, in Mauritius it has shown to reduce particulate matter by 60% when compared to conventional afternoon burns (Seeruttun *et al*, 2003).

Table 21. Strengths, opportunities, weaknesses and threats - POP emissions from sugar cane burning

Strengths and Opportunities	Weaknesses and Threats
Minimise sugar cane burning	
• Plenty of environmental, agronomic, social and health benefits from eradicating cane burning, including reduction of POP emissions • Extension of mechanised harvesting also allows mulching, with agronomic and environmental benefits in regards to reduction of presence of weeds (reduced herbicide application) and soil moisture conservation (reduced water requirements)	• Potential socio-economic impacts if mechanised harvesting introduced (unemployment) • Potential socio-economic impacts for cane cutters (reduced income due to a lower efficiency of cutting in terms of ha/day) if manual GCH is required, if no compensation measures envisaged • May require extended access to mechanical harvesters • If mechanised, not possible where topography is unsuitable for mechanised harvesters • Not possible in very humid areas (mulching leads to excess humidity) • Requires capacity-building of farmers on mechanised harvesting and field preparation • Requires awareness amongst farmers on benefits of GCH
Promote 'cool burning'	

[33] Darley, E.F. and Lernan, S.L. (1975) *Air pollutant emissions from burning of sugar cane and pineapple residues from Hawaii*, EPA 450/3-75-071. Cited in Echavarria (1996).
[34] Universidad de La Salle (1992) *Evaluación y plan de manejo ambiental de la quema de la caña de azúcar en el Valle del Cauca*, Cali, Colombia. Cited in Echavarria (1996).
[35] Cited in Echavarria (1996).
[36] US EPA (1993) The plain English guide to the Clean Air Act, EPA 400-K-93-001. Cited in Echavarria (1996).

• Reduces emissions of particulate matter	• Requires awareness-raising of benefits of 'cool burning'

12. Key aspect 8: Securing a co-generation policy that optimises efficient use of bagasse from the sugar sector (low priority)

12.1. Current state

Co-generation of sugarcane bagasse is one of the most attractive and successful energy projects that have already been demonstrated in many sugarcane producing countries, such as Mauritius, Reunion Island, India and Brazil. Bioenergy from sugarcane in the form of power generation in these countries offers renewable energy options that promote sustainable development, take advantage of domestic resources, increase profitability and competitiveness in the industry, and cost-effectively address climate mitigation and other environmental goals.

Most sugarcane mills have achieved energy self-sufficiency for the manufacture of raw sugar and can also generate a small amount of surplus electricity. However, using traditional equipment such as low pressure boilers and counter pressure turbo alternators, the level and reliability of electricity production is not sufficient to change the energy balance and attract interest for export to the power grid. On the other hand, revamping the boiler with high-pressure boilers and condensing extraction steam turbine can substantially increase the level of exportable electricity. This experience has been witnessed in Mauritius where, following major changes in the processing configurations, the exportable electricity from its sugar factories increased from around 30-40 kWh to around 100–140 kWh per tonne of cane crushed

Despite the contribution being proportionally small in terms of total electricity generation in some countries, the potential of bagasse cogeneration in absolute terms is quite high. Furthermore, the electricity generated is based on more efficient use of a biomass waste product, which makes it an inherently renewable and environment-friendly energy source.

Status of bagasse co-generation

Except for Mauritius, no SADC country has invested significantly in bagasse co-generation. The market for power from bagasse co-generation is increasingly recognised as viable and beneficial, and could bring additional revenue to the sugar industry. In Zambia all sugar mills produce electricity, partially satisfying their own needs, and none is currently sold to the public grid. ZS's electricity generation satisfies 98% of their requirements but with the installation of the 6th boiler will become fully self-sufficient throughout the year. CF satisfies its factory energy requirements but still relies entirely on the national grid for their irrigation power requirement. KE satisfies 100% of its electricity needs during the cropping season, but relies on the national grid for electricity in the off-season.

Some sugar mills in Zambia already use high pressure boilers and counter pressure turbo alternators with pressures of 40 bars and 440°C (ZS and CF). KE uses a 32 bars and 440ºC power plant. More modern power plants use higher pressures, up to 87 bars and 510°C temperature configuration or more. A higher pressure normally generates more power with the same quantity of bagasse or biomass fuel. The average increase of power export from 40 bars to 60 bars to 80 bars stages is usually in the range of 7-10%. For co-generation to be effective, the minimum crushing capacity should be around 200-300 tc/hr, as has been demonstrated in Mauritius. In Zambia only ZS reaches this level.

Bagasse co-generation can also play an important role in remote areas by satisfying electricity needs. Generally, the establishment of a centralised sugar cane processing complex with annexed cogeneration facility creates further opportunities and at the same time increases the viability for exploiting additional cane based co-products. However, there are difficult socio-economic conditions as well. Power generation is undertaken by the national utility as a monopolistic activity whereas the issue of renewable energy/bagasse might be more profitable if

undertaken by Independent Power Producers. This entails that a proper Government policy should be defined to promote this type of investment.

The Energy Policy embraces the issue of co-generation and transmission capacity. Measures and strategies on the issue include: (i) promotion of new sources of power generation, including co-generation; (ii) promotion of private sector involvement in the generation and transmission of electricity; (iii) adopting an open access transmission regime; (iv) developing a policy framework for transmission pricing keeping in mind the objectives of open access; (v) developing and implementing a licensing regime compatible with the open access regime.

The new policy also envisages improving legislation and the institutional framework for the private sector electricity generation through a reviewing/enacting appropriate legislation for investment in the power sector. Though government has yet to approve the Energy Regulating Board (ERB) proposal on "Restructuring the Electricity Market in Zambia" the country already boasts of having created conditions that are attractive to independent power producers (IPPs).

12.2. Expected impacts in absence of the ZNSS

More efficient use of bagasse, through co-generation is expected to take place in the existing sugar mills as they upgrade their equipment. As discussed above ZS, with the installation of its sixth boiler, will become fully independent from ZESCO. Increase of co-generation in the other mills is still uncertain but, if they take place, would be to increase their energy self-sufficiency. No contribution of energy to the national power grid is expected for the short- or medium-term.

12.3. Expected impacts with implementation of the ZNSS

If co-generation is successfully promoted, it will allow not only for the sugar companies to become self-sufficient for their energy needs, but also to contribute energy to the national power grid. This would have the following implications: (i) efficient use will be made of a by-product from the sugar process; (ii) energy would be liberated for other uses; (iii) dependency on hydro-power would be reduced, contributing (albeit initially in a very limited manner) to reducing pressure on certain water resources with competing demands (e.g. in the Kafue flats).

12.4. Options to address the Key Aspect

In spite the Energy Policy already promotes co-generation, for it to materialise adequate incentives must be put in place, and the appropriate regulatory framework set-up to ensure sales from IPPs to the national grid. These issues would need to be matured and further defined.

13. Other aspects

Apart from the key aspects discussed above, the following opportunities to enhance the environmental performance of the ZNSS were also identified and deemed useful to discuss:

1. Promote general good environmental and social management practices in the sugar sector (mills, estates and out-growers), including through Fair Trade certification.
2. Promote sound environmental and management practices of farmers and the general population surrounding sugar cane developments, especially with regards to agricultural practices and health.
3. Undertake changes in the general wording of the ZNSS to ensure it is consistent with the sustainable development paradigm.
4. Encourage an adequate use of this SEA report and its findings.

Promote good environmental and social management practices

General good environmental and social management practices for the sugar sector in general can cover several aspects, including e.g. water efficiency; choice of fertilisers and agrochemical products and their application; disposal of molasses, filter cake, bagasse and other by-products and waste products; control of atmospheric emissions; land clearing and land preparation practices; choice of harvesting methods; mulching practices; soil conservation practices; waste

water treatment; field drainage; solid and hazardous waste management; conservation of riparian vegetation; child labour; employment benefits; social services; minimum wages; gender policy; training in environmental and social management practices; corporate structures to manage social and environmental management; etc.

Minimum performance is regulated by national legislation (e.g. emission standards), but not best practices on environmental and social management. Some international companies have developed corporate procedures which they systematise and apply. Small-growers such as KASCOL have opted for Fair Trade certification, which obliges them to implement good environmental and social management. In other countries the industry has developed voluntary codes of practice on environmental management (e.g. South Africa, Jamaica).

Other options available include the ISO 14001:2004 certification on Environmental Management Systems (EMS), or the Social Accountability SA8000 standard, regulated by Social Accountability International (SAI). So far no sugar company in Zambia has opted for either the ISO 14001:2004 or the SA8000 standards certification.

The ZNSS, as well as the EC, would do well in promoting voluntary mechanisms to further help secure good environmental and management practices in the sector. Alternatives include encouraging new out-grower schemes and sugar companies to eventually opt for Fair Trade certification; promote ISO 14001:2004 certification, especially amongst the sugar mills; and/or promote the development of Good Practices guidance to which the sector may subscribe. Fair Trade sugar and ISO management systems are briefly described below.

Fair trade sugar

Fair trade sugar has a market niche in developed countries, especially in the EU. It is also a way to promote social and environmental sustainability. It is regulated under a series of standards, which affect producers and traders; and there is a standard specifically for sugar cane (FLO, 2009a). Environmental sustainability is an integral component of fair trade; for example, under the Standards for Small Producers' Organization (FLO, 2009b).

ISO 14001:2004 and SA8000

The EMS under the ISO 14001:2004 standard is certifiable. Certification shows, amongst other aspects, that the company: (i) has an Environmental Policy; (ii) has identified the environmental aspects relevant to its operations; (iii) is compliant with all applicable environmental regulations or, otherwise has a clearly spelled-out plan to achieve full compliance; (iv) has a commitment to continuous improvement in its environmental performance, beyond mere compliance with applicable regulations; (v) has an environmental management plan with clearly spelled out objectives, targets, actions, designation of responsibilities and resources; (vi) has developed environmental management procedures to address all environmental aspects, and has in place systems for ensuring the revision, distribution and general management of these procedures; (vii) has developed a system to register, respond and monitor non-compliances; (viii) undergoes periodic internal and external audits.

As for the SA8000 standard the company, apart from complying with national laws and regulations, must satisfy a series of requirements in relation to child labour; forced and compulsory labour; health and safety; freedom of association & right to collective bargaining; discrimination; disciplinary practices; and remuneration. The company must also have a social management system in place, which includes elements such related to: social accountability and labour conditions policy; management representation; workers representation; management review of the system; planning and implementation of the management system; control of suppliers/subcontractors and sub-suppliers; addressing concerns and taking corrective action; outside communication and stakeholder engagement; access for verification; and records.

Promote sound environmental and management practices of farmers and the general population surrounding sugar cane developments

New out-grower schemes and sugar developments - especially in sparsely populated areas - will result in a population increase in these areas, bringing about associated environmental damages, including increased deforestation (e.g. fire-wood collection, charcoal production, agriculture).

In order to reduce these negative effects, new developments could promote sound environmental practices, such as sound agricultural practices (as opposed to slash-and-burn agriculture) and the use of gel fuel as a charcoal and fire-wood substitute where it is available. An initiative in this regard is to be implemented in Kasama Sugar, promoting conservation agriculture and using a demonstration plot; the design and effectiveness of this initiative could be studied in order to determine feasibility of reproducing it in other areas.

Undertake changes in the general wording of the ZNSS to ensure it is consistent with the sustainable development paradigm

ZNSS details need to be defined, and these should be environmentally integrated, bringing environmental and social sustainability to the forefront as an underlying element of the strategy.

Encourage an adequate use of this SEA report and its findings

There is a risk that this SEA (as all similar studies) becomes another report to be shelved. This report is only one component of the SEA process, and an early one for that matter. The challenge ahead is to actively and effectively coordinate discussions on the implications of the finding for the ZNSS, and bring about actions that will enhance the environmental and social sustainability of the sugar sector.

14. Performance indicators

Environmental performance indicators for the ZNSS, in line with the recommendations made in this SEA, are proposed and presented in Table 22 below. For each indicator an indication is given of possible sources of information and aspects to take into account in their application.

Table 22. Proposed environmental performance indicators for the ZNSS

Indicator	Measurement	Observations
Water availability in the Kafue Flats		
1. Water balance study for the Kafue River basin is completed	Production of complete water balance study report.	The water balance study should address the issues indicated in the section of recommendations of this SEA.
2. Available water rights for sugar cane production in the Kafue Flats are established	Policy statement by the MEWD and Water Board	Availability of water rights should be determined based on the water balance study for the Kafue River basin. Existing water rights may also be reappraised.
3. % sugar cane area under centre-pivot and drip irrigation in relation to total sugar cane irrigated area in the Kafue Flats	Information provided by the sugar cane producers to the MEWD	The GRZ only has indirect means to influence irrigations systems chosen by the sugar companies. Nevertheless, in a situation of water stress more water efficient irrigation systems should be promoted.
4. % licensed water abstraction points in the Kafue Flats with installed metering devices	Information provided by the water rights holders in the Kafue Flats	
Vinasse management		
5. Policy developed by the GRZ for the management of vinasse from distillery operations	Policy by MTENR and/or ECZ	A clear understanding of environmental vinasse management must exist within the competent authorities. This should be translated in the form of a policy for environmental management of vinasse, which would be used as a guide for its regulation (e.g. on acceptable technologies, acceptable disposal methods, on fertigation, on land application during rain events and in environmentally sensitive areas, etc.)
6. Relevant ECZ staff	Capacity building	For the GRZ to adequately regulate vinasse, it

undergo capacity-building on alternatives for good environmental management of vinasse	programme developed and delivered.	must have a good understanding of vinasse (physical and chemical properties), its risks for the environment, and good environmental management practices. Only in this way can it adequately establish conditions for its management by producers, appraise EIAs of distillery operations, etc.
7. % exceeded of maximum discharge values of water contaminants from sugar sector waste water discharge licence holders (composite index)	Composite index based on bi-annual mandatory reports	Establishing a composite index is not evident, due to the difficulty in objectively specifying which pollution parameters are more important or relevant. A simple index, however, could be developed which measures in an aggregated form how much discharge limits were exceeded. For example, a certain license holder has to comply with 4 parameters: a, b, c and d. If average discharge values in the period for all parameters is below the discharge limits, then the degree to which each parameter exceeded the maximum value is 0%, so the indicator will measure 0%. However, if parameter 'a' was exceeded in 25% (e.g. average value in the period of 125 mg/l when discharge limit is 100 mg/l), parameter 'b' was exceeded in 14%, parameter 'c' was compliant, and parameter 'd' exceeded in 5%, then the composite index would be: (25+14+0+5)/4 = 11%. In this case maximum discharge values were exceeded an average of 11%. A composite could be developed for all license holders in the sugar sector, factory and field operations included. A potential draw back in applying this indicator is that at the moment it seems that license holders are not regularly submitting their bi-annual reports.
HIV/AIDS		
8. % of sugar companies and out-grower schemes that that have an HIV/AIDS awareness programme that includes non-health impacts	Documentation from companies and out-grower schemes; interviews with people responsible for the programmes	In applying one such indicator it should be ascertained that the awareness programmes are effectively implemented, and that they not only exist on paper. For this, interviews with people responsible, as well as with programme beneficiaries should take place.
Gender		
9. % of sugar companies and out-grower schemes that have a gender programme that also addresses equitable access and control of household resources as well as sharing of benefits from productive activities.	Documentation on the gender awareness programmes from companies and out-grower schemes; interviews with people responsible for the programmes	In applying one such indicator it should be ascertained that the awareness programmes are effectively implemented, and that they not only exist on paper. For this, interviews with people responsible, as well as with programme beneficiaries should take place.
10. % staff from sugar companies who are women	Information from sugar companies	
11. % out-growers who are women	Information from out-grower schemes	
12. % management staff from sugar companies who are women	Information from sugar companies	
13. % committee members	Information from out-	

from out-grower schemes who are women	grower schemes	
Ethanol production and fuel blending		
14. The GRZ approves fuel blending ratios	Official regulation	
15. Agreement reached between potential ethanol producers and GRZ on framework for ethanol production and fuel blending	Official framework approved	As some dissent from certain stakeholders may exist, application of this indicators can only be qualitative and will required a subjective appraisal based on interviews with key stakeholders, namely the MEWD, the Department of Energy and the sugar companies
Gel fuel		
16. Pilot study for the introduction of gel fuel is carried out	Pilot study reports	The pilot study should include the elements recommended in this SEA
17. % Zambian households that employ gel fuel as main source of cooking fuel	Household surveys	If main sources of fuel are not being systematically measures in Zambia, then measurements could be limited to the sugar cane areas where the gel fuel is produced, based on household surveys.
18. Average price of gel fuel as % of average price of charcoal (weight basis)	Surveys	If main sources of fuel are not systematically measured, measurements could be limited to the sugar cane areas where the gel fuel is produced, based on household surveys.
Roads and railways		
19. Stock-taking exercise of EIA effectiveness in the transport sector is carried out	Stock-taking exercise reports	The pilot study should include the elements recommended in this SEA
20. % roads projects with acceptable degree of implementation of Environmental Management Plans	RDA Environmental and Social Management Unit data	Application of this indicator may require development of a simple compliance checklist by the ESMU, who have as part of their remit the monitoring of compliance with EMPs and standard Environmental Clauses of road projects.
21. % of roads projects with acceptable degree of compliance with the standard environmental clauses	RDA Environmental and Social Management Unit data	Application of this indicator may require development of a simple compliance checklist by the ESMU, who have as part of their remit the monitoring of compliance with EMPs and standard Environmental Clauses of road projects.
POPs		
22. NIP for the POPs Convention is revised and integrated emissions from sugar cane burning	Revised NIP (POPs Convention)	
23. Action plan is developed for the promotion of Green Cane Harvesting	Revised NIP (POPs Convention)	An Action Plan for the reduction of unintended emission of POPs is required under the POPs Convention
24. % are under sugar cane where Green Cane Harvesting is practised	Information from sugar cane producers	Information for this indicator should be requested by a competent authority, either the ECZ or MACO. Although not linked to any obligations (unless established in a revised NIP for the POPs Convention), it will give an indirect indication of emission of POPs from sugar cane burning
Co-generation		
25. A framework for co-generation (and IPPs) is agreed between the GRZ and potential producers	Official framework approved	As dissent from certain stakeholders may exist, application of the indicators can only be qualitative and will required a subjective appraisal based on interviews with key stakeholders, namely the MEWD, Department of

		Energy, ERB and sugar companies
26. kWh electricity produced by sugar companies	Information from sugar companies	
Other aspects		
27. Environmental and Social Code of Practice for the sugar sector developed	Code of Practice approved by stakeholders	This is an initiative that can be promoted by the Government, but is of a voluntary nature and thus not linked to any established obligation. However such a Code of Practice would be of great value as a framework for good practices.
28. Tonnes sugar cane produced under a certified environmental management system or under Fair Trade certification	Information from sugar cane producers	
29. Tonnes sugar produced under a certified environmental management system or Fair Trade certification	Information from sugar companies	

PART III RECOMMENDATIONS

14. Recommendations

14.1. Addressing high-priority aspects

14.1.1. Water efficiency in the lower Kafue River Basin

- The GRZ needs to conduct a comprehensive Water Balance study of the whole Kafue River Basin (not limited to the Flats) to establish a realistic estimate of water availability for any increase in irrigated agricultural activity. Such a study has been foreseen but apparently not being given the importance it deserves. The study should address: (i) determining a comprehensive inventory of water users and their current and future demand (including illegal and unregulated water abstractions); (ii) establishing the water rights already allocated; (iii) mapping water abstraction points and flows; (iv) registering flow metering devices in place; (v) determining water inputs (e.g. run-off, groundwater and surface water in-flows) and losses (e.g. evapotranspiration, outflows); (vi) determining water flows required to ensure environmental health of the basin.
- The **moratorium on the allocation of water rights** in the Kafue Flats should be maintained until completion of the water balance study. No new sugar cane expansions or developments should be allowed in the area until it is clear that water will be available.
- **Development of additional hydropower capacity** should be sought in other places other than the present Kafue Gorge hydropower station site.
- **Institutional and capacity building** programmes need to be developed and implemented for the new natural water resources monitoring programme.
- **Institutional and capacity building** should be undertaken to ensure effective implementation and operation of the new structures foreseen under the coming National Water Policy, e.g. envisage decentralised structures of the Water Resource Management through Catchment and Sub-catchment administrations, and Water Users Associations.

14.1.2. Vinasse management

- **Capacities within ECZ** need to be developed to ensure they can effectively carry out their functions as executive agency with regards to the challenges posed by a new industrial process in Zambia (alcohol distilleries), and its main waste product (vinasse). Such

capacity building would allow ECZ to objectively assess EIAs for distilleries and determine adequate conditions.

- **Training and capacity building** for ECZ needs to be undertaken on: (i) knowledge of the ethanol production process; (ii) knowledge of vinasse: its properties, expected production quantities, risks to the environment, available treatment and disposal methods and technologies (including advantages and disadvantages of each of them); (iii) options for generating carbon credits (e.g. through biodigestion of vinasse), in order to be able to promote such projects and offer appropriate guidance to secure them; (iv) study tours could be organised where sound vinasse management by the sugar industry if being carried out in the region.
- The MTENR should have a policy stance on biofuels, including aspects related to vinasse management, up-take of land and sound environmental practices.
- Policy for vinasse management should be established in a preliminary fashion, as pilot testing of effectiveness of disposal methods may be required to fine-tune policy and associated regulations. As a starting point the following recommendations are made with regards to fertigation: no vinasse should be generated during the rainy season or prolonged rain events, and no fertigation should occur during rain events, as a measure to avoid run-off into water bodies; application of vinasse on fields should in principle be limited to 50 m^3/ha, the producer clearly technically justifying any higher applications; vinasse should not be applied within 100 metres of water bodies. These measures should be fine tuned once fertigation has occurred based on analysis of pilot experiences (e.g. close monitoring of runoff under different scenarios for applications, rain events, soil types, etc).
- Establish basic guidance on vinasse management, to be used for evaluation of applications, quality of EIA reports and determining conditions to be attached to development consents. Such basic guidance should include elements such as: (i) normal ranges of vinasse application through fertigation (m^3/ha) and options for application; (ii) minimum requirements for vinasse storage and pre-treatment (e.g. lined ponds, etc.); (iii) treatment systems that could effectively bring levels of contaminants to compliance with applicable standards; (iv) basic safeguards for disposal through fertigation (e.g. in relation to disposal during rain events) and factors that affect the determination of safeguards (e.g. soil types, presence of water bodies and sensitive areas).
- The private sector will also need to develop capacities for vinasse management (ZS has in-house knowledge and experience, but this is not the case for the two other sugar factories), consistent with the waste water regulations and the policy for vinasse management that may be developed by the MTENR and ECZ.

14.1.3. HIV/AIDS

- There is need for the GRZ to amplify through the NAC, ZNAN and other stakeholders the need for responses to **non-health impacts of HIV/AIDS** in the strategic framework for the multi-sectoral responses to the pandemic, in order to elevate their importance and hence attract more allocation of resources for activities addressing these impacts.
- The GRZ should encourage sugar companies and other employers within the sugar sector (such as road contractors, developers of irrigation infrastructures) to mainstream HIV/AIDS activities taking into account non-health impacts as well as the normal health ones through the existing NASF.
- The EC support to the development of out-grower schemes should be on condition that enhanced HIV/AIDS mainstreaming taking account of non-health impacts is part of the core activities in the implementation process. Addressing non-health impacts is centred around empowering community members especially the vulnerable groups (women, female headed households, etc) within and around outgrower schemes so that they do not engage in risky behaviour in order to make ends meet.

14.1.4. Gender

- There is need for the GRZ to increase awareness through the GIDD and other stakeholders that gender is much more than level of participation of men and women in particular activities, as it includes important issues such as decision making, use and control of resources and sharing of benefits from productive activities amongst others.
- The GRZ should encourage sugar companies and other employers within the sugar sector (such as road contractors, developers of irrigation infrastructures) to **mainstream gender** going beyond the proportion of women employed to sensitising their employees on pertinent gender issues using existing institutions specialising in gender activities.
- The EC support to the development of out-grower schemes should be on condition that gender is properly mainstreamed beyond the number of women out-growers or scheme committee members. Such issues include sensitisation with regard to equitable access and control of household resources as well as sharing of benefits from productive activities.
- Recommendations on the development of sugar out-grower schemes covering organisational arrangements and implementation modalities made by Struyf and Chuba (2009) should as much as possible be followed.

14.2. Addressing medium-priority aspects

14.2.1. Ethanol production, fuel blending and gel fuel

- GRZ should make a firm commitment towards the **mandatory blending** of petrol with ethanol.
- The **legal and institutional framework** should be developed soonest for the national fuel-blending sub-sector, to enhance the interest from potential ethanol producers and the fuel blender(s) and guarantee the market.
- A **framework of incentives** should be developed to attract potential investment into the ethanol production industry.
- The **regulatory framework** should establishing guarantees to potential producers that a market will be available for the ethanol they produce, whilst at the same time producers should guarantee that they will supply the quantities of ethanol necessary to satisfy the fuel-blending requirements.
- ***In situ*** **fuel blending** options (decentralised) should be given consideration, to encourage ethanol production destined to fuel blending and which is not in the proximities of the Indeni refinery.
- A study should be carried out to establish the **acceptability of gel fuel** as a substitute of wood-fuel and charcoal, particularly in the rural and low-income urban areas. This study should be in line with the only already foreseen in 2004, but which was apparently never completed, and draw lessons from neighbouring countries (e.g. Malawi).
- A **policy framework** is developed to support investment in the gel fuel production through appropriate incentives, standards and research. **Study tours** where gel fuel has been introduced (e.g. Malawi) could be organised.
- Any production and commercialisation of gel fuel should address the **potential socio-economic impacts** on the people engaged in producing and commercialising charcoal, giving them stakes in the gel fuel sub-sector.

14.2.2. Environmentally integrated roads and railways policy

- The EIA process is the main tool available to ensure transport infrastructure projects adequately address the environment; however there are indications that the EIA system is not fulfilling its potential. The **EIA process in Zambia should be evaluated** through a

stock-taking exercise, in order to strengthen it, including: (i) quality of the EIAs produced for transport infrastructures; (ii) adequacy and quality of substantive issues related to the EIA process, including public participation and transparency of the process; (iii) quality of revisions of EIA reports made by the ECZ and the ESMU – the degree to which they identify shortcomings in the reports and respond to them; (iv) appropriateness of the conditions attached to development consent notices established by the ECZ; (v) degree of implementation of Environmental Management Plans, Environmental Clauses and stipulated conditions by the contractors; (vi) quality of follow-up of EMPs, Environmental Clauses and stipulated conditions by the ECZ and the ESMU.

- The *Procedures Manual for Environmental and Social Management in the Roads Sector in Zambia*, prepared by the RDA should be more accessible. It should be freely available on-line through key institutional web sites (e.g. MCT, RDA, ECZ) if it is to fulfil its potential as a guidance document.
- The EC advisory services for environmental integration have developed a **framework for the evaluation of the quality of road EIAs** (unofficial document), which could be considered as guidance for the above evaluation.
- Based on the above revision, **capacity-building and training needs** should be defined for both the ECZ and the ESMU.
- The **curricula of university degrees** in engineering and social sciences should be appraised in order to identify opportunities to introduce elements on EIA. Only in this way can national capacities to design and carry out EIAs be developed.
- The above elements could be considered as part of the upcoming **SEA of ROADSIP II**, which will be financed by the EC.
- **Strategic Environmental Assessment** should be promoted at the Transport Policy level within the MCT, with a view to apply it in the context of the next revision of the policy.
- The **transport policy-making and planning system** should be revised to ensure the environmental stakeholders (especially the ECZ) play an active role in it, ideally through SEA processes carried out in an integrated manner to the policy-making and planning processes in the transport sector.

14.3. Addressing low-priority aspects

14.3.1. POPs

- Zambia's National Implementation Plan of the Stockholm Convention should **acknowledge the unintended production of POPs from the burning of sugar cane**, and explicitly include its contribution to the generation of POPs. Consequently the response strategy should seek alternatives to minimise emissions.
- The ZNSS should **promote Green Cane Harvesting** (GCH); but any strategy to reduce sugar cane burning must ensure it does not result in significant socio-economic impacts of farmers and cane cutters.
- 'Cool burning' practices should be encouraged as to reduce emission of particulate matter.

14.3.2. Co-generation

- The **legal and institutional framework** for co-generation should be developed soonest, to enhance interest from potential producers in the sugar sector and guarantee the market.
- A **framework of incentives** should be developed to attract potential investment into electricity production from biomass.

14.4. Recommendations of a general nature

14.4.1. Environmental and Social Management Systems

- The development of an **Environmental and Social Management Code of Practice** in the sugar sector should be promoted, to be prepared jointly by all key stakeholders. Implementation of the Code of Practice should be voluntary and in no way undermine the role of legislation or of the regulatory authorities.
- The MTENR (canalised through the ECZ) should promote the implementation of **environmental and social management systems**, such as ISO 14001:2004 and SA8000, as well as Fair Trade certification, as a way to improve the environmental performance of the sector. Although in principle applicable to all levels, the ISO 14001:2004 EMS is more adequate for the sugar companies than the out-grower schemes or commercial farms, due to their complexity and associated certification costs. On the other hand, the SA8000 and Fair Trade certifications could be more easily pursued by out-growers and commercial farms once they are successfully operational.

14.4.2. Environmental capacity-building for new out-growers

- It should be ensured that the training and **capacity-building of farmers in the new out-grower schemes** include elements of good environmental and social management practices, including but not limited to: water use efficiency; selection and application of fertilisers and agrochemical products; drainage; waste water treatment; Green Cane Harvesting if possible; soil conservation; environmental permitting.

14.4.3. Promote sound environmental and management practices of farmers and the general population around sugar cane developments

- Promote, as part of new out-grower schemes and new sugar developments sound agricultural practices, as well as the use of gel fuel as a charcoal and fire-wood substitute (where and when available).

14.4.4. Waste water discharges and atmospheric emissions licensing

- The ECZ should **review the waste water and atmospheric emission permitting process**, ensuring all producers hold a license and are submitting the required reports in a timely manner. Any non-compliances should be tackled immediately.

14.4.5. Water balance study for the Luena Farming Block

- Water balance studies should be carried out to determine **water availability for the Luena Farming Block** and potential impacts of the five dams proposed, *before* proceeding with authorisation for works. The EIA report for the Farming Block (Lungu *et al*, 2009) is not conclusive, but should provide initial guidance on such studies.

14.4.6. Fleshing-out and wording of the ZNSS

- The **Zambia National Sugar Strategy** must be taken beyond its current "Core Elements" phase, fleshing it out; defining a Logical Framework with clear objectives, strategies, actions, resources and responsibilities; and leading to official endorsement of all stakeholders involved.
- The wording of the ZNSS should be environmentally mainstreamed. Environmental sustainability should be an integral component of the ZNSS; the environment as a cross-cutting issue should not be limited to describing the potential environmental impacts of each ZNSS component.
    - The **Introduction to the ZNSS** should establish that the adaptation of the sugar sector should take place in the context of sustainable development. Moreover it should clearly recognise that performance of the sugar sector is closely related to the

environment and to social development, and thus that environmental protection and socio-economic development are integral components of the ZNSS.

- The **recommendations made in this SEA Study should be clearly reflected in the text** of the ZNSS and its associated logical framework.
  - Strategies and Objectives should systematically make reference to environmental sustainability and socio-economic development.
  - Project measures should integrate the recommendations made above, for example: (i) implementation of good environmental and social management practices as part of new outgrower schemes (ZNSS Component 1); (ii) promotion of EMSs and Fair Trade certification (ZNSS Component 1); (iii) development of a regulatory framework and capacities of the ECZ to adequately regulate vinasse management (ZNSS Component 2); etc.
  - The section on Expected Benefits should clearly point out the expected environmental and socio-economic benefits from the measures envisaged.
- The logical framework should state any environmental assumptions and risks made (e.g. in relation to the effects of climate change).
- The logical framework for the ZNSS should define environmentally sound indicators, meaning that indicators should be checked to ensure their achievement will not imply significant negative environmental effects. Any necessary environmental indicators should be developed, in line with the measures recommended in this SEA and taking as a basis the indicators suggested in Section 14 above.

14.4.7. Use of the SEA findings and SEA follow-up

- Optimal use should be made of this SEA exercise and report:
  - This SEA report should be distributed to <u>all</u> key stakeholders, taking the original list of invitees to the Stakeholders' Workshop as an indication of stakeholders;
  - This SEA report should be made publicly available and published in the web sites of *at least* the following organisations: Ministry of Commerce, Trade and Industry; Environmental Council of Zambia; and European Commission (Zambia Delegation).
  - The MCTI and the EC should ensure that the findings of this SEA are properly discussed in the ZNSS Steering Committee, and decisions/commitments made on how its finding will be implemented. Decisions and commitments should be recorded.
- It is recommended for the GRZ and the EC to carry out a **follow-up on the effectiveness of this SEA process**; this could take place around 6 to 12 months after its completion. The follow-up would respond to questions such as: (i) did the recommendations made in the SEA get implemented? Why or why not?; (ii) did the SEA lead to better decisions from an environmental and socio-economic point of view?
- The EC's environmental advisory services have developed a framework for the evaluation of SEA effectiveness (unofficial document), which could be used as a basis for the follow-up effectiveness assessment. There are other guidance documents available which could be used as reference (e.g. in the OECD DAC SEA guidance – OECD DAC, 2006).
- The results of the follow-up study should be used to draw lessons useful for the development of an SEA system in Zambia, as well as for future SEAs financed by the EC. Experiences could be shared in the region and internationally (e.g. at the IAIA – International Association for Impact Assessment – annual conference), also as a way to trigger discussions with experts in the area that could be useful for improvement. This would also raise visibility of GRZ and EC efforts to effectively mainstream the environment in the policies, plans and programmes.

TECHNICAL APPENDICES

Appendix 1: Maps and other illustrative information

Figure 1. Environmental impacts associated to Zambia Sugar and Consolidated Farming

SUGAR INDUSTRY	Water balance	Cont. of groundwater	Cont. of surface water	Soil salinisation	Soil erosion	Soil compaction	Other soil characteristics	Ambient air quality	Greenhouse gas emissions	Protected areas	Deforestation	Biodiversity	Terrestrial flora and fauna	Aquatic flora and fauna	Wetland systems	Landscape	HIV/AIDS	Malaria	Respiratory disease	Other human health factors	Food security	Energy efficiency	Social conflict	Employment	Social services	Rural infrastructure
Field operations																										
Field expansion																										
Field preparation																										
Planting																										
Manual harvesting																										
Use of organic fertilisers																										
Use of inorganic fertilisers																										
Use of other agrochemical products																										
Surface water abstraction																										
Irrigation - Furrow																										
Irrigation – Centre-pivot																										
Sugar cane burning																										
Transport of sugar cane to factories																										
Sugar factories																										
Disposal of water - mills and evaporators																										
Filter cake disposal (slurried)																										
Disposal of molasses on roads																										
Boiler ash and fly ash disposal																										
Boiler atmospheric emissions																										
Burning of bagasse																										
Co-generation																										

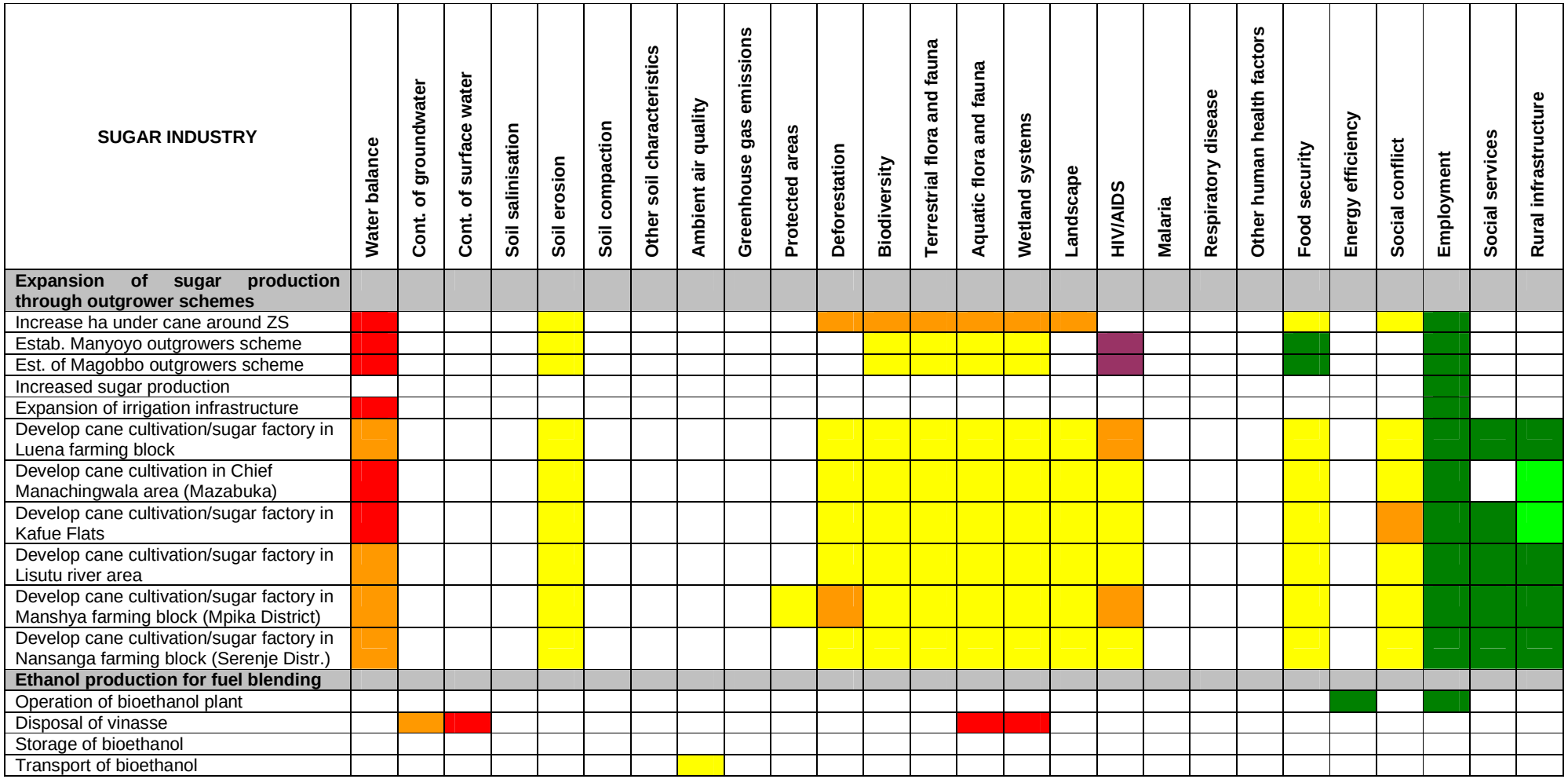
Colour key: Yellow: neg., low sign; Orange: neg., medium sign; Red: neg., high sign; Light green: positive, low sign.; Dark green: positive, high sign; Purple: negative of positive.

Figure 2. Environmental impacts associated to Kalungwishi Estates Ltd (Kasama)

SUGAR INDUSTRY	Water balance	Cont. of groundwater	Cont. of surface water	Soil salinisation	Soil erosion	Soil compaction	Other soil characteristics	Ambient air quality	Greenhouse gas emissions	Protected areas	Deforestation	Biodiversity	Terrestrial flora and fauna	Aquatic flora and fauna	Wetland systems	Landscape	HIV/AIDS	Malaria	Respiratory disease	Other human health factors	Food security	Energy efficiency	Social conflict	Employment	Social services	Rural infrastructure
Field operations																										
Field preparation																										
Planting																										
Mechanised harvesting																										
Use of organic fertilisers																										
Use of inorganic fertilisers																										
Use of other agrochemical products																										
Surface water abstraction																										
Irrigation – Centre-pivot																										
Mulching																										
Transport of sugar cane to factories																										
Sugar factories																										
Disposal of water - mills and evaporators																										
Filter cake disposal (slurried)																										
Disposal of molasses on roads																										
Boiler ash and fly ash disposal																										
Boiler atmospheric emissions																										
Burning of bagasse																										
Co-generation																										

Colour key: Yellow: neg., low sign; Orange: neg., medium sign; Red: neg., high sign; Light green: positive, low sign.; Dark green: positive, high sign; Purple: negative of positive.

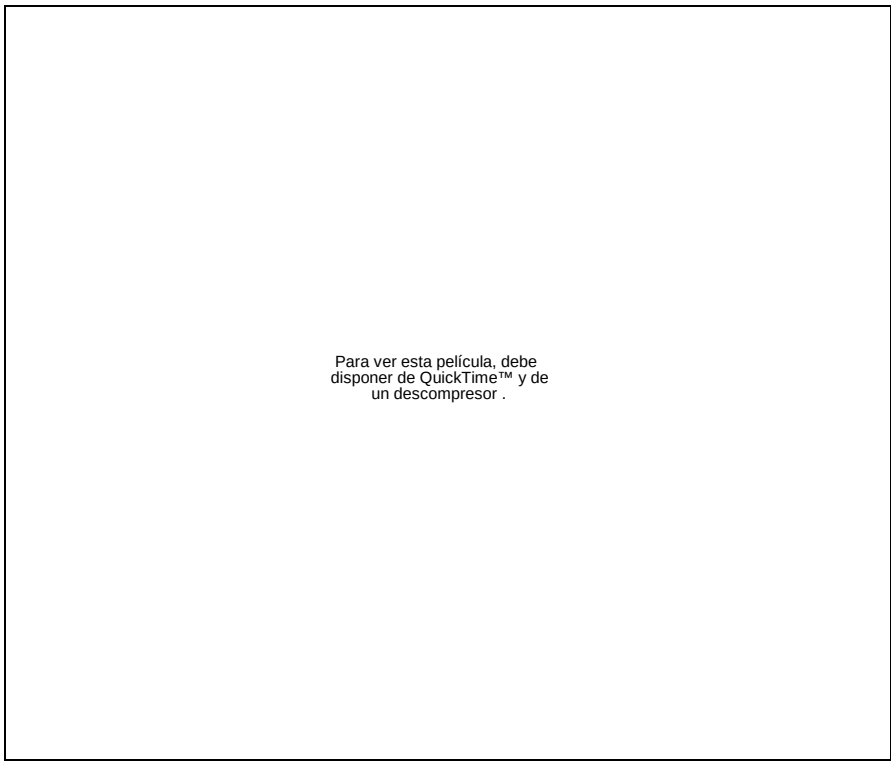
Figure 3. Potential environmental impacts of ZNSS implementation



Fuel blending (E10)																											
Gel fuel production																											
Gel fuel production																											
Use of gel fuel in households																											
Road development																											
Upgrading of major road links																											
Extension of road network																											
Railway development																											
Extension of railway links																											
Upgrading of railway lines																											
Develop national sugar trade policy																											
Develop sugar trade policy																											
Cogeneration of electricity																											
Cogeneration of electricity using bagasse																											
Installation of high pressure boilers																											
Sales of electricity to national power grid																											
Production of refined sugar																											
Construction and operation of a sulphatation plant																											

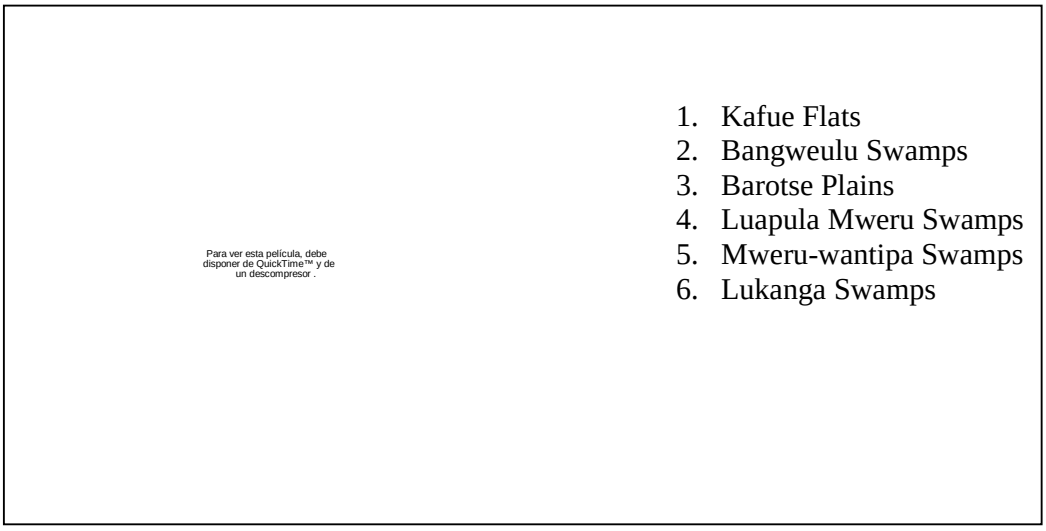
Colour key: Yellow: neg., low sign; Orange: neg., medium sign; Red: neg., high sign; Light green: positive, low sign.; Dark green: positive, high sign; Purple: negative of positive

Figure 4. Agro-ecological zones of Zambia



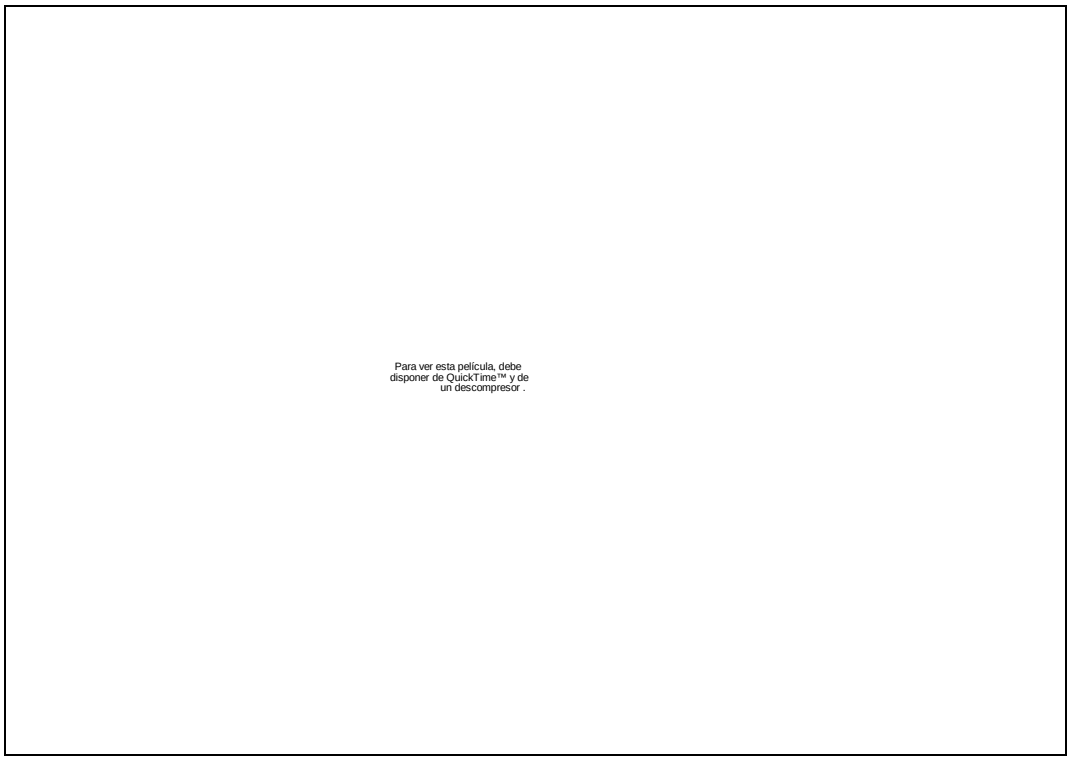
Source: Kalinda *et al*, 2008.

Figure 5. Wetlands of Zambia



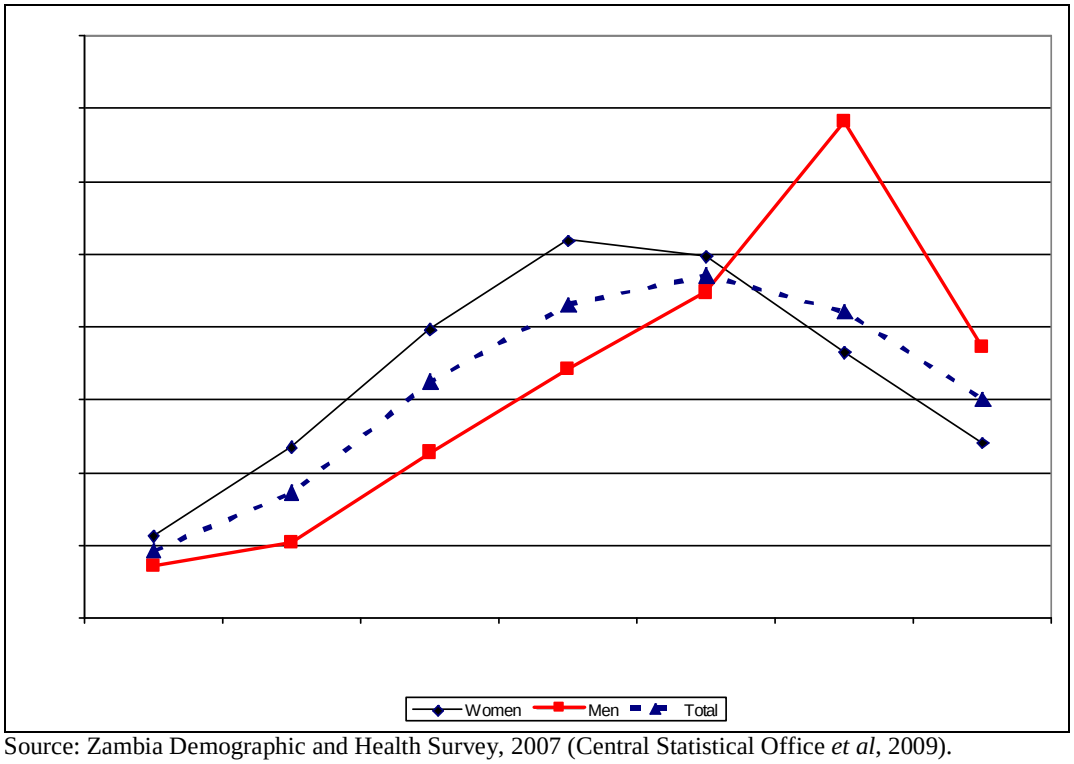
Source: ECZ, 2001.

Figure 6. Distribution of ecosystems in Zambia



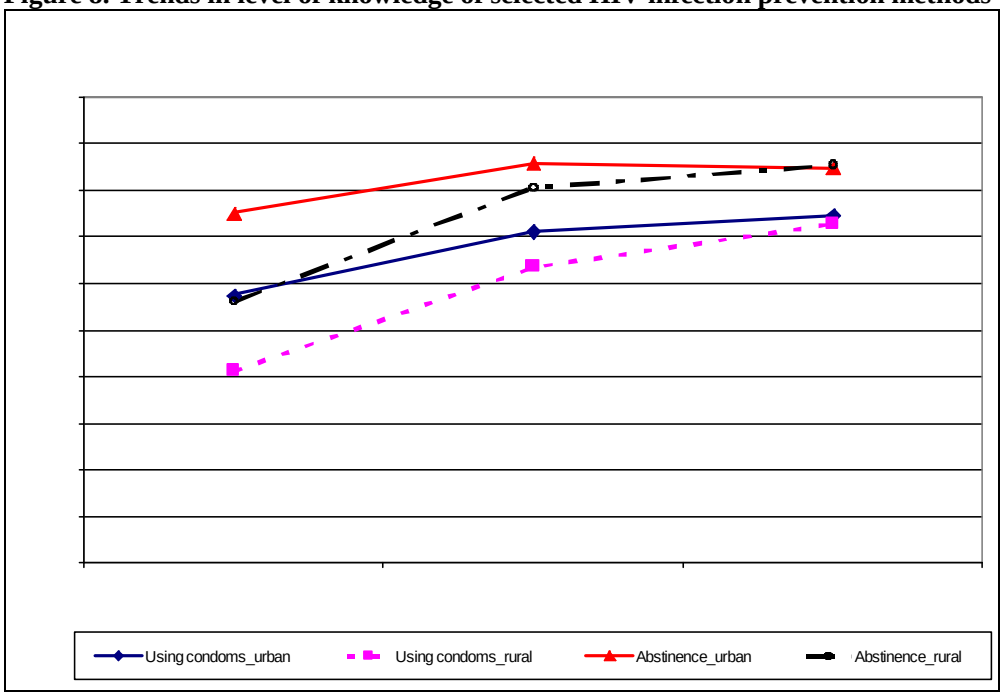
Source: ECZ, 2001.

Figure 7. HIV prevalence by age and gender



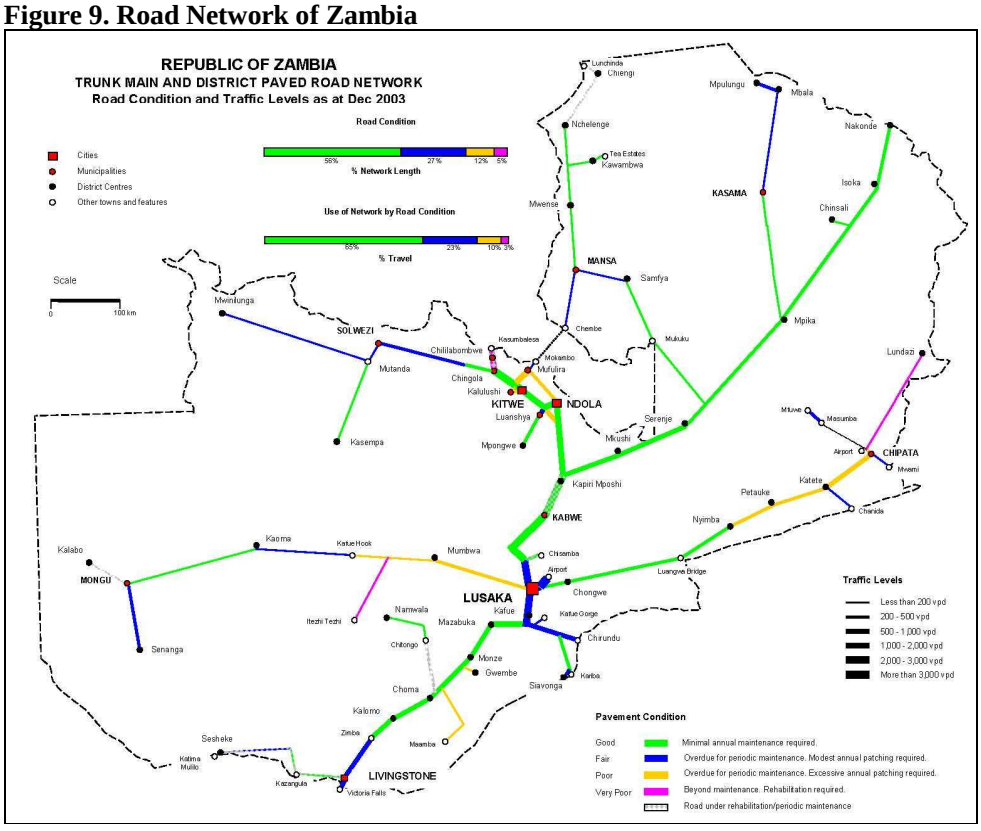
Source: Zambia Demographic and Health Survey, 2007 (Central Statistical Office *et al*, 2009).

Figure 8. Trends in level of knowledge of selected HIV infection prevention methods



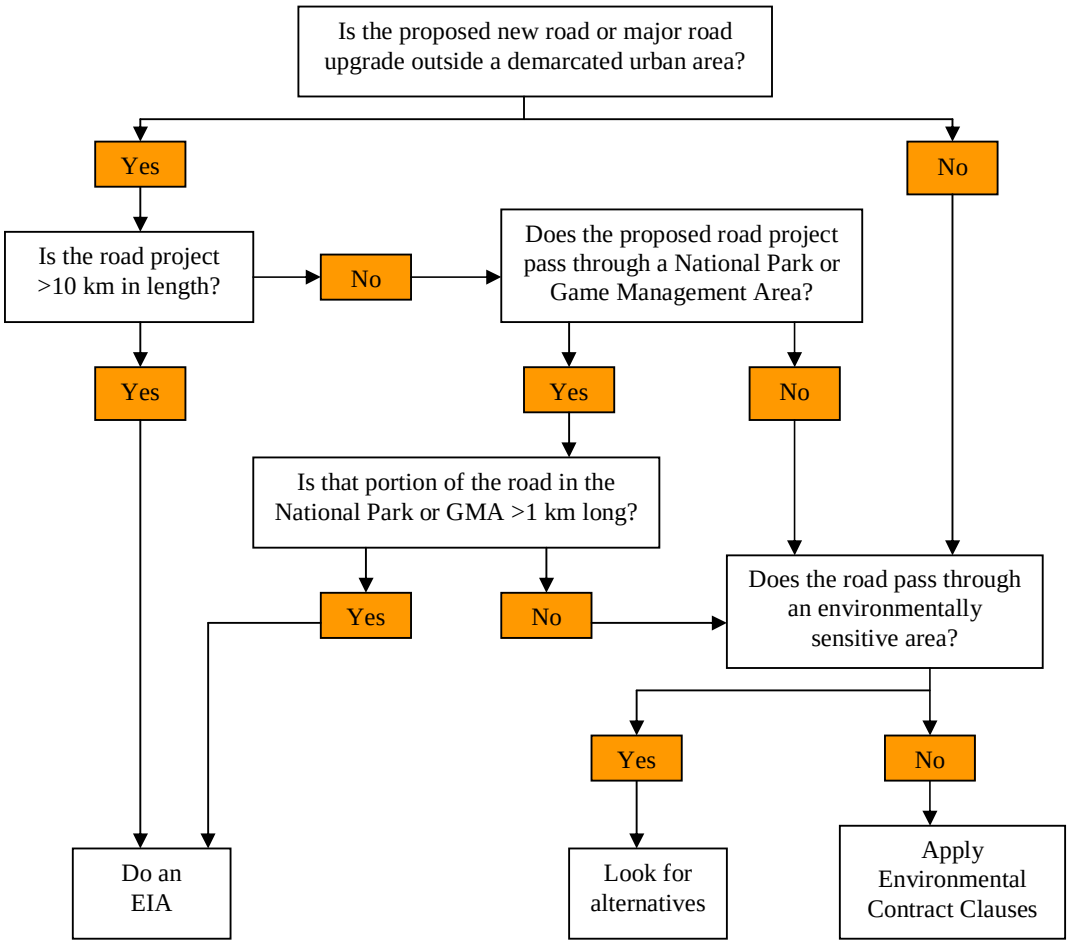
Source: 2007 ZDHS Preliminary Report and 2005 Zambia Sexual Behaviour Survey Report (Central Statistical Office *et al*, 2009; Central Statistical Office *et al*, 2006).

Figure 9. Road Network of Zambia



Source: National Road Fund Agency, available at: http://www.nrfa.org.zm/index.htm)

Figure 10. EIA Screening process for road projects



Source: Zambian Ministry of Works and Supply, 2007.

Figure 11. Southern Africa railway network

Source: http://www.reliefweb.int

Appendix 2: Sugar production, field and factory operations

Sugar cane cultivation and sugar production: resource use and potential for contamination

Sugar cane is renowned for its efficiency in converting solar energy to organic material. This is one of the most widely cited examples of positive environmental features of the sugar industry. It is asserted that sugar cane is a crop unparalleled in its capacity to trap sunlight energy and has the highest harvest index (ratio of material utilised to material grown in the field) of all crops. To fulfil this growth potential, the cane plant requires strong sunlight and abundant water.

Sugar cane is a perennial crop. The first crop after planting, known as the 'plant crop', takes 10-24 months to mature, depending on local conditions. After harvesting, the stools are left to produce ratoon crops, each taking about one year to mature. When the economic return of the crop becomes unprofitable or, if the crop is plagued by disease or pests, the field is cleared and a new plant crop is planted. Sometimes a fallow period is left before replanting. The period of the plant and ratoon crops before replanting is known as the' crop cycle'. Sugar cane is normally grown on the same land for many years.

Land clearing

If new land under bush is to be cultivated to sugar cane, it must be cleared completely before planting sugar cane. Bulldozers are frequently used but hand clearing is still in use. This clearing leads to loss of biodiversity but might also have wider impacts on ecosystem functions, like changes to hydrology and increased soil erosion. Particular concern has been expressed over impacts on wetland habitats and the effects on associated ecosystems such as the rivers. Such impacts include sedimentation of waterways and rivers as a consequence of soil erosion.

Land preparation

The preliminary cultivation and land preparation should create the best possible conditions for the growth and development of a good root system and crop. During the cropping cycle, tilth is inevitably lost and can only be restored on most soils by cultivation before replanting.

Deep cultivation is only possible every 4-5 years or even longer intervals. Furthermore, the soil has been subject to compaction, particularly where heavy machines are used. On all but the lightest soils some form of mechanical cultivation is essential for optimum yields. Preparatory cultivation operations are now fully mechanized in most places. As the depth of tillage is relatively large, power requirement of the machines is high, and it is often done during the dry season. It might however still be done by manual labour or animal-drawn implements on smallholdings where it has to be carried out in the wet season. On heavier soils the land is ploughed to 25-35 cm, heavy tractors often being used. Ploughing is followed, up to 6 weeks later, by chiselling or knifing to a depth of 45-60 cm, particularly where a hardpan is present. When drainage is not impeded, disc-harrowing, which pulverizes the topsoil, may replace chiselling. Then follows furrowing and banking preparatory to planting.

On light soils minimum cultivation can be practiced, where ploughing may not be necessary before replanting. The old crop is chemically destroyed, trash and dead roots removed or used as mulch. Furrows are then made between the old rows of cane, in which new cane setts are planted. In smallholder cultivation many of the lighter operations, apart from the ploughing and harrowing, are done by hand. Environmental impacts caused by the land preparation are limited to erosion either by wind or water. As most activities are carried out in the dry season water erosion is at its minimum.

Ongoing cultivation (Cane husbandry)

Land management systems, including field layout, drainage systems and soil preparation depend on rainfall,. Field layout and drainage systems must be adapted where rainfall is excessive, in which case drainage must be provided and the crop grown on cambered beds,

banks or ridges-and-furrows; or where rainfall is inadequate, requiring moisture conservation; and whether or not furrow or overhead irrigation is practiced.

Irrigation

Sugarcane is noted for its high water consumption. Although rain-fed in some regions, in many others cane cultivation relies on irrigation. Quantities of water used are a cause of concern. It has been estimated that a crop of 100 tc/ha would require about 7.5 Ml/ha of water. If this demand cannot be met by rainfall, it will be met by substantial applications of irrigation water. Several irrigation systems are practiced, in order of water use efficiency (lowest to highest): furrow irrigation; pressurised overhead sprinkler irrigation (standpipe and centre-pivot); and drip/trickle irrigation. Besides the efficiency of water use, the efficiency of the management of any irrigation system is of major consequence to the economic viability of the sugar enterprise.

On hilly or rough land, grading, required for efficient furrow irrigation, is expensive and at times not advisable from a soil profile point of view. Under such conditions overhead irrigation may be preferable. Soils which are porous and of varying texture, hamper the achievement of acceptable efficiency in furrow irrigation. Here, also, overhead irrigation may be preferable. When applying water to young cane, or in areas with a high water table, it may be necessary to apply small amounts of water more frequently. Light wettings at relatively short intervals may be required. Overhead or trickle irrigation then would be preferred to furrow irrigation.

There are concerns that these water extractions for cane have resulted in over-commitment and degradation of river systems. Despite their importance to the sugar industry, irrigation systems have often been found to be inefficient, leading to wastage of water. In addition to concerns over excessive water consumption for irrigation, it is also worth noting that irrigation may exacerbate other cultivation impacts, particularly salinisation of the soil.

Fertilisation

As sucrose consists solely of carbon, hydrogen and oxygen, it should be possible, theoretically, to maintain soil nutrients by returning all plant residues to the land. In practice this is not feasible as the trash may be burnt before or after harvesting, some constituents are changed during the extraction of the sucrose, much of the bagasse is usually burnt to supply steam in the factory, potassium is removed with the molasses, and practical difficulties and expense prevent returning all residues to the land from which they were originally derived.

Sugar cane removes large quantities of nutrients from the soil. A crop of 75 t of cane per hectare is said to remove 110 kg N, 60 kg P_20_5 and 300 kg K_20. Adequate fertilization is the key to good yields and sugar cane has a high demand for N, P and K during its early stages of growth. Adequate water, supplied by natural rainfall or by irrigation, is essential to derive maximum benefit from nutrients supplied. Chemical fertilizers are used on an ever-increasing scale.

Organic fertilisers

Use of animal manure was formerly much more important than it is today. Its use is now limited by availability and the cost of transport and spreading. Its NPK value is often very variable. Filter mud, a by-product from the factory, contains 3-4% P_20_5 and 1-2% nitrogen on dry weight basis. It is usefully disposed of from the factory, where it presents a fire hazard, by returning it to the field at the rate of 5-10 t/ha or more. Molasses, containing 3-7% K_20, is used as manure when prices are low, and up to 7 t/ha are applied. Vinasse, the still effluent from distilling molasses, is rich in potash and could be used as fertilizer, applied at some 50-80 m^3/ha. Bagasse is sometimes used as mulch, but incorporation in the soil is not easy and is expensive. About 2.7 kg N should be applied for every tonne of bagasse used. It may also be composted. In some areas where cane is cut without burning, trash and cane tops are used for mulch, which, apart from supplying organic matter, is useful for conserving moisture in areas of low rainfall.

Green manuring, the planting of a Leguminous Break Crop is also practiced to improve the latent potential and fertility of the soil, to replace minor elements and organic matter in the soil and to rest the soil and break the continuous cycle of cane after cane.

Weed control, particularly in the early stages, is essential for satisfactory growth of the crop. Inadequate weed control during the first 6 weeks can cause a 45% reduction in crop. Not only do weeds compete with the young cane for sunlight, water and nutrient, but can cause great trouble during harvesting. Weeds can be controlled by hand-weeding, using a hoe, inter-cultivation by animal- or tractor-drawn tools, flaming, or by chemicals. Mechanical cultivation requires a well-defined field layout, spacing to permit use of the machines, and it may be impossible to perform on heavy land in wet weather when it is most wanted; it can also damage tilth and cause compaction. Biological control has been successful with a few species, e.g. *Cordia curassavica* in Mauritius. It is also necessary to weed field traces, headlands and irrigation and drainage ditches.

Selective herbicides are now widely used and may be combined with manual weeding. Pre-emergents are used before and at the time of planting, followed by post-emergent spraying at 6-8 weeks intervals until the rows close in and shading renders further control unnecessary. Control of broad-leaved weeds is relatively easy, but grasses are more difficult, as herbicides must be used which will cause little damage to the sugar cane. Weed surveys to determine the species to be controlled and their prevalence should first be made.

Inorganic herbicides, such as sodium chlorate and arsenic compounds, were used in the past, but are difficult and dangerous to handle. These were followed by petroleum oils with chlorinated phenols, and 2,4-D was widely used. Substituted ureas and triazines are now increasingly used. Monuron is widely used as a pre- and post-emergent spray applied from aircraft.

Control of aquatic weeds in irrigation ditches and drainage canals may also be done with chemicals, but may cause fish mortality. The herbivorous fish, *Tilapia mossambica*, has been found useful in controlling aquatic vegetation.

Methods of **inter-row cultivation** and **weed control in ratoon** crops depend on whether or not the cane has been burnt. After burning the land may be inter-cultivated mechanically using implements such as the rotary hoe as soon as the young shoots show the position of the rows. The soil, which has been compacted during harvesting, is cut to a depth of 11-13 cm. When the cane has not been burnt trash is heaped in the centre of the inter-row spaces, allowing the stools to grow and be fertilized. The number of weedings with unburnt cane is greatly reduced. If the cane has not been cut at ground level, stubble-shaving may be done, which removes the short portion of the stem above the ground level so that the ratoon may sprout below the surface. Sometimes the trash is burnt immediately after harvesting.

Pest control

Most diseases and pests are not controlled by pesticides, with the exception of nematodes, locust and rats. Control of a disease is achieved by changing one or more of the three factors necessary for infection: reduce host susceptibility (changing to resistant sugarcane varieties), take measures against the pathogen (e.g. roguing diseased stools or using a fungicide) or change environmental conditions (e.g. choice of planting date or by irrigating to avoid stress).

Most important sugarcane diseases, including Ratoon Stunting Disease (RSD), smut, mosaic, leaf scald and, to some extent, red rot, are systemic, i.e. they are present within the cane stalk and can be spread by planting infected seedcane. The planting of healthy seedcane is therefore essential for general disease control. Growers should establish 'nurseries' with heat-treated stock or participate in seedcane production schemes to provide healthy, high quality seedcane to meet their annual planting requirements. Hot water treatment, at 50°C for two hours, is essential for the control of RSD and eliminates several other diseases, including smut and chlorotic streak.

Red locust swarms can migrate over considerable distances. As the adults can feed on many different plants, such migrations can be of international concern. In southern Africa, where breeding grounds of this insect occurred in northern Zambia and southern Tanzania, an international Red Locust Control Service was set up. Regular inspections to detect swarms in good time and subsequent aerial spraying of a contact insecticide, such as Carbaryl (nSevinn), at 1 kg active ingredient per ha, should keep the infestation under control. For environmental

reasons the use of insecticides such as DDT, BHC, Dieldrin or Endrin must be avoided. In the absence of any natural control, a contact insecticide will have to be used. When the infestations are the result of swarming, using spray aircraft, applying low volume applications of insecticides, may well be the only effective way to control and eradicate the pest.

Residual populations may remain. With regular inspections the size of any such population can be estimated and control procedures initiated before the population matures fully. Spraying insecticides by means of knapsacks, in these smaller areas, may lead to satisfactory results.

As for nematodes, on sandy soils the use of nematicides, such as aldicarb (Temik ISO G), at the rate of 3 kg/ha, placed over the cane row can be cost effective. In extreme cases a crop may not be viable without the use of nematicides. If a nematode problem is detected, it will be useful to set up some single factor trials, with the objective of determining the economic optimum of the nematicide to be used. Once the cost of the treatment is higher than the value of the additional cane, produced by the treatment, a continued application of nematicides is not justified. As the pest may be present in a large part of a cane area, trials should be carried out in order to determine the threshold value of the percentage of clay over which the application of nematicides would not be regarded as cost effective. The matter is complicated by the fact that nematicides do not fully remove the nematodes from the root environment. Although a significantly beneficial effect from the application of these chemicals may result, renewed activity will become apparent again after some time.

Watercourses and aquatic habitats can be polluted by agrochemicals and sediments arising from sugarcane cultivation. Ground waters can be affected by leaching of nutrients from fertilisers and other agrochemicals applied to the crop. These impacts may extend to downstream ecosystems, such as rivers and wetlands. Surface runoff can also create pollution of watercourses and aquatic habitats.

Harvesting

Controlled burning of sugar cane before harvesting to get rid of the trash is practiced in many places. It makes harvesting easier and is necessary for some forms of mechanical harvesting.

Where burning is practiced, the best time to burn is at daybreak and only enough cane should be burnt for one day's allocation. Evening burns increase the delay to crushing by 10 or 11 hours. Cane quality starts deteriorating immediately after it is either burnt or cut so it is important to reduce the delay to crushing as much as possible. The average loss is estimated at about 2% Recoverable Value (RV) per day, but it is temperature related, and is also affected by many other factors. Using green cane chopper harvesters and cutting cane mostly during daylight hours, the average cut to crush delay is less than 12 hours. Consequently the burning should be carefully regulated and correlated with the early supply to the factory.

In Africa most cane is burnt at harvest, but in South Africa since the introduction of the RV quality payment formula, more growers have started cutting green cane. In many other cane growing countries as well, there has been a shift to green cane harvesting. Whereas ten years ago most of Australia's crop was burnt, 70% is now cut green. Cutting green cane eliminates the burning delay, thus resulting in fresher cane being delivered to the mills.

Burning of cane is practiced in ZS and CF, while KE practices green cane harvesting with chopper harvester. It is regrettable that advantages of sugar cane trash, for instance for moisture conservation, weed control and protection against erosion, are lost as a result of burning the cane. The burning of cane prior to harvesting creates air pollution and may be a nuisance.

Sugarcane processing and sugar manufacturing

All sugar factories in Zambia use generally the same processing systems. The whole or chopped (KS) sugar cane sticks are received by the factories by weighing the cane. The cane is than passed through two sets of knives to cut-up and split-up the cane. After the second cutting strands of thread-like fibre and pith (fluffy in form) can be seen exposed in cane that is well

prepared. The next step is the crushing and washing and a last squeezing to dry the spent fibre as bagasse at about 50% moisture, which is sent to the boilers as fuel.

Milling is the separation of juice and fibre. Prepared cane is passed through a series of mills. Imbibition water from impure condensate is applied to the fibre before the last mill. The juice from this last mill is than applied to the fibre of the mill before, and this is repeated until the second mill. The juice of the second mill is then mixed with the juice of the first mill and forms the mixed juice that is passed on for further processing. The mixed juice is weighed and this, compared with the weight of the cane crushed, indicates the efficiency of the milling.

The next step is clarification, the removal of insoluble matter. There is virtually no change in purity from mixed to clear juice. As part of the clarification process the juice is heated to 104º C to sterilize, coagulate some impurities, expel air during flashing and optimise the formation of filter mud (filtercake), after which it is rapidly cooled to 100ºC. By adding lime to the juice, clarification of the juice is achieved. The precipitate (mud) is basically tricalcium phosphate.

The precipitate is separated from the clear juice by a filtration (under vacuum) process. Filtercake (filter press mud), which has a moisture content of 70%, is often sent back to the fields as a soil enhancer. The clear juice is concentrated to increase its brix[37] from about 11% to above 65% through a quadruple effect evaporator (4 vessels) arranged in series, where the water is boiled off. Steam is the medium for the boiling.

The so concentrated syrup from the last vessel is fed to and boiled in the vacuum pans. The pans is where the sugar crystals are grown in A- massecuite, B-massecuite and C – massecuite. The massecuites are allowed to cool to allow crystal growth to continue in crystalisers. The massecuites are than fed into centrifugals to separate the crystals (sugar) from the molasses.

A-massecuites produce A sugar or Plantation white; B-massecuite produces B-sugar or brown sugar. Sugar from C-massecuite is returned in the process for re-melt. Sugar from centrifugals is dried, which enhances its keeping and handling qualities, and then bagged or packed.

Environmental impacts of sugar processing

Impacts on biodiversity

Most impacts of sugar processing on biodiversity are secondary effects from environmental pollution, such as the discharge of effluent into waterways.

Impacts on water

Processing of sugarcane is a relatively water intensive activity, involving a number of stages that consume water. In some cases the need to wash off soil and other extraneous materials from the cane in washing plants exacerbates water consumption. Modern sugar factories have water recovery installations to reduce the high water demands. Sugar processing produces effluents that can cause pollution when discharged into waterways. Pollution effects are exacerbated by the high oxygen demand of effluents and the use of agents such as lime in processing operations.

Impacts on soils

Soils can be negatively affected by poorly managed application of wastes (by-products) from sugar processing, or poorly managed irrigation with processing waste waters. There are however also positive effects from the use of process wastes used as soil enhancers.

Impacts on air quality

The practice of burning bagasse to fuel cane processing operations can result in undesirable emissions. This represents the utilisation of a by-product and may be less polluting than alternative arrangements. The wastes generated by cane processing can result in significant odour problems, from the release of noxious gasses.

[37] Brix is the percentage by weight of dissolved solids in a sugar solution.

Appendix 3: Key stakeholders

Main institutional actors relevant to the ZNSS

Institutional Actor	Description / relevance to the ZNSS
Ministry of Tourism Environment and Natural Resources (MTENR)	Key ministry responsible for environmental policy and planning. Relevant Departments within MTENR include: - Forestry Department: responsible for management of forest resources in Zambia. This Department is relevant insofar as new sugar cane production areas may affect forest zones. - Planning and Information Department: responsible for co-ordinating, monitoring and evaluating development and implementation of ministerial policies, plans and programmes and ensuring information management. - Environment and Natural Resources Management Department: responsible for overall policy formulation on environment, natural resources, pollution control, as well as monitoring and evaluating operation of executive agencies created to implement policies on behalf of the GRZ. In the sugar sector, all issues related to water and atmospheric pollution, fertiliser and pesticide use, and waste management are within the remit of the MTENR. As well, potential environmental impacts on, e.g. water, air and forests, are of its concern.
Ministry of Commerce Trade and Industry (MCTI)	Main GRZ body responsible for administering national policy for private sector development. It coordinates industrial, commercial and trade matters and liaises with various public and private sector organisations to facilitate implementation of sector policies related to trade and industry. MCTI is the lead authority in the preparation and implementation of the ZNSS, as well as leading this SEA process. It is also the co-chair of the Sugar Accompanying Measures Steering Committee.
Ministry of Agriculture and Co-operatives (MACO)	MACO is responsible for policy on all matters pertaining to production and marketing of crops, livestock and fisheries. This is spearheaded by the Department of Policy and Planning, while a number of departments within it are responsible for implementing policy. Recently matters relating to livestock and fisheries have been alienated to the newly formed Ministry of Livestock and Fisheries.
Ministry of Communications and Transport (MCT)	MCT is responsible for formulating and administering policies in communications, transport and meteorological sectors. The Planning Department is of relevance to the ZNSS: - Planning Department: responsible for coordinating the development and implementation of policies relating to transport and its sub-sectors of road, rail, air and water. It is also responsible for ensuring implementing agencies in the transport sector develop and implement strategies and action plans that are in tandem with the transport policy and other pivotal national policy documents. Relevance to the ZNSS is due both to the inclusion of enhancement of the transport infrastructure as part of the ZNSS as well as to the fact that some areas targeted by the GRZ for sugar cane production require development of transport infrastructure.
Ministry of Energy and Water Development (MEWD)	The MEWD is responsible for formulating policy on matters of energy and water development. Implementation is responsibility of the Department of Energy and the Energy Regulation Board, on the Energy side, and the Department of Water Affairs and the Water Board on water issues. Issues with relevance to the ZNSS are: Through the Department of Water Affairs (DWA) and the Water Board: (a) water availability; (b) water distribution /water rights; (c) water pricing. Through the Department of Energy (DoE): (a) fuel blending policy and strategy; (b) fuel pricing policy; (c) independent power production (IPP) policy; (d) renewable energy policy; (e) infrastructure development (electricity transmission and distribution facilities).

Ministry of Lands (MOL)	The Ministry of Lands is responsible for land administration in Zambia through the implementation of the Land Policy. The Vision of the Land Policy is to have a Zambia with secure, fair and equitable access and control of land tenure for sustainable land use for socio-economic development of the people. This Vision is to be achieved through the following objectives: • To ensure that all land users, agriculture etc are consistent with sustainable land use planning and long-term national interest; • To facilitate and regulate orderly land market transactions; • To encourage decentralisation and delegation of land administration services to established and credible participatory local land management institutions. Within the context of the ZNSS, one core element is increased sugar production, which will involve acquisition of new lands and/or conversion of land ownership from customary to leasehold title and/or block title. These are the domains of the Ministry of Lands.
Environmental Council of Zambia (ECZ)	ECZ is an executive agency under the MTENR mandated to protect the environment and control pollution. Amongst the specific functions of the ECZ, those most relevant to the ZNSS include: • Draw up and enforce regulations related to water, air, pesticides and toxic substances, waste management and natural resources management; • Advise the government on the formulation of policies related to good management of natural resources and environment; • Advise on all matters relating to environmental conservation, protection and pollution control; • Conduct studies and make recommendations on standards related to improvement and maintenance of sound ecological systems; • Identify projects, plans and policies that need EIA; • Monitor trends in the use of natural resources and their impact on the environment; • Request information on the quality, quantity and management methods of natural resources and environmental conditions; • Responsible for the development of guidelines, regulation and promotion and enforcement of the use of SEA.
Road Development Agency (RDA)	RDA is a statutory institution created to provide for the care, maintenance and construction of public roads in Zambia. It is relevant to the ZNSS, as the ZNSS includes a component for upgrading and development of roads; as well, development of new areas targeted for sugar cane cultivation and processing may also require construction of roads.
Zambia Development Agency (ZDA)	An Agency responsible for fostering economic growth and development in Zambia through promoting trade and investment and an efficient, effective and co-ordinated private sector-led economic development strategy. The Agency also has the challenge to develop an internationally competitive economy through innovation that promotes high skills, productive investment, and increased trade.
Water Board	See MEWD. Responsibilities of the Water Board of relevance to the ZNSS include water distribution/water rights, and water pricing.
Zambia Wildlife Authority (ZAWA)	ZAWA is an autonomous body governed by the Zambia Wildlife Act. Amongst its objectives, the following are more relevant to the ZNSS: • Management of sustainable biodiversity in national parks and game management areas; • Reverse the decline in wildlife resources; • Considerably improve the wildlife resource base investment in co-operation with the private sector and local communities. Relevance to ZNSS insofar as new sugar cane areas may affect areas important for wildlife.
Gender in Development Department (GIDD)	The GIDD is responsible for coordinating and implementing the National Gender Policy. The vision of Government on gender is to achieve full participation of both

	women and men in the development process at all levels in order to ensure sustainable development and attainment of equality and equity between sexes. In addition to other sectors, the policy measures aim at redressing the gender imbalances in the agricultural sector, by: (a) underlining service provision to especially women farmers, (b) encouraging the training of more female extension workers, (c) incorporating gender studies for extension workers, (d) rehabilitation and construction of rural infrastructure to assist especially rural women farmers, (d) formation of women farmer groups, (e) research and technology development targeted at women, (f) strengthening NGOs dealing with women in the agricultural sector, (g) incorporate women in decision-making structures in the sector, (h) promote gender sensitive guidelines for targeting beneficiaries for agricultural projects/programmes, (i) promote the reduction and streamlining of collateral demands for small-scale farmers especially women to enable them access to credit for working capital and productive assets, (j) allocation of more resources to research and extension on production and processing of traditional crops grown by women, (k) protection of women from exploitative tendencies by local agricultural agencies, (l) promote women accessing irrigation technology and resources, and (m) promote food conservation and storage technologies to ensure availability of adequate food throughout the years, especially among women farmers.
Ministry of Community Development and Social Services (MCDSS)	The MCDSS is responsible for policy co-ordination and implementation of activities relating to community development and social welfare of the vulnerable people in all parts of the country. In relation to the ZNSS expansion core element, the ministry has representation country-wide in a manner similar to that of the extension service of MACO and assists in development of community groups, a vehicle through which rural development is being spearheaded. Its mandate would include assisting, in conjunction with NGOs, sugar out-grower associations in various group dynamics and other developmental issues. It also supports vulnerable but viable small-scale farmers with input packs through the Food Security Pack implemented by the Programme Against Malnutrition.
Ministry of Health (MOH)	The MOH is responsible for policy co-ordination and implementation of health related activities in the country and is the umbrella body for all health institutions, including rural health centres which interact directly with communities that are to be involved in sugar out-grower schemes. Management of these activities at the district level is under the various District Health Management Teams.
National AIDS Council (NAC)	The mandate of the NAC is to co-ordinate, monitor and evaluate multi-sectoral national anti-HIV/AIDS interventions, undertake research and provide technical guidance to implementing agencies. At the provincial level of this structure there shall be the Provincial HIV/AIDS Committee/Task Force within the Provincial Development Coordinating Committee; at the district level the District HIV/AIDS Committee/Task Force within the District Development Coordinating Committee; and the Area or Resident Development Committees at sub-district level, which shall interact with the communities. Other NGOs and Faith Based Organisations (FBOs) also operate throughout this hierarchy addressing HIV/AIDS issues. In addition, many development organisations at all levels have been mainstreaming HIV/AIDS in their activities.

Other stakeholders relevant to the ZNSS

Stakeholder	Description / relevance to the ZNSS
Kaleya Smallholder Company Ltd (KASCOL)	KASCOL is the management company for the Kaleya Smallholders Scheme, the first sugar out-grower scheme in Zambia.
Manyonyo Water Users Association	With support from the African Development Bank through the MACO Smallholder Irrigation Project, irrigation works are being done in the planned sugar

(MWUA)	out-grower scheme to be managed by KASCOL.
Magobbo Cane Growers Association (MCGA)	A farmer organisation for the new sugar out-grower scheme to be developed with co-funding from the EC (€3,020,000 i.e. 59,5% of the total costs) managed by a firm to be identified.
Magoba Outgrowers	Magoba Outgrowers is planned adjacent to Consolidated Farming Ltd in Kafue. About 500 ha under sugar cane are planned. The traditional leadership has given its blessings to the development of the scheme and land clearing has started.
Zambia Sugar Plc	Zambia Sugar Plc is based in the Southern Province town of Mazabuka. The company belongs to the Illovo group of companies – Sugar Illovo Limited. Its operations cover both cane production and processing. Apart from growing its own sugar cane the company gets cane from commercial farms and an out-grower scheme around Mazabuka. The new smallholder out-grower schemes (Manyonyo and Magobbo) will provide additional cane to Zambia Sugar.
Consolidated Farming Ltd (Kafue Sugar)	Second sugar producer in Zambia; they cultivate approximately 6,000 ha of sugar cane and also have a mill. The Kafue Sugar plantation is located in Nampundwe, on the outskirts of Lusaka. Expansion of sugar cane area under cultivation is foreseen.
Kalungwishi Estates Ltd (Kasama Sugar)	Kasama Sugar is a small estate and sugar mill located near Kasama, in the Northern Province, with approximately 400 ha under cultivation.
Zambia National Farmers Union (ZNFU)	ZNFU looks at the interests of its members, which also includes organisations such as sugar companies. Its main aim is to lobby for Government policy that is favourable to the farming community in areas such as tariffs, taxes, etc. It has for some time been advocating for reduced import charges on agricultural equipment and machinery, which also affects sugar estates.
Delta Farm (Mazabuka)	Delta Farm produces sugar cane, which it sells to ZS, and provides an opportunity for establishing an out-grower scheme with neighbouring small scale farmers. The Farm may provide management services for the out-growers.
Imbebe Farm (Mazabuka)	Imbebe Farm produces sugar cane, which it sells to ZS and provides an opportunity for establishing an out-grower scheme with neighbouring small-scale farmers. The Farm may provide management services for the out-growers.
Biofuels Association of Zambia	Professional organisation for the promotion of biofuels in Zambia, and of direct relevance to the biofuels component of the ZNSS.
Keepers Zambia Association	NGO working in the following areas: (a) agriculture and food security; (b) water supply, sanitation and hygiene; (c) rural enterprise and private sector development; (d) environment and natural resource management; and (e) social protection.
Zambia Agriculture Research Institute (ZARI)	One of the departments in MACO. The overall objective of the department is to provide a high quality, appropriate and cost effective service to farmers, generating and adapting crop, soil and plant protection technologies. ZARI also carries out work on food security. It does not deal directly with research and development for sugar cane.
Oxfam Zambia	The focus of Oxfam in Zambia is on HIV/AIDS, sustainable livelihoods, and helping people cope with drought.
National Association for Peasants and Small Scale Farmers of Zambia	The association looks at the interest of peasant and small scale farmers that are not members of the Zambia National Farmers' Union. Its main concern is that this category of farmers is quite often neglected by Government and exploited by the private sector, including out grower companies.
Wildlife and Environmental Conservation Society of Zambia (WCSZ)	Environmental NGO working mainly on promoting sustainable environmental policies, with an emphasis on public participation and environmental awareness rising.
Centre for Energy, Environment and Engineering (CEEEZ)	The specific role of CEEEZ is to investigate, analyse and make useful conclusions and policy recommendations on energy, environment and engineering concerns. In addition, CEEEZ carries out studies, research and development, consultancy and training in the areas of energy, environment and engineering.
Zambia Land Alliance	Network of NGOs advocating for just land policies and laws that take into account the interests of the poor. Strategic objectives are: (1) lobby and advocate for policies and laws that are inclusive of the rural and urban poor, most of whom depend on land for their livelihoods; (2) conduct research on land related laws and policies, and investigate and document the efforts by various stakeholders on equitable access and ownership of land; (3) raise awareness on land issues; and (4)

	network and collaborate with national, regional and international bodies to share experience and discussions on the future courses of action on land issues as they relate to poor rural families.
Zambia Water Partnership	Partnership comprising of stakeholders in the water sector and interested organisations with a mandate to promote the implementation of integrated and sustainable water resources management in Zambia.
Programme Against Malnutrition	Umbrella organisation whose objective is to facilitate and provide services for the attainment of prosperous livelihoods for vulnerable people in Zambia through improved food security, nutrition and incomes.
Participatory Ecological Land Use Management (PELUM)	Network of Civil Society Organizations / NGOs working with small-scale farmers in East, central and Southern Africa.
Environmental Conservation Association of Zambia (ECAZ)	Affiliated to the ZNFU from which it receives much support. Its general objective is to work towards the conservation and sustainable utilization of Zambia's natural resources. Currently, however, the emphasis is on: (1) promoting the conservation of indigenous forests and their replacement in felled areas; (2) promoting community forestry, community based natural resource utilization and management and income generating activities; (3) lobbying Government, policy makers, donors etc on environmental issues; (4) stimulating public awareness of environmental issues through information collection and dissemination; (5) promoting conservation and education in schools; and (6) opposing pollution and degradation of the environment in all its forms.
Citizens for a Better Environment	NGO working to save the severely polluted Kafue River.
WWF	International NGO which, amongst other aspects, is involved in projects on water management in the Kafue river basin, the miombo eco-region and the sugar sector.
IUCN	International NGO for conservation of nature. In Zambia IUCN mainly deals with climate change issues.
FAO	FAO has for a long time been working on gender and HIV/AIDS issues in agriculture and emphasises recognising the inter-linkages between poverty, gender inequality and HIV/AIDS. Using the Sustainable Livelihood Approach it has demonstrated that HIV/AIDS depletes assets at community and household levels and affects more the vulnerable including female headed households and orphans and these need to be empowered for sustainable development.
UNDP	In Zambia the role of UNDP is mainly centred on issues of climate change.
Finnish Embassy	Lead donor on environment in Zambia. Finland is the Chair of the troika lead in environment and natural resources. Other leads are UNDP and World Bank.
MS Zambia	MS Zambia Programme aims at supporting the empowerment of the under privileged community members to have real influence on their living conditions. MS Zambia, in collaboration with its partners endeavour to see to it that Agricultural Management at Community Level is indeed based on the five dimensions of empowerment: well being, awareness, participation in decision making, access and control. It is through this empowerment that communities can express and claim their rights and develop alternative powers to positively influence their living conditions using agriculture as a tool. Sugar out-grower schemes need to consider this in their design and implementation.
Zambia National HIV/AIDS/STI/TB Council	Broad-based corporate body with government, private sector and civil society representation. Mandated to coordinate, monitor and evaluate inputs, outputs and the impact of HIV/AIDS programmes and interventions. Supported by a National AIDS Council Secretariat, whose role is to implement Council decisions, including development of technical guidelines for coordination of multi-sectoral response.
Zambia National AIDS Network (ZNAN)	The membership of ZNAN works at the community level to mitigate the impacts of HIV/AIDS. The ZNAN membership has left the medical authorities to look at the health issues of the pandemic and concentrate on non-health effects through sensitization and economic empowerment. They target vulnerable groups who are supported in many ways, including income generating activities. These are weaned as their capacity improves, and other vulnerable people are taken on board.
Women for Change (WFC)	A Zambian gender focused NGO working with communities, especially women and children, in rural areas to contribute towards sustainable human development

	using popular education methodologies. Its programmes include, *inter alia*: Gender Analysis and Awareness Raising; Income Generating Activities; Advocacy; and HIV/AIDS Sensitization and Impact Mitigation.

Appendix 4: Main policy documents and legislation relevant to the ZNSS and SEA

Main Government policies, plans and programmes relevant to the ZNSS

Policy, Plan or Programme	Description / relevance to the ZNSS
Zambia Vision 2030	This vision document underpins the FNDP, and includes references to secure appropriate environmental sustainability policies and practices.
Fifth National Development Plan 2006-2010 (FNDP)	The FNDP provides a blueprint for the development of Zambia up to the year 2030. The FNDP has identified two critical areas for public spending: (a) strengthening the relevant economic and social infrastructure, especially roads, schools and hospitals; and (b) enhancing agriculture and rural development. Both of these are directly related to the sugar sector and the ZNSS. The FNDP also includes a series of Sector Plans including, *inter alia*, for: agriculture, infrastructures, natural resources, energy, health, water and sanitation and social protection. Any proposals to enhance the performance of the sugar sector should be consistent with the FNDP.
National Policy on Environment (2005)	The National Policy on Environment recognises six main areas of environmental concern: (1) Deforestation; (2) Wildlife depletion; (3) Land degradation; (4) Heritage destruction and loss of spiritual and cultural values; (5) Air pollution; and (6) Inadequate management of water resources, water pollution and inadequate sanitation. All of these components are relevant either because of their association to current activities in the sugar sector, or potential impacts of ZNSS implementation. The Policy also defines objectives and strategies specific to, *inter alia*, agriculture, the forest sector, wildlife sector, water and energy.
Environment and Natural Resources Management and Mainstreaming Programme (ENRMMP) (2008)	Programme aimed at improving co-ordination and implementation capacity to the environment and natural resource management sector, based on the FNDP. It consists of two components: (1) a capacity development component to build internal capacity of MTENR to lead policy development in ENR, and which will support mainstreaming of ENR in other government bodies; and (2) development and operation of an Interim Environment Fund that will finance key environmental investments. The ENRMMP may offer opportunities to address measures designed to enhance the environmental performance of the sugar sector and the ZNSS.
National Adaptation Programme of Action (NAPA) (2007)	Climate change may affect the performance of the sugar sector, and thus any strategy for the sugar sector should be consistent with the climate change adaptation challenges identified through the NAPA.
National Implementation Plans (NIPs) for the Management of Persistent Organic Pollutants (POPs) in Zambia (2007)	The NIP provides a framework for achieving compliance with the Stockholm Convention on POPs. As sugar cane burning emits a series of POPs, international commitments may have an implication on the regulation of cane burning practices.
National Energy Policy (2008)	The main objective of the Energy Policy is to create conditions that will ensure the availability of adequate supply of energy from various sources, which are dependable, at the lowest economic, financial, social and environmental cost with national development goals. The specific objectives relevant to the ZNSS are: • Environmentally sustainable exploration of the biomass resource through better management and introduction of new sources such as bio-fuels;

	• Expand generation (co-generation) and transmission capacity and also increase access to electricity; • Adequate, reliable and affordable supply of petroleum products at competitive and fair prices, and the reduction in importation costs (fuel blending and fuel additives), • Address barriers to widen dissemination of Renewable Energy Sources (RES) and also increase their deployment; • Reduce dependence on wood-fuel and ensure sustainable provision of affordable, reliable modern energy services (gel fuel) to rural and urban households as a means of reducing poverty and raising standards of living.
National Agricultural Policy 2004-2015	The policy stipulates the following objectives for the sector: • To ensure nation and household food security through dependable annual production of adequate supplies of foodstuffs at competitive cost, • To ensure that the existing agricultural base is maintained and improved upon, • To generate income and employment through increased agriculture production and productivity; • To contribute to sustainable industrial development by providing locally produced agro-based raw materials; • To increase agricultural exports thereby enhancing the sector's contribution to the national balance of payments. The strategies for attaining these policy objectives include, amongst others, the strengthening and monitoring of the liberalized markets, facilitation of the private sector development, and diversification of agricultural production, particularly among small-holder farmers. Other areas of focus are the review and realignment of institutions and legislative arrangements in support of the above requirements.
Biodiversity Policy (1999)	Developed by the GRZ after ratification of the Convention on Biological Diversity. The Government's mission is "to establish legal, policy and institutional frameworks and mechanisms that promote the conservation, management and sustainable use of Zambia's biological resources and the equitable sharing of benefits from the use of these resources by all sectors of the population". Guiding principles include: • Protection, conservation and sustainable utilisation of biodiversity are a responsibility of every citizen of Zambia; • All Zambians depend on biodiversity, should share responsibility for managing biological resources sustainably, and should benefit equitably from the use of biodiversity; • All Zambians should be encouraged to participate in decisions involving the use of biophysical resources, including air, water, land, plants and animals.
National Biodiversity Strategy and Action Plan (NBSAP)	Developed in fulfillment of commitments under the Convention on Biological Diversity. Its six main goals are to: • Ensure the conservation of the full range of Zambia's natural ecosystems through a network of protected areas; • Conserve the genetic diversity of Zambia's crops and livestock; • Improve the legal and institutional framework and human resources to implement the strategies for conservation, sustainable use and equitable sharing of benefits from biodiversity management; • Sustainably manage and use Zambia's biological resources; • Develop an appropriate legal framework and the needed human resources to minimise the risks of the use of Genetically Modified Organisms (GMOs). Full implementation of the NBSAP is, however, not been completed. It does not seem to be a guiding policy document.

National Forests Policy (1998) and Action Plan (ZFAP)	Forest policy objectives as detailed in the Zambia Forest Policy, the Forest Act of 1999 and the Zambia Forest Action Plan (2000) are to: • create and develop capabilities of women, children and men at all levels of government, the private sector and NGOs in the forest sector policy, planning, education, training, research and extensions; • improve the welfare of women, men and children living in rural and urban communities through equitable and complementary participation in sustainable forest management and utilization; • meet, on a sustainable basis, society's forest product requirements for sawn timber, fuel wood, poles, fodder and non-wood forest products; • increase the contribution of the forest sector to the national economy through the creation of both formal and informal employment for women and men engaged in the forest sector, and the export of forest products; • conserve forest ecosystems and biodiversity through sustainable management for the benefits of women, men and children of both the present and future generations; • protect major watersheds to ensure sustenance of overall surface and underground water, climate stability, maintenance of hydro-power supply, and other water-based ecosystems; and • support sustainable agricultural production and enhance food security through improved land husbandry. Due to slow progress in implementing the ZFAP, the Forest Department has initiated efforts to revise its objectives and goals to reflect and address emerging challenges, including mitigation and adaptation to climate change and the need to open up forest areas for ecotourism development (Kalinda *et al*, 2008). There is currently a draft Forestry Policy (October 2009).
National Water Policy (1994)	The National Water Policy of 1994 recognises the importance of water for public health, food production, industry, production of energy, natural environment and other important aspects that enhance the quality of life such as transportation, recreation and tourism. It aims at promoting sustainable water resources development with a view to facilitating adequate, equitable, and good quality water for all users at acceptable costs and ensuring security of supply under varying conditions. Amongst the key policy strategies relevant to the ZNSS are: • Recognizing the important role of the water sector in the overall socio-economic development of the country; • Promoting water resources development through an integrated management approach; and • Recognising water as an economic good. This Policy is currently being revised.
National Transport Policy, 2002	As a land locked country, Zambia depends heavily on roads and rail to transport inputs and outputs to markets within and outside the country. Objectives of the transport sector include, *inter alia*: • To pressure the investments that have been made in the transport and communications sector; • To develop and construct new infrastructure to link neighbouring countries and new areas of economic activity; • To promote intermediate forms of transport; • To strengthen the technical, institutional and managerial capacity in the management of roads.
Road Sector Investment Programme (ROADSIP) II	Ten-year programme (2002-2012) for roads development. Objectives of ROADSIP II include: • Rehabilitation/Periodic and routine maintenance of the core road network through various funding agencies; • Improve road conditions for Trunk, Main, District, Primary

	feeder roads, tourist roads and selected urban roads through full and accessibility improvements as per "need" and priorities; • Institutional strengthening of the construction industry through appropriate approaches; • Create employment opportunities through appropriate road intervention; • Improve environmental management by building capacity; • Improve rural transport mobility through road improvements; • Improve management of Community roads through the RDA; • Address poverty and HIV/AIDS countrywide and the National Policy on HIV/AIDS. This document is of direct relevance as the ZNSS includes a component on upgrading/development of roads.
National Gender Policy (2000)	The National Gender Policy aims to achieve the Government's vision of achieving full participation of both women and men in the development process at all levels in order to ensure sustainable development and attainment of equality and equity between sexes. It is implemented through the National Gender Strategic Plan, and the Gender in Development Department (GIDD) at Cabinet Office is the national implementing and co-ordinating body. Line ministries have a Gender Coordinating Point/Gender Focal Person. Gender Focal Persons are also available at provincial and district levels within the administrative structures.
National HIV/AIDS/STI/TB Policy (2002)	This policy is implemented through the National HIV/AIDS/STI/TB Strategic Intervention Plan 2006 – 2010. This was developed through a participatory and highly consultative process involving the Secretariat of the National AIDS Council (NAC), NGO stakeholders, and Government ministries and cooperating partners whose main aim was to guide the addressing of the HIV/AIDS epidemic. With a vision of a nation free from HIV/AIDS, its mission is to provide national leadership for a coordinated fight against HIV/AIDS in order to eliminate HIV/AIDS and associated opportunistic infections for the benefit of society. Its overall goal is to reduce HIV/STI transmission among Zambians and to reduce the socio-economic impacts of HIV/AIDS.
Irrigation Policy and Strategy	The overall objective of the National Irrigation Policy is to have a well regulated and profitable irrigation sector that is attractive to both private investors and Zambia's development partners through: • accessible, demand-driven institutions characterised by efficient, transparent procedures and a service oriented ethos; • regulated, stable, transferable and mortgageable water rights; • transparent, well regulated irrigation resources, goods and services; • affordable, appropriate accessible credit mechanisms; • functional, expanded access and communications infrastructure; • Zambia's market chain adding value to irrigated produce; • increased profitability of irrigated farming.

Environmental legislation relevant to the ZNSS

Piece of Legislation	
Environmental Protection and Pollution Control Act (No. 12 of 1990, amended 1999)	Establishes the Environment Council of Zambia and its functions. It also establishes the legal framework for the regulation of some environmental aspects that are directly relevant to the sugar sector: water discharges, air emissions, waste management, pesticides and toxic substances, and natural resources conservation. This Act is currently under revision.
Water Pollution Control (Effluent and Waste Water) Regulations, 1993 (Statutory Instrument No. 72 of 1993)	Establishes the licensing system for the discharge of effluents into the aquatic environment, including application, monitoring and reporting. As well its Third Schedule establishes Standards (limits) for effluents and wastewater. These regulations are relevant for discharge of effluents from the sugar mills into the aquatic environment, and eventually to the release of vinasse from any future ethanol plants.

Air Pollution Control (Licencing and Emission Standards) Regulations, 1996 (Statutory Instrument No. 141 of 1996)	Establishes the licensing system for atmospheric emissions, including application, monitoring and reporting. Its Third Schedule contains Long-Term Emission Limits for Air Pollutants by Type of Industry/Process; sugar mills fall under the category of "other processes", for which emission limits seem not to be specified. These regulations apply to stack emissions from the sugar mills.
Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997 (Statutory Instrument No. 28 of 1997)	Establishes the EIA process which informs development consent decision-making. Projects listed in the Second Schedule require an Environmental Impact Assessment (i.e. preparation of an Environmental Impact Statement – EIS), and those in the First Schedule a Project Brief (based on the Project Brief an Environmental Impact Assessment may be required). Many projects that may derive from implementing the ZNSS will require either a Project Brief or directly an EIA, for example: <u>Project Brief:</u> - Land consolidation schemes - Hydropower schemes and electrification - Projects located in or near environmentally sensitive areas <u>Environmental Impact Assessment</u> - Major roads outside urban areas, construction of new roads and major improvements over 10 km in length or over 1 km in length if the road passes through a national park, GMA - Railway lines, 10 km from built up area - Dams and barrages covering a total of 25 ha or more - Land clearance for large scale agriculture - Irrigation schemes covering an area of 50 ha or more - Aerial and ground spraying - Food processing plants of 400 tonnes or more output a year - Electricity generation stations - Electrical transmission lines of 220 kV and more than 1 km long
Hazardous Waste Management Regulations (Statutory Instrument No. 125 of 2001)	Regulations that apply to the control and monitoring of generation, collection, storage, transportation, pre-treatment, treatment, disposal, export, import and transboundary movement of hazardous waste. These Regulations are unlikely to be relevant for key environmental aspects of the sugar sector and/or the ZNSS.
Pesticides and Toxic Substances Regulations, 1994 (Statutory Instrument No. 20 of 1994)	These regulations are relevant to sugar cane cultivation insofar as they address the general handling, use and safety of pesticides and toxic substances. They are unlikely to be relevant for key environmental aspects in the sugar sector and/or ZNSS.
Water Act	This Act provides for the control, ownership and use of water, excluding that of the Zambezi, Luapula and Luangwa rivers, which form borders with other countries. It establishes the Water Board and regulates the use of public water, including protection against pollution of public waters. In 1994 the Government reviewed the Act and came up with a Water Policy which seeks to promote the sustainable use of water resources within the context of new economic policies. The Water Act is currently in the process of transformation into the Integrated Water Resources Management Act.
Energy Regulation Act, 1995	Establishes an Energy Regulation Board and defines its functions and powers; and provides for the licensing of undertakings for the production of energy or the production or handling of certain fuels. This Act is relevant to the ZNSS insofar as the ZNSS promotes co-generation of electricity to contribute to the national power grid.
Electricity Act	Regulates the generation, transmission, distribution and supply of electricity. This Act is relevant to the ZNSS insofar as the ZNSS promotes co-generation of electricity to contribute to the national power grid.
Forests Act, 1999	Establishes the Zambia Forestry Commission and defines its functions. It also provide for: the establishment of National Forests, Local Forests and joint forest management areas; the participation of local communities, traditional institutions, non-governmental organisations and other stakeholders in sustainable forest management; the conservation and use

	of forests and trees for the sustainable management of forest ecosystems and biological diversity; the implementation of the Convention on International Trade in Endangered Species of Wild Flora and Fauna, the Convention on Wetlands of International Importance, the Convention on Biological Diversity and the Convention to Combat Desertification. This Act is relevant insofar as new sugar cane cultivation areas, infrastructure projects and/or new settlements may have an impact on forest areas. This Act is currently under revision.
Lands Act, 1995	The Act vests all land in Zambia to the President who holds it in perpetuity for the people of Zambia. Under this Act, the President has the power to alienate land vested in him to any Zambian. However the President cannot alienate any land situated in a district or an area where land is held under customary tenure: a) Without taking into consideration the local customary law on land tenure which is not in conflict with this Act; b) Without consulting the Chief and the Local Authority in the area in which the land to be alienated is situated and in the case of a GMA, the Director General of Zambia Wildlife Authority, who will identify the land to be alienated; c) Without consulting any other person or body whose interest might be affected by the grant; or d) If an applicant has not obtained the prior approval of the Chief and the Local Authority with whose area the land is situated. The act gives guidelines on how to acquire land by both Zambians and non-Zambians.
Wildlife Act, 1998	Establishes the Zambia Wildlife Authority and defines its functions. It provides for, *inter alia*: the establishment, control and management of National Parks and for the conservation and enhancement of wildlife eco-systems, biodiversity, and of objects of aesthetic, pre-historic, historical, geological, archaeological and scientific interest in National Parks; the establishment, control and management of Game Management Areas (GMA); the sustainable use of wildlife and the effective management of the wildlife habitat in GMAs; enhancement of the benefits of GMAs both to local communities and to wildlife; to involve local communities in the management of GMAs; the development and implementation of management plans; the implementation of the Convention on International Trade in Endangered Species of Wild Flora and Fauna, the Convention on Wetlands of International Importance Especially, the Convention on Biological Diversity and the Lusaka Agreement on Cooperative Enforcement. This Act is relevant insofar as ZNSS promoted activities may affect protected areas and wildlife.
The Local Government Act – Act No. 22 of 1991	Provides for the establishment of Councils in districts and sets out the functions and administrative structure of local natural resources including responsibility for conserving natural resources, preventing soil erosion, controlling weeds, controlling local forest, operating sanitation services for refuse and effluent and establishing and maintaining drains and sewerage systems. Any sugar estate or out grower scheme will operate within the jurisdiction of the respective District Council.
Council By-Laws	District Councils are mandated under the Local Government Act to enact by-laws for the efficient administration of local authorities. This includes by-laws on levies which have a direct bearing on farmer activities. New sugar estates and/or out grower schemes may be affected by such levies.
Societies Act, Chapter 119 of the Laws of Zambia	Under the Societies Act Chapter 119, Society means any Club, Company, Partnership or other Association of ten or more persons, whatever its nature or objective formed or established in Zambia or having its headquarters or chief place of business in Zambia and any branch of such Club, Company, Partnership or Association. This piece of legislation would be relevant especially for mobilisation of smallholder farmers into groups/associations to reduce transaction costs in input and output marketing and provision of extension or general out-grower services.

Agricultural Credit Act	Out-grower schemes are governed under this Act. Out-grower schemes provide inputs on credit and receive payment in kind or cash as part of the crop output. They provide lending services according to the provisions of the Act and require mutual consent between lender and borrower. All agricultural loan collateral should be registered with the Registrar of Lands or on his behalf, with the District Agriculture Coordinator (DACO) at district level according to the provisions of the Act.

Appendix 5: Stakeholder engagement methodology

Scoping Stage

Stakeholder engagement is a key component of the SEA. During the Scoping Stage bilateral consultations were carried out with some of the key stakeholders (see list in Appendix 2), including stakeholders from Government institutions, the private sector and NGOs. The aim of the bilateral interviews was to clarify uncertainties with regards to the scope and intentions of the ZNSS and relevant policies and regulations, as well as to start gathering concerns with regards to the environmental performance of the sugar sector in Zambia and the potential environmental implications (positive and negative) of implementing the ZNSS.

Due to time limitations, and sometimes unavailability of persons, interviews could not be held with certain key stakeholders at the scoping stage. Such key stakeholders were targeted for bilateral consultations during the SEA Study phase.

To complement the bilateral interviews during scoping, a site visit was made to Consolidated Farming Ltd (sugar cane fields and sugar mill). This site was selected for the first visit since abundant literature already exists for Zambia Sugar (Nakambala Estate), and the other sugar factory – Kalungwishi Estates – was too far to accommodate in the time available for scoping.

SEA Study Stage

For the SEA Study stage, stakeholder engagement took place according to a combination of:

- *Bilateral interviews* with certain key stakeholders from Government institutions, civil society, NGOs and the private sector. These included, amongst others, key stakeholders not interviewed during the scoping stage.
- *Stakeholders' Workshop* to which all key stakeholders were invited (see Appendix 3 for preliminary list of participants), with the aim of exploring more in-depth the key aspects identified and alternative measures to minimise negative effects on the environment and optimise positive ones. The workshop was held on 14 October and background material (namely the scoping report excluding appendices, and the ZNSS Core Elements) was circulated beforehand to participants by the MCTI/EC. A draft Agenda for the workshop is presented in Appendix 4 below.
- The list of stakeholders invited was agreed with the MCTI, who also extended the invitations.

  The workshop followed a 'World Café' format, which allowed all participants to engage in discussions on each key aspect in a small group format. The 'world café' format consists of making general presentations of the key issues under discussion (in plenary) and the subsequent splitting into thematic tables. Each table discusses one key issue and has one facilitator; discussions last for approximately 15-20 minutes. After the initial 15-20 minutes are over, participants change tables, and discuss based on the preliminary findings of the previous group. This allows all participants to discuss all (or most) key issues in small groups; people that may not be inclined to contribute in plenary discussions dominated by a few (normally loud or reputable) voices, will normally be able to better contribute in smaller groups. Facilitators then synthesise discussions and findings and present them at the end of the day.
- *Site visits* – During the SEA Study site visits were organised to the Magobbo, Manyonyo and Kaleya out-grower schemes.

Appendix 6: List of stakeholders engaged or consulted

Scoping phase

Date	Time	Name	Organisation	Position
02-09-09	09.00	Ms Stephanie Rousseau	EC Delegation to the Republic of Zambia	Programme Officer, Sugar Accompanying Measures
03-09-09	14.30	Mr Temwani Chihana	National Authorising Office (NAO)	EDF Projects Coordinator
04-09-09	08.45	Mr Julius Shawa	Ministry of Agriculture and Co-operatives	Director, Policy and Planning Department
04-09-09	09.30	Dr Rainer Droste	MACO, Support to Agriculture Diversification and Food Security Programme in Western and North Western Provinces (SADFSP)	Team Leader
		Xavier Rouillard	GFA Consulting Group - SADFSP	Technical Advisor
07-09-09	09.00	Mr Andy Mondoka	MEWD, Water Resources Action Programme	Programme Manager
08-09-09	10.00	Mr Mwabwa	Centre for Trade Policy and Development	Director
08-09-09	11.30	Ms Elisabeth Ndhlovu	Finnish Embassy	Sector Advisor
09-09-09	14.30	Mr Arnold Simwaba	Department of Energy, Ministry of Energy and Water Development	Acting Principal Electrification Officer
		Ms Harriet Zulu	Department of Energy, Ministry of Energy and Water Development	Senior Energy Officer - Biomass
09-09-09	16.00	Mr Henry Sichembe	Ministry of Agriculture and Co-operatives	Deputy Director, Technical Services
11-09-09	09.00	Mrs Mutale Chiseche	Ministry of Tourism, Environment and Natural Resources	Chief Planning Office
11-09-09	11.30	Mr Happy Sikazwe	Water Board	Senior Water Resource Engineer
11-09-09	14.30	Mr Chris Mwasile	WWF	EU sugar project
		Mr Newton Moyo	WWF	Miombo Ecoregion project
11-09-09	10.00	Dr Alex Simwanza	Zambia National AIDS Council	Director, Prevention Multisectoral Response
11-09-09	11.30	Mr Geoffrey Kauseni	Zambia National AIDS Network	Director of Programmes
11-09-09	12.30	Ms Salome Nakazwe	Women for Change	Programme Officer
14-09-09	09.00	Mr Julius Daka	Environmental Council of Zambia	Manager – Planning & Information Management
14-09-09	10.00	Ms Suzane Rattray	Rankin Engineering Consultants	Socioeconomist, roads feasibility study
14-09-09	11.30	Mr Hillary Kumwenda	Ministry of Commerce Trade and Industry, Department of Foreign Trade	Economist – Multilateral Trade
14-09-09	14.00	Mr Wiseman Sangulube	Ministry of Tourism, Environment and Natural Resources, Forestry Department	Chief Extension Officer

14-09-09	14.30	Mr Excellent Hachileka	IUCN	Regional Coordinator – Climate Change
14-09-09	15.00	Mr Machwani	Kawambwa-Mushota-Luwingu Road SEA	Environmental Economist
15-09-09	12.00	Mr Essof Alloo	Consolidated Farming Ltd	Manager
		Mr Etweu Moyo	Consolidated Farming Ltd	Safety, Health and Environment Officer
		Mr Srinivasan	Consolidated Farming Ltd	Agronomist

SEA Study Phase

Date	Time	Name	Organisation	Position
06/10/09	10.00	Mr Julius Daka	Environmental Council of Zambia	Manager – Planning & Information Management
		Mr Patson Zulu	Environmental Council of Zambia	Manager – Inspectorate
		Ms Irene Lungu	Environmental Council of Zambia	Senior Information & Documentation Officer
		Mr Edwin Chipompo	Environmental Council of Zambia	Inspector Zone E5
		Ms Nancy Mushota	Environmental Council of Zambia	Inspector Zone E 1A
		Mr Constantino Mwembela	Environmental Council of Zambia	Inspector
		Mr Simon Zimba	Environmental Council of Zambia	Senior Technical Officer
		Mr Teddy Daka	Environmental Council of Zambia	Inspector Zone 4
07/10/09	14.30	Mr Vedad Alavian	Kalungwishi Estate Limited (Kasama Sugar)	Director
12/10/09	am	Mr Tison Hamaamba	Mazabuka District	District Commissioner
	am	Mr Alex Nonde	Ministry of Agriculture and Co-operatives, Mazabuka	
	am	Mr Tony King	Zambia Sugar	Agriculture Business Development Manager
	pm	Magobbo out-growers	Magobbo out-growers farmers association	(Site visit and meeting with all out-growers)
15/10/09	09.30	Mr Samuli Leminen	United Nations Development Programme	Programme Officer, Energy & Environment Unit
15/10/09	14.30	Mr Mehdi Mahjoub	European Commission	Engineering Advisor, Infrastructure Section
16/10/09	11.30	Mr Mushimbei Muliya	Road Development Agency	Principal Environmentalist Officer
09/11/09	09.00	Mr Happy Sikazwe	Water Board	Senior Water Resource Engineer
13/11/09	11.00	Mr Evans Sichikata	Manyonyo Water Users Association	Vice-Secretary
13/11/09	14.00	Mr Redson Sialwiindi	KASCOL	Small-holder Development Officer
13/11/09	15.30	Mr Solomon Njobvu	KASCOL	Estate Manager
16/11/09	09.00	Mrs Annelise Boysen	DANIDA (Royal Danish Embassy)	Counsellor, Development

OTHER APPENDICES

STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA) OF THE ZAMBIA NATIONAL SUGAR STRATEGY

WORKSHOP
14 October, 2009 – Taj Pamodzi Hotel, Lusaka, Zambia

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Appendix 8 Agenda for the Stakeholders' Workshop

Strategic Environmental Assessment for the Zambia National Sugar Strategy

Stakeholders' Workshop

14 October, 2009 – Taj Pamodzi Hotel, Lusaka

AGENDA

08.30 – 09.00	Registration of participants	
09.00 – 09.10	Opening	Principal Secretary, MCTI
09.10 – 09.20	Workshop objectives and dynamics	Dr Juan Palerm, SEA Team Leader
09.20 - 09.35	The Zambia National Sugar Strategy	Mr Hillary Kumwenda, MCTI
09.35 – 09.50	The EC's Sugar Accompanying Measures	Ms Stephanie Rousseau, EC Delegation
09.50 – 10.00	Overview of key aspects addressed in the SEA Study	Dr Juan Palerm, SEA Team Leader
10.00 – 10.15	Key Aspect 1: Water availability in the lower Kafue River basin	Mr Tonnis Sierevogel, SEA sugar sector expert
10.15 – 10.30	Key Aspect 2: Vinasse management, a challenge from ethanol production	Dr Juan Palerm, SEA Team Leader
10.30 – 10.50	COFFEE BREAK	
10.50 – 11.05	Key Aspect 3: Securing the positive effects of ethanol production and fuel blending, the policy and regulatory dimension	Mr Tonnis Sierevogel, SEA sugar sector expert
11.05 – 11.20	Key Aspect 4: Expansion of sugar cane expansion and its effects on deforestation	Dr Juan Palerm, SEA Team Leader
11.20 – 11.35	Key Aspect 5: Expansion of sugar cane expansion and its implications for food security	Mr Munguzwe Hichaambwa, SEA socio-economist expert
11.35 – 11.45	World Café dynamics	Dr Juan Palerm, SEA Team Leader
11.45 – 12.05	World Café: Round 1	
12.05 – 12.25	World Café: Round 2	
12.25 – 13.30	LUNCH BREAK	
13.30 – 13.50	World Café: Round 3	
13.50 – 14.10	World Café: Round 4	
14.10 – 14.30	World Café: Round 5	
14.30 – 14.50	COFFEE BREAK	
14.50 - 15.40	Reporting of discussion tables	Facilitators
15.40 – 15.55	Conclusions	Dr Juan Palerm, SEA Team Leader
15.55 – 16.00	Closing	Mr Hillary Kumwenda, MCTI

Appendix 9 Study methodology/work plan

The SEA methodology and work plan herewith presented corresponds to the original that was submitted in the tendering process, and which was used in the SEA. Minor changes were made according to the findings of the scoping study as described in the main text of the SEA Study report, but these did not alter the overall approach used, which is still faithful to that described below.

Methodology and Work plan

Strategic Environmental Assessment (SEA) is a tool used primarily to assess the potential environmental impacts of a policy, plan or programme in order to enhance its environmental performance. SEA relates to a strategic level of decision-making, and thus its findings and recommendations must be accordingly targeted at this level.

The sugar sector is intrinsically related to the environment, in relation not only to its field operations (e.g. water use, use of agrochemical products, sugar cane burning) and sugar cane processing (e.g. discharge of wash waters, atmospheric emissions), but also to other associated sub-sectors, including energy production, biofuels and transport. Any strategy for the development of the sugar sector, such as the Zambian National Sugar Strategy (ZNSS) and the support given by the EC through the Accompanying Measures for Sugar Protocol Countries (AMSP) merits an analysis of its links to the environment, in order to minimise potential negative impacts of the environment and optimise opportunities to improve their environmental performance.

Ideally an SEA should start as soon as the planning process begins. This is not the case here, where the ZNSS has already been agreed and even updated. However experience has shown that if the policy-makers are committed to the SEA process and have the willingness to improve the environmental dimension of their policies, then a late SEA can prove to be a useful tool to improve environmental sustainability. Care must and will be taken to ensure the SEA produces an analysis and recommendations oriented to policy elements which can be acted upon.

The SEA will be a focused exercise and analysis will strictly be kept at a strategic level in accordance to agreement with the EC and the GRZ.

The activities under the SEA can broadly be classified in three categories: desktop work (e.g. literature review, analysis, write-ups); consultations (including interviews and workshops) and travel (e.g. site visits). All three components are equally important and necessary. Ongoing interaction with stakeholders (including the GRZ and the EC) will be key to success.

The kick-off meeting (both at the start of scoping and the SEA Study) are key points in the SEA, in order to ensure there is a clear understanding of expectations and the approach to the SEA. For this reason it will be important that the kick-off meeting involves not only the EC but also representatives from the GRZ (e.g. MCTI, ECZ) who will be involved in managing the process.

Under the SCOPING STUDY, the first stage will be the review of policies, institutional set-ups, legislative framework and relevant studies. This will be done through a comprehensive (albeit focused) literature review as well as through targeted bi-lateral interviews to fill-in knowledge gaps. Broader knowledge of the sugar sector and its relationship to the environment will be provided by the international expertise present in the team, allowing a more critical analysis. This first stage will allow the team to have a clear picture of the framework under which the ZNSS has been developed and where it (together with the AMSP) will be implemented. It will provide an early indication of windows of opportunity (as well as possible obstacles) for environmental integration. Socio-economic considerations will also be addressed, normally to the extent that these issues are related to environmental aspects, but may address wider socio-economic aspects as agreed during briefing.

Bilateral interviews is proposed as the main approach to consultations during scoping. This approach allows having targeted interviews with key stakeholders (raising specific issues which may not be possible in a larger forum with a wider mix of stakeholders) and minimising 'consultation fatigue' (leaving larger workshops to the SEA Study phase). Interviews will be focused and semi-structured, allowing to integrate new elements into the interviews as the interviews develop. These interviews during scoping will be used primarily to: (a) explore the views of stakeholders with regards to the environmental performance of the sugar sector generally, and of the possible environmental implications of the ZNSS more particularly; and (b) to fill-in knowledge gaps on institutional settings, policy and regulatory framework.

Based on the literature review and the interviews, key environmental issues (of the ZNSS and AMSP) will be identified, i.e. the key elements of the sugar sector in general, and the ZNSS/AMSP in particular which are important from an environmental point of view. The environmental baseline and the 'zero alternative' (its projection to the future under the assumption of no-ZNSS implementation) will focus on these key aspects (although treating other –more minor- environmental aspects in lesser detail). During the scoping phase an identification will be made of the knowledge gaps to complete the environmental baseline and the 'zero alternative', and sources of information will be identified. Targeted questionnaires will be prepared and sent out to key interviewees in order to advance the compilation of the missing information. It will be preferable if such questionnaires are sent at finalisation of the scoping stage, in order to gain time and begin the SEA Study phase with as much information as possible.

Interviews during the scoping phase may imply travel to sugar areas in order to speak to key representative stakeholders who would not be available in Lusaka (e.g. farmers, sugar factory staff). As well, site visit(s) to sugar area(s) during scoping will take place in order to get a closer insight into the context (both field and factory operations). Due to time constraints and long distances it may not be possible to cover all current and potential sugar areas, so representative site visits will be organised and complemented with others to take place during the SEA Study phase.

The Scoping Report will be presented to the Steering Committee and relevant stakeholders, and later submitted for review. It will include a proposal on how the SEA Study will proceed, including allocation of resources.

The SEA STUDY phase will also comprise elements of desk-top work, consultations and travel. The establishment of the environmental baseline and the 'zero alternative' will mainly be desk-top work based on information compiled earlier, but specific interviews (face-to-face or telephone) may still be required.

A stakeholders' workshop will be organised in order to present the key environmental aspects identified and advance preliminary ideas on how they can be addressed in the context of the ZNSS/AMSP. The venue for the workshop will be carefully selected in order to ensure wide and representative participation. Key experts (e.g. from the GRZ) may be invited to make short presentations on some of the key issues identified. As well it will be desirable that the workshop is convened by the GRZ as part of 'their' SEA process. Invitations are to be widely distributed.

The objective of the workshop will be to validate the key environmental aspects identified and explore ways to address them (e.g. mitigation measures, indicators, environmental safeguards). In order to make best use of limited time, and allow more in-depth exploration of issues and solutions (including exploration of threats and opportunities), a 'world café' approach is proposed.

The 'world café' format consists of making general presentations of the key issues under discussion (in plenary) and the splitting in thematic tables. Each table discusses one key issue and has one facilitator; discussions last for approximately 20 minutes. After the initial 20 minutes are over, participants change tables, and discuss based on the preliminary findings of the previous group. This allows all participants to discuss all (or most) key issues in small groups; people that may not be inclined to contribute in plenary discussions dominated by a few

voices, will normally be able to better contribute in smaller groups. Facilitators then synthesise discussions and findings and present them at the end of the day.

The main obstacle in organising a 'world café' is securing sufficient facilitators, for which cooperation from GRZ/EC stakeholders will be invited.

More than one workshop may be organised if necessary and if time allows (e.g. to cover different geographical areas). Number and duration of workshops will be proposed during scoping and discussed early in the process. Early decisions will be necessary in order to carefully make all necessary logistical arrangements (e.g. securing venues, allowing stakeholders to organise assistance).

As well other site visits may be organised during the SEA Study as seen fit to see field and factory operations.

Based on all of the above the consultants will prepare their findings. Care will be taken to ensure all recommendations are made at a strategic level, prioritising areas where it is easier to act upon and where environmental benefits will be larger. Recommendations for the GRZ (to enhance the ZNSS and its implementation) and for the EC (to enhance the support programme to the ZNSS) will be differentiated, and will include analysis of the environmental soundness of proposed performance indicators.

The final SEA report will be presented to key stakeholders at the end of the process.

Appendix 10 Consultants' itinerary

Date	Activity
27 August	Start of the SEA. Documentation review
31 August	Start of Mission 1 (scoping study) Travel to Zambia (TL and Agronomist)
02 September	Briefing meeting with EC
03 September	Interview: NAO
04 September	Interviews: MACO
07 September	Interview: MEWD
08 September	Interviews: Centre for Trade Policy and Development; Finnish Embassy
09 September	Interviews: MACO, MEWD
11 September	Interviews: WWF, MTENR, Water Board, Zambia National AIDS Council, Women for Change
14 September	Interviews: Rankin Engineering Consultants, MCTI, MTENR, IUCN
15 September	Field Visit to Consolidated Farming (Kafue Sugar)
17 September	Presentation of findings of the Scoping Study to the sugar strategy Steering Committee, MCTI premises
18 September	End of Mission 1 for Agronomist – travel back to Europe
19 September	End of Mission 2 for Team Leader – travel back to Europe
27 September	Submission of Draft scoping report
04 October	Start of SEA Study and of Mission 2 Travel to Zambia (TL and Agronomist)
06 October	Interviews: ECZ
07 October	Interview: Kalugwishi Estates Ltd
11 October	Submission of final scoping
12 October	Site visit: Magobbo outgrowers Interviews: MACO (Mazabuka), Zambia Sugar, Mazabuka District Commissioner
14 October	Stakeholders' Workshop
15 October	Interviews: UNDP, EC (infrastructures)
16 October	Interviews: RDA End of Mission 2 for Agronomist – travel back to Europe
17 October	End of Mission 2 for Team Leader – travel back to Europe
11 October	Submission of final scoping
03 November	Start of Mission 3 for TL and Agronomist – travel to Zambia
06 November	Meeting with EC Delegation
09 November	Interview: Water Board
13 November	Site visit: Manyonyo outgrowers Interviews: Manyonyo Water Users Association, KASCOL
16 November	Interviews: DANIDA Presentation of findings to key stakeholders (EC, MCTI, ECZ) at EC Delegation premises
17 November	End of Mission 3 for TL and Agronomist – Travel back to Europe
29 November	Submission of draft SEA Study report

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Appendix 12 Curricula vitae of the consultants

TEAM LEADER

Name: Juan PALERM
Date of birth: 01 October 1971
Passport holder of: Spain
Education:

Institution (Date from - Date to)	Degree(s) or Diploma(s) obtained:
Imperial College (10/1995-12/1998)	PhD in Environmental Policy and Management
Imperial College (10/1994-09/1995)	MSc in Environmental Technology
University of Guadalajara, Mexico (01-09/1994)	Diploma in Environmental Management
ITESO University, Mexico (08/1989-06/1993)	Chemical Engineer

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Spanish	1	1	1
English	1	1	1
Catalan	1	1	3
Portuguese	2	3	
French	3	5	

Membership of professional bodies:
- Member section on SEA of International Association for Impact Assessment (IAIA) (1996 to date)
- Member of the OECD DAC SEA Task Team (2005 to date)
- Member of the ReCoMaP (Regional Coastal Management Programme, Indian Ocean) Regional Technical Advisory Panel (2008 to date)
- Visiting Research Associate, Centre for Tourism and Cultural Change, Leeds Metropolitan University (2008 to date)
- Journal of Environmental Assessment Policy and Management–Editorial Committee (2006 to date)

Selected relevant professional experience

Date	Location	Position	Description
03/2009	**Zambia**	**SEA expert**	**Preparation and facilitation of stakeholders workshop for awareness raising of SEA in sugar and roads sectors**
02-05/'09	Jamaica	Team Leader	**Strategic Environmental Assessment (SEA)** of the implementation of the Multi-annual adaptation strategy 2006-2015
09/2008	Costa Rica	SEA expert	Capacity-building and TA to IUCN Central America –on behalf of the Netherlands Commission for Environmental Assessment– on use of SEA for land use planning in Central America.
Fulltime: 05-12/'08 05/'05-03/'07 Ad hoc support: 05/2007; 12/2007; 01/2009	EU and Worldwide	Full-time member of the Helpdesk for Env Integration into EC Development Cooperation	Mainstreaming the Environment into EC Development Co-operation project provides assistance to EC on environmental integration in development co-operation. It included preparation of Handbook on Environmental Integration, training in Brussels and EC Delegations and provision of HelpDesk services. Trainings delivered by Dr Palerm in: Peru, Chile, Nicaragua, Dominican Republic, Colombia, Ukraine, Bolivia and Syria, and Brussels. Specific activities have included, amongst others: - Preparation of Sector Guidance Notes for integration of Climate Change in the EC's Mid-Term Review Process - Evaluation of effectiveness of SEA process for the Mauritius Multi-annual Adaptation Strategy to the Sugar Reform and preparation of case study as contribution to the OECD DAC's SEA Task Team process - Review of process and follow up of SEAs - Development of SEA effectiveness assessment framework - Representation of DG Aidco in OECD DAC SEA Task Team - Preparation of EIA Good Practice note for DG Aidco - Review and of various ToR for environmental integration projects - Design of SEA approach applicable to EC development co-operation, including model ToR and screening procedures - Review of degree of environmental integration into CSPs and NIPs

			- Design of framework for Country Environmental Profiles and model ToR for the EC - Design of an analytical framework for the assessment of the degree of environmental integration into EC CSPs and NIPs - TA in design and review of the SEA for the Maldives' Regional Development Plan, and assessment of the pilot experience - Assistance in the preparation of ToR for SEAs and CEPs - Quality review of various of Country Environmental Profiles - Specific training to EC staff and partner Governments on SEA, preparation of CEPs, environmental integration into CSPs and the international climate change regime
12/2007 to date	Honduras	SEA expert	**Technical Assistance and Training on Strategic Environmental Assessment** for Municipal planning processes in municipalities of Olancho and Choluteca.
08-11/'07	SW Indian Ocean	SEA expert	**Sustainable development of coastal tourism in the South West Indian Ocean: Strategic Environmental Assessment at National and Regional Levels project**
05-06/'07	General	SEA expert	Revision of **training course** on **Strategic Environmental Assessment**, for GTZ
02-05/'05	Venezuela	Team Leader	**Review of the Environmental, Health & Safety and Social Management System for Vinccler Oil & Gas**
09/'04-12/'05	Mexico	Advisor	**EIA for the "La Yesca" Hydroelectric Dam Project.** Advisor to management throughout the EIA process, developed overall methodology.
11/2002-01/2005	Mexico (Guadalajara)	Senior Researcher	Coordinating research projects in environmental policy and management, as well as lecturing in environmental policy planning and management to BSc, MSc and PhD students.
01/'04-04/'04	Mexico	Env expert	**Review of the Environmental Planning Process for Approval of the Arcediano Dam Project.** Review of the planning process to find alternative sources of drinking water for Guadalajara urban area, including the review of the Arcediano dam EIA.
01/'03-08/'04	Mexico	Team Leader	**SEA and Planning in Mexico.** Potential to develop an SEA system in Mexico. The project was based mainly on the analysis of the international best-practice as well as a case study on hydrological planning in the Lerma-Chapala watershed.
11/'02-02/'04	EU	Env expert	**Evaluation of Approaches to Integrating Sustainability into Community Policies (EC Secretariat General)**
08/'01-01/'04	Kazakhstan	TL for policy advice	**Support to the Oil and Gas Production and Transportation Sectors of the Republic of Kazakhstan**
1-10/03	Mexico	Team Leader	**Environmental Assessment of the Rio Blanco Watershed.**
04/'03-05/'03	Andean Countries	Key Expert	**Project for Enhancement of Tourism Sector in the Andean Community.** Focus on environmental sustainability indicators.
01-12/'02	EU-wide	Team Leader	**Land Use: Exploring the Scope for Action at the EU Level.**
06/'99-11/'02	Spain (Barcelona)	Head Int'l Env Consultancy	Project management for international environmental consultancy projects, mainly under contracts for donor agencies and the European Commission.
01/'00-05/'01	EU, accession countries	Key Expert	**Study on Current Regulatory Status in the EU Member States and the Applicant Countries Concerning EIA for Decommissioning of Nuclear Installations**.
01/'00-05/'01	EU and former accession countries	Key Expert	**SEA and the Integration of the Environment in Strategic Decision Making**. DG ENV project aimed at reviewing integration mechanisms and SEA procedures in all Member States (+ some non-EU countries) to define a European strategy for the integration of the environment in decision-making on policies, plans and programmes.
01-12/00	EU	Team Leader	**Guidelines for the Evaluation of Environmental Claims according to International Standard ISO 14021:1999**
09/'95-12/'98	Hungary, Spain	Researcher	Research project developed a theoretical analytical framework for public participation in EIA, focusing on Central and Eastern Europe and the EU.
10/'94-12/'98	UK (London)	Research Associate	Research in EIA, SEA and public participation in environmental decision making, with a strong emphasis on Central and Eastern Europe.
03/'97-06/'97	Switzerland (Geneva)	Intern	Assistance to the Secretariat during the negotiations for the Aarhus Convention on access to environmental information, public participation in environmental decision making and access to justice in environmental matters.
06-08/95	Czech Rep, Romania	Researcher	**EIA in Central and Eastern Europe, analysis of the Czech and Romanian cases.**

AGRONOMIST / SUGAR SECTOR EXPERT

Name: Tonnis Jan SIEREVOGEL
Date of birth: 18 December 1942
Nationality: Dutch
Education:

Institution	Degree(s) or Diploma(s) obtained:
Agricultural University, Wageningen, The Netherlands 1969 – 1969	Post-graduate – Advanced studies in Irrigation and Drainage of agricultural lands
Institute for Tropical and Subtropical Agriculture, Deventer, The Netherlands 1964 -1965	MSc Soil Science and Tropical Crops
Institute for Tropical et Subtropical agriculture, Deventer, The Netherlands 1961 -1964	BSc Agronomy and Tropical Agriculture

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
Dutch	1	1	1
English	1	1	1
French	1	1	1

Selected relevant professional experience

Date	Location	Position	Description
2008-2013	Tanzania	Outgrower consultant	**CFC/ISO East African Sugarcane Improvement Project –** Responsible for providing annual short-term inputs to support research and development activities within the East African Community (EAC) Sugar Industry.
2007 - 2008	Madagascar	TL/ Agro-Economist	**EU Framework contract** – Study of the Rehabilitation of the Agricultural Infrastructure and possibility of Extension of Production area of the existing **Sugar Complexes of Ambilobe and Brickaville**, Madagascar.
2007	Tanzania	TL / Agro-Economist	**EU Framework contract - Restructuring the Sugarcane Research and Training Institutes in Tanzania.** Responsible for leading a team of multidisciplinary consultants analysing and reforming the research and training services in the sugar industry.
2006 - 2007	Zimbabwe	TL / Agro-Economist	**EU Framework contract** - Preparation of an **Adaptation Strategy for the Sugar Industry of Zimbabwe.** Responsible for leading a team of consultants to assess the impact that the ending of EU preferences had on the sugar industry and to identify new market opportunities for the sector.
2006	Cote d'Ivoire	TL / Agro-Economist / Agronomist	**EU Framework contract -** Preparation of an **Adaptation Strategy for the Sugar Industry of Cote d'Ivoire** to assess the impact that the end of EU preferences had on the sugar sector and to identify new market opportunities.
2006	Malawi	TL / Agro-Economist	**EU Framework contract -** Preparation of an **Adaptation Strategy for the Sugar Industry of Malawi** following changes to the EU preference system. The main aim of the project was to identify the impacts on the sugar sector and to identify new market opportunities.
2002 – 2005	Ghana	Senior Project Consultant	Responsible for the formulation, development, design and implementation of a 3,000ha irrigation project designed to improve food security and self-sufficiency for communities on the left bank of the Volta River. Specific activities included designing, managing and implementing a **Strategic Environmental Impact Assessment**.
2003	Burundi	Sugarcane Agronomist	**Rehabilitation and expansion of Societé Sucrière du Moso (SOSUMO).** Member of a team of consultants responsible for undertaking an evaluation of SOSUMO and for preparing proposals for extension of the sugar complex, including both industrial processing facilities and agricultural production. Activities undertaken included an **analysis of labour requirements and characteristics**; **a review of agricultural sugar production and industrial processing; an assessment of the environmental impact of the development;** and the production of a series of recommendations for capacity, human resource and processing improvements.
1997 - 2002	Ghana	Project Manager	Responsible for the provision of institutional strengthening, capacity building support and technical assistance to the Kpong Irrigation Project. Main Duties included managing a 3,000ha irrigation scheme to support small scale farmers, providing food security policy and operations support to the Government of Ghana, and the **design, development and implementation of Environmental Impact Assessments** on the project.

1997	Chad	Agronomist	**Agronomist specialist** in a multidisciplinary team of consultants responsible for investigating options for the **Privatisation of the Chad Sugar Industry: Evaluation of the potential of existing sugar estates.** Prepared a series of recommendations for privatisation, including a review of labour requirements and characteristics, **processing reforms** and modernisation, an assessment of environmental impacts and costs for private investors
1997	Cameroon	Agronomist	**Member of a team of consultants** evaluating the SOSUCAM sugar estate to support the privatisation process.
1996	Uganda	Team Leader / Agronomist	Researched and produced the **Mid-term evaluation of the second phase of the Uganda Smallholder Tea Industry Rehabilitation programme**.
1995 - 1996	Uganda	Team Leader / Agronomist	Responsible for managing Phase 1 and 2 of an Agricultural Development Options project for smallholder farmers in the South Bugosa Region. Duties included managing a multinational and multidisciplinary team of 8 consultants; overseeing an evaluation of smallholder economic diversification options; the formulation of an implementation programme; and the **production of a final report**.
1993 – 1995	Sierra Leone	Team Leader and Project Manager	Responsible for leading and managing the Farmers Association Support Programme (FASP), an Integrated rural development project to support local farmer's associations.
1990 – 1993	Uganda	Team Leader and Training Specialist	Responsible for leading a team of consultants on an evaluation and capacity building project to improve human resources and staff capacity at the **Kakira Sugar Works**. Duties included **analysing internal labour processes and characteristics;** developing staff training courses and supporting materials; undertaking trainer training; and the **development of new labour management and staff processes.**
1989 – 1991	Burundi	Project Manager and Agronomist	Responsible for providing institutional development and capacity building support for the local management team implementing an integrated rural development programme.
1989	Congo	Training specialist	Human resource development of the agricultural section of the **SOSUCO Sugar Complex.** Responsible for implementing an in-depth **review into the existing labour characteristics within the organisation**. Specific duties included the identification, development and management of training and capacity building resources, including guidelines and manuals, to enable more effective and productive use of human resources within the sugar production process.
1987	Benin	Support Agronomist	**Agronomic support for a Technical Assistance programme for the Societe Sucrier de Save**
1985 – 1987	Côte d'Ivoire	Senior Agricultural Adviser	Provided agricultural technical assistance for Estate Managers and Head Office staff in SODESUCRE, Ferke II Complex
1985	Sudan	Agronomist	Responsible for undertaking a full **Technical Evaluation of the Sudanese Sugar Industry**. Activities undertaken included an **environmental impact assessment**, an evaluation of **agricultural capacity constraints**, **labour resources and capabilities**, and an analysis of financial implications.
1978 – 1988	Various countries	Various Team Leader and Agronomist positions	Employed on various short-term and long term projects as Team Leader, Project Manager and Senior Agronomist, including: • **Management of the Nosy-Be Sugar Complex** in Madagascar • **Crop diversification feasibility study for the north-western part of Madagascar's mainland** • **Evaluation of study report concerning the counties sugar industry** in Bangladesh • **Agricultural and Training Adviser** responsible for UK-based technical Sugarcane support and project management.

SOCIO-ECONOMIST

Name: Munguzwe HICHAAMBWA
Date of birth: 13 February 1963
Nationality: Zambian
Education:

Institution	Degree(s) or Diploma(s) obtained:
University of Zambia, 1993 - 1995	Master of Agricultural Sciences
University of Zambia, 1983 - 1988	Bachelor of Agricultural Sciences

Language skills: Indicate competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
English	1	1	1
Tonga	1	1	1
Nyanja	3	3	3
Bemba	3	3	3
Lozi	3	3	3

Membership of professional bodies: Farming Systems Association of Zambia (FASAZ)

Selected relevant professional experience

Date	Location	Position	Description
2005-date	Zambia	Research Fellow	Responsible for undertaking socio-economic studies and reviews of horticultural value chains. Activities undertaken include: • **Designing, implementing, collating and analysing participatory rural and stakeholder socio-economic surveys;** • **Staff capacity building in research and data collection techniques;** • **Supervision of data entry and analysis;** • **Production of rapid appraisal report** of domestic market channels; • Monitoring and Analysis of the Living conditions monitoring survey of the central statistical office expenditure and other related data; and • Designing, testing and development of fresh produce price and market information systems in Zambia's urban areas
2007	Zambia	Consultant	Responsible for **monitoring socio-economic data** relating to food security issues. Specific activities included monitoring food security issues in the Fifth National Development Plan (FNDP) and in District plans. Produced a series of recommendations to improve the monitoring frameworks under the FNDP.
2006	Zambia	Consultant	Community Markets and Conservation (COMACO) Project. Responsible for the design of socio-economic research tools and guidelines to support data collection and analysis for a **Livelihood Baseline Survey**. Specific duties included the development of qualitative survey tools and systems, undertaking data collection, data analysis and processing, and production of a final report.
2006	Zambia	Consultant	Responsible for providing specialist socio-economic, and statistical analytical support for a series of **Impact Assessments** for food security projects.
2006	Zambia	Consultant	Responsible for the design, development and implementation of **Monitoring and Evaluation systems** for agricultural programmes under the FNDP.
2006	Zambia	Consultant	**Socio-Economist** responsible for monitoring, analysing and validating the poverty reduction impact of the **Irrigation and Smallholder Markets** (PRISM) project. Working with a team of consultants, responsible for undertaking a range of socio-economic surveys, **stakeholder workshops and consultations**, field trips and data collection**.**
2005	Zambia	Consultant	Responsible for the preparation and production of a training manual and guidelines for MS Zambia Partner organisations.
2005	Zambia	Consultant	Responsible for **organising and managing a stakeholder workshop** for the Disaster Management and Mitigation Unit (DMMU). Other duties included the development of workshop materials, including a draft Disaster Management Operation Manual and the Drought Code.
2005	Zambia	Consultant	Member of a team of multi-national consultants, responsible for undertaking an **appraisal** of the **Programme for Luapula Agricultural and Rural Development (PLARD) programme.** Activities undertaken included implementing a series of **rural appraisals, stakeholder consultations and workshops,** field trips, monitoring and evaluation of on-going projects, and donor reporting.
2005	Zambia	Consultant	Responsible for carrying out a terminal evaluation of the Smallholder Markets creation project.

2005	Zambia	Consultant	Responsible for carrying out a feasibility/viability appraisal of commercial Farm blocks in Zambia. Activities included producing a case study of the Nansanga Farm Block; undertaking **stakeholder consultations**; and the production of a series of programme options and recommendations.
2005	Zambia	Consultant	Prepared a quantitative data analysis procedure and tool kit to support a Food and Crop Assessment Survey.
2005	Zambia	Consultant	Prepared a quantitative data analysis procedure to support development and promotion of conservation techniques in local farming.
2005	Zambia	Consultant	Responsible for carrying out an **Impact Assessments** of food security projects funded by Harvest Help. Projects assessed included: the Kaoma Rural livelihood project, the Ipongo Development Project, the Naluyanda Rural Livelihood Project, and the Chikwanda Mukungule Initiative for Poverty Reduction programme.
2004	Zambia	National Consultant	**HIV/AIDS Rural Livelihoods and Gender Inequality - The Impact of HIV/AIDS on Rural Livelihoods in Northern province**: Responsible for undertaking an analysis of non-health **socio-economic impacts of the HIV/AIDS** pandemic on rural communities at both community and household level using the sustainable livelihoods approach and by employing both qualitative and quantitative techniques.
2004	Zambia	Consultant	**Forest Resources Management Programme Socio-Economic Survey** – Responsible for **training project staff** in SEAGA. Activities undertaken included training in qualitative and quantitative survey techniques; data analysis; data entry and cleaning; and report writing. All the training was organised through **a series of practical workshops** for participants.
2004	Zambia	Consultant	Responsible for carrying out **Socio-Economic and Gender Analysis Training** for the **Forest Resources Management Project**.
2003	Zambia	Consultant	Responsible for carrying out an analysis of the inter-linkages of **HIV/AIDS, Gender/Rural Youths, Information Management and Environment -** a qualitative and quantitative assessment of the impacts of HIV/AIDS on household and community livelihood assets.
2003	Zambia	Consultant	Responsible for developing coping mechanisms and undertaking **Impact Assessments** of food security projects.
2003	Zambia	Associate Consultant	**Strategic Environmental Impact Assessment of the Kafue River Basin –** Led a team of researchers that conducted a socio-economic survey of selected areas of the basin.
2003	Zambia	Consultant	Responsible for carrying out a qualitative/participatory assessment of wetland utilisation in Zambia looking at: (i) Basic dambo utilisation including historical use, current agricultural requirements, potential conflicts over access, and changes in resource utilisation; (ii) Socio-economic impacts of dambo resource utilisation; and (iii) **Environmental impacts** of dambo utilisation covering variations in natural characteristics of dambos over time, local knowledge on use of dambos, and community regulations on use of the dambos
2003	Zambia	Consultant	Responsible for organising and managing **stakeholder and beneficiary workshops** on Organic Farming and Marketing, and the Post – World Summit on Sustainable Development.
2003	Zambia	Consultant	Responsible for carrying out **mid-term evaluations** of the People's Participation Service Rural Livelihood Improvement programme and Young Women Christian Association Rural Livelihood Improvement programme.
2002	Zambia	Consultant	Part of team responsible for carrying out **Mid-term Evaluations** of the World Vision Integrated Agro-Forestry project and the CLUSA Natural Resources Management Programme
2001	Zambia	Consultant	Responsible for undertaking a Livelihood Assessment and Strategy Planning for Chikwanda –Mukungule Development Programme
2001	Zambia	Associate Consultant	Member of a team of Consultants that carried out an **Evaluation and Assessment for Sector Performance Analysis of the Agricultural Sector Investment Programme (ASIP)**
1999	Zambia	Consultant	Responsible for carrying out an **Impact Assessment of the 1998/99 Relief Food Programme in Zambia**
1997	Zambia	Consultant	Responsible for carrying out a follow up study to the 1995/96 Study of the Effects of and Responses to the 1992 drought in Zambia
1997	Zambia	Consultant	**Participatory socio-economic constraint analysis** of irrigation and liming demonstrations in two districts of Zambia

Appendix 13 Terms of Reference

Request for Services Lot 6 – 2009/209-305/2

Specific Terms of Reference

Strategic Environmental Assessment (SEA) of the Sugar Sector in Zambia

1. Background

The Government of the Republic of Zambia (GRZ) and the European Commission (EC) require a Strategic Environmental Assessment (SEA) to be carried out for the support of Zambian National Sugar Strategy (ZNSS) and for the implementation of the EC 'Accompanying measures for Sugar Protocol Countries' (AMSP).

Although Zambia is in the process of developing its SEA regulatory framework and methodologies, the Environmental Protection and Pollution Control Act of 1990 and the subsequent 1997 regulatory legislation incorporates a large body of guidelines, standards, processes and regulations, including at the Environmental Impact Assessment (EIA) level.

The main policy, planning and programming documents at national level relevant to appraise the development of the sugar sector and its relationship to the environment include:

- the Fifth National Development Plan (FNDP) (December 2006),
- the National Policy on Environment (May 2005),
- the Formulation of the National Adaptation Programme of Action on Climate Change (September 2007)
- the Country Environmental Profile (CEP, 2006),
- the National Energy Policy (2008),
- the 2008 'Environment and Natural Resources Management and Mainstreaming Programme' developed by the GRZ,
- the Zambian National Sugar Strategy (2006).
- the EC funded 'Accompanying measures for Sugar Protocol Countries' - Annual Action Programme 2007 for Zambia (€ 6,000,000),
- the Accompanying Measures for Sugar Protocol Countries – allocation 2006 (€ 562,000).

The Zambian National Sugar Strategy, developed in 2006 and revised in March 2008, has defined key objectives for the sector:
(1) to increase the contribution of the sugar sector to Zambia's socio-economic development;
(2) to increase the level of value-added in country to sugar and its by-products;
(3) to improve the export infrastructure that supports the sugar, and other export orientated sectors.

To support the Zambian National Sugar Strategy, the overall objective of the Annual Action Programme 2007 for Accompanying measures for Sugar Protocol Countries is to increase the sustainability of the sugar sector and its contribution to Zambia's socio-economic development. The specific objective of the programme is to support the expansion of sugar production and sugar products export volumes achieving a significant increase in permanent employment in the sugar sector. Three main results are expected from the ZNSS:
(1) Establishment and expansion of outgrower schemes in sugar-production areas are facilitated;
(2) Competitiveness of Zambia's sugar products is improved by reduced transport costs;

(3) Policies and regulatory environment related to sugar sector strategy are implemented.

An SEA is specifically planned to evaluate possible negative environmental impacts of the ZNSS and foresee control measures to mitigate them.

The implementation of the ZNSS has the potential to affect the environment, in a negative or positive manner. As well, it also has the potential to address the environmental sustainability challenges that the sector faces. This SEA will help discern these relationships and identify ways to minimise the negative effects and optimise the positive ones.

The SEA conclusions and recommendations will also be fully applicable at the sector level and for the future 2011-2013 Accompanying measures for Sugar Protocol Countries.

The Ministry of Commerce, Trade and Industry (MCTI), on behalf of the GRZ, will lead the SEA process, together with the technical support of the Ministry of Tourism, Environment and Natural Resources, especially the Environmental Council of Zambia. The Sugar Accompanying Measures Steering Committee (see composition in the Steering Committee Terms of Reference in Appendix 3) **will facilitate and coordinate the SEA process. The EC will be the Contracting Authority.**

This SEA will be complementary to two other SEAs funded by the EC in 2009 in the road sector and the agriculture sector.

2. Objectives

The objective of this SEA is to describe, identify and assess the likely significant effects that the ZNSS may have on the environment. It will also assess the degree to which the ZNSS addresses the major environmental sustainability challenges in the sector. The SEA will provide recommendations at a strategic level on how potential negative effects can be minimised and how positive effects can be optimised. Findings and recommendations will be taken into consideration for the implementation and the review of the Strategy and the Accompanying Measures.
The SEA will provide decision-makers in Zambia, the EC and other Cooperating Partners (CPs) with relevant information to assess the environmental challenges and considerations with regards to the National Sugar Strategy, the implementation of AMSP 2007-2010 as well as the design of AMSP 2011-2013. It is anticipated that the findings of the SEA will also influence policy development in the sugar sector.

This information should help to ensure that environmental concerns are appropriately integrated in all sector decision-making, implementation and monitoring processes.

3. Results

The SEA is composed of two parts: a scoping study and an SEA study.

The scoping study will define the issues that will be the focus of the SEA study, considering the specific context in which the sector programme is being developed and is likely to be implemented. The activities and calendar for the SEA study will thereafter be determined on the basis of the conclusions of the scoping study.

Given the cross-sectoral nature of the Sugar Industry and its complex interaction with the environment, considerable care will be needed to ensure that the outputs of the scoping study

match expectations and environmental needs. Temporal issues also need consideration to ensure that future developments (positive or negative) are foreseen, or provided for wherever possible.

The interval between the scoping study and the SEA study should be of **two weeks**.

The SEA scoping study will deliver the following results:

i. a description of the ZNSS and AMSP 2007-2010 and any relevant adjustments;
ii. a brief description of the institutional and legislative framework of the Sugar Sector, including its interactions with Agriculture, Commerce, Trade and Industry, Energy and Water Development, and Communications and Transport;
iii. a brief presentation of the relevant environmental policy and objectives in the country (taking into account the information provided in the CEP and more recent reporting);
iv. an identification of the key stakeholders and their concerns (with regards to the environmental sustainability of the sector and the potential implications of ZNSS implementation);
v. an identification of the key current environmental concerns of the sugar sector (field operations and cane mills);
vi. a preliminary identification of the key environmental impacts that ZNSS and AMSP 2007-2010 implementation may have on the environment;
vii. based on the key concerns identified, a description of the scope of the environmental baseline to be prepared and the main sources from which the baseline will be compiled;
viii. an identification of the impact identification and evaluation methodologies to be used in the SEA study;
ix. a description of the stakeholder engagement mechanisms proposed for the SEA study;
x. an indication of the time frames, and resources needed to carry out the SEA study.

The SEA study will deliver the following results:

i. an environmental assessment of the ZNSS and AMSP 2007-2010, taking into account the potential environmental impacts of its implementation, the degree to which it addresses the key environmental concerns of the sector, and its consistency with Zambian environmental policies and objectives;
ii. strategic recommendations for the implementation and review of the ZNSS and the associated AMSP 2007-2010, as well as for the AMSP 2011-2013 formulation and for sector programme enhancement. Recommendations to the GRZ for enhancement of the ZNSS's environmental performance, and to the EC for the environmentally-integrated formulation of its support strategy will be differentiated. The recommendations will include performance indicators, as well as possible accompanying measures to deal with identified weaknesses, notably in the area of capacity development.

4. Issues to be studied

4.1 Scoping study

4.1.1 Overview of the sector programme and its institutional and legislative framework

The consultants must provide a general description of the ZNSS and the AMSS.

A description must be made of the sector programme's institutional and legislative framework, including the institutions responsible for the implementation of the sector programme, for the management of its environmental impacts and for the SEA process.

A general description must be made of the relevant environmental and sectoral policy, legislation and institutions. As the sugar sector, in the context of this SEA, covers field operations, sugar cane processing, energy production and ethanol production, the review of institutional and legal framework should address these sub-sectors.

The specific policy-making and planning decisions and processes that should/could be influenced by the SEA must be identified.

An overview must also be given of the wider policy framework related to the sector programme in order to identify other planning or policy documents which will need to be explored in the SEA study. The National Energy Policy is of particular relevance and any regulatory documentation that may be developed to support its implementation. It is recommended that the consultant also examines recent sugar sector EIAs to familiarise themselves with current field issues.

A *'Study to examine the availability of water resources for the expansion of sugar cane production in Zambia in the context of competing uses for hydropower and other users'* has been completed by COWI in April 2009. Relevant conclusions and recommendations of this study should be considered.

4.1.2 Description of key stakeholders and their concerns

The involvement of stakeholders in the SEA process is a key success factor. The consultants should identify key stakeholders (key groups and institutions, environmental agencies, NGOs, representatives of the public, private sector), including those groups potentially affected by the likely environmental impacts of implementing the ZNSS. Particular emphasis should be given to all the actors along the sugar value chain.

The consultants must review the records of any national public consultation processes that may have taken place as part of the sector programme preparation process. Based on this review and on a stakeholder analysis, they should propose a gender-balanced list of stakeholders to be engaged. They should identify key stakeholders' concerns and values with respect to the sector programme under consideration.

The stakeholder engagement strategy to be employed has to be agreed with the GRZ and the EC before being implemented in order to avoid unnecessary conflicts or raise expectations. The strategy should provide stakeholders an opportunity to influence decisions. If the public is not used to being engaged, particularly at the strategic level, and if there are no precedents, it would be important to include an education component in the stakeholder engagement process. This could actively promoting participation; emphasising, at the start of participatory processes (e.g. workshops) the importance and value of public participation; and actively seeking involvement of key stakeholders that were absent in previous participatory fora.

The consultants will have to ensure wide participation, but at the same time have to consider the possibility of participation 'fatigue'. The willingness of key stakeholders to participate in workshops and interviews in repeated occasions should be taken into account, and preference should be given to less, but more focused and strategically planned workshops in key stages of the process.

Currently, sugar is produced in three main areas that should be the focus for the stakeholder analysis: Mazabuka, Kafue and Kasama in Northern Province. In the context of future development other potential areas of sugar production expansion, such as the government's

identified northern farming blocks in the Kalungwishi and Chambeshi catchments, and possibly the Kariba shoreline should also be considered. Key stakeholders should be identified, especially targeting directly affected and vulnerable groups as well as key stakeholders that may not have been adequately represented in the sector programme preparation. Records must be kept of all consultations and comments received.

The outcome of these consultations will have important implications for the direction and focus of the SEA study. Consequently, a structured analysis of available material will be needed to determine the key conclusions and areas of concern.

4.1.3 Description of key environmental aspects to be addressed in the SEA

On the basis of the policy, institutional and legislative framework analysis, as well as stakeholder consultations, the consultants must identify the key environmental issues in the sugar sector, as well key potential environmental impacts of ZNSS implementation (i.e. key ZNSS-environment interactions). These aspects should be addressed in details the SEA study.

Specific aspects to be explored include: water management (water availability and water use efficiency), water pollution from use of agrochemical products, soil conservation/erosion, alternative land uses, waste water discharges, atmospheric pollution (stack emissions and cane burning), management of vinasse from ethanol production; biodiversity, clean energy production technologies (bagasse-coal based electricity co-generation, ethanol production, fuel gel production), expected effects of climate change.

Depending on expected impacts on society and the scope of other studies, there is also a need to determine to which extent social impacts should be assessed; issues of HIV/AIDS associated to workers' migratory dynamics and resettlement issues should be considered. In this case, impacts on humans should be disaggregated according to sex, age, or other relevant social criteria.

4.1.4 Description of the scope of the environmental baseline to be prepared in the SEA study

The consultants must provide indications on the scope of the environmental baseline needed for the SEA study, taking into account that the environmental baseline must provide a general description of the state of the environment but a more detailed description of the key issues identified in the previous step. The consultants will give particular attention to the existing sugarcane cultivation areas as well as to the new potential areas. The scope of the baseline study should be elaborated in detail to: 1) enable effective budgeting and 2) to demonstrate it is cost-effective.

The information and data needed to complete the environmental baseline (including associated pressures and trends) must be identified, giving an indication of the likely sources where this information/data may be obtained. As well, information/data which is likely to be difficult to obtain, either because it may never have been generated or access may be difficult, should be pointed out.

4.1.5 Recommendations on specific impact identification and evaluation methodologies to be used in the SEA study, as well as for stakeholder engagement

The consultants should provide an indication of the impact identification and evaluation methodologies that will be used in the SEA study. Special attention should be given to identifying those environmental interactions that will merit quantitative analyses and those for which qualitative analyses should be carried out.

Any particular mechanisms for stakeholder engagement, which are a deviation from the initially agreed stakeholder engagement strategy should be described.

4.1.6 Review of the time frames and resources needed to carry out the SEA study

The Team Leader, in coordination with the rest of the team, may review/adapt the initial time and expertise to complete the SEA study, and develop a schedule of resources needed, including:

- person-days of technical input for each of the experts;
- operational support costs, including participatory processes and special technical inputs (workshops, group participation training);
- any special mapping or data collection costs; and
- the Consultant's team operating costs (out-of-town transport, accommodation, etc.).

The financial impact of the proposed review shall be limited to a transfer within the fees, or between the fees and reimbursable, involving a variation of less then 15% of the original amount of the contract. In that case, the changes will be agreed upon in writing (administrative order) and do not require an addendum to the contract.

The draft Scoping Study report will be presented to the GRZ, the EC and relevant stakeholder in a workshop at the end of the scoping mission.

4.2 SEA study

The scope of the SEA study will be agreed with the GRZ and the EC on the basis of the results of the scoping study. The SEA study will include:

i) An environmental baseline study;
ii) An identification of environmental opportunities and constraints;
iii) An identification and assessment of potential environmental impacts;
iv) An analysis of performance indicators;
v) An assessment of institutional structures and capacities, and of the policy and regulatory framework, to address environmental challenges;
vi) Conclusions and recommendations (for the ZNSS and AMSP implementation/reformulation/improvement).

4.2.1 Environmental baseline study

A description and appraisal must be made of the current state of the environment in relation to the sugar sector, focusing on those key environmental components identified by the scoping study (but giving also a general account of other non-key factors). The pressures acting on the key environmental aspects must be identified as well as the trends, and a projection must be made of the state of the environment for the key issues on the short-, medium- and long-term in the assumption of no implementation of the ZNSS (i.e. the 'zero' alternative). External factors must be taken into account, including the influence of other sectoral policies and the potential effects of climate change.

If the "no implementation" scenario is unrealistic the most probable "business as usual" scenario should be selected. The geographical (or mapping) units to be addressed should be described, if relevant.

4.2.2 Identification and evaluation of environmental opportunities and constraints

The effects of the current state of the environment (especially with regards to the key environmental issues identified) on the effectiveness, efficiency and sustainability of the sugar sector and the proposed ZNSS must be described.

An analysis must be made of the degree to which the ZNSS addresses these issues, i.e. foreseeing and addressing negative environmental aspects that affect the sector and making optimal use of opportunities offered by the environment to enhance sector performance.

A matrix approach is suggested to illustrate the findings, indicating the environmental factors and resources; the positive and negative impacts and degrees of significance; and the programme assessment variables.

4.2.3 Identification and evaluation of impacts

The potential environmental impacts and risks from implementing the ZNSS must be identified and described, taking into account the views and concerns of stakeholders. Their significance should be determined according to their characteristics (e.g. duration, probability, magnitude, mitigability, reversibility) and the sensitivity of the environment. Attention must be given to the effects that ZNSS implementation may have on exacerbating existing negative trends, as well as other potential impacts. Those significant impacts should be assessed in details taking into account:

- the views and concerns of stakeholders,
- the consistency with international environmental commitments (including MEAs),
- the socio-economic consequences (especially on vulnerable groups and ethnic minorities),
- compliance with environmental regulations and standards,
- consistency with environmental objectives and policies, and
- their implications for sustainable development objectives.

It is suggested that a matrix is used to illustrate the findings, showing which ZNSS components have an effect on which environmental aspects, and the significance of such impacts.

4.2.4 Analysis of performance indicators

The performance indicators proposed by the AMSP 2007-2010 should be assessed and revised from an environmental perspective, i.e. their usefulness to identify the environmental effects (positive and negative) of sector programme implementation. Also existing (environmental or not) indicators should be analysed to ensure that they do not promote negative environmental impacts. Proposals should be made for the development/improvement of the ZNSS performance indicators and monitoring system.

The set of indicators will be based on the baseline and be Specific, Measurable, Affordable, Realistic and Timely. It may include:

- "pressure" indicators[38];
- "state" indicators, for sectors with a direct and major link with key environmental resources (e.g. river natural resources, soil for agriculture, forest resources for forestry)[39];
- indicators of other specific issues, such as key institutional weaknesses identified by the SEA[40].

Consultants should give an indication of how recommended indicators may be applied, including:
- information/data needed to apply the indicators, the sources where it may be obtained, and an indication of possible costs;
- other resources needed to apply the indicator (e.g. specific equipment or technical capacities).

4.2.5 Assessment of the capacities to address environmental challenges

The consultants will assess the adequacy of institutional structures and capacities, of the regulatory framework, financial and human resources to address the key environmental concerns associated to ZNSS implementation and the sugar sector.

4.2.6 Stakeholders' engagement

The Consultant will ensure that the sector stakeholders are fully engaged throughout the SEA study, as planned during the scoping process and in the scoping report. Stakeholder engagement should include a mix of different mechanisms, such as questionnaires, focused semi-structured interviews and workshops with key stakeholders (both in Lusaka and selected regions, as agreed).

4.2.7 Risks, assumptions and other limitations to the SEA

The Consultant will identify the risks and other limitations, and assumptions that have influenced the orientation and/or effectiveness of the SEA study.

4.2.8 Conclusions and recommendations

This chapter will summarise the key environmental issues for the sector, including policy, institutional and regulatory constraints, challenges and main recommendations. Recommendations should be prioritised. Recommendations should be made both to the GRZ and to the EC in separate sections.

Recommendations to the GRZ should be made on how to optimise positive impacts and the opportunities to enhance the environment, as well as on how to mitigate environmental constraints, negative effects and risks. These recommendations will be oriented on improving the environmental performance of the ZNSS. They should suggest the selection of an alternative approach (if considered necessary) within the ZNSS, potential changes to the National Sugar Strategy, and other initiatives at institutional, policy and regulatory level that may be necessary to improve environmental performance of the ZNSS.

Recommendations addressed to the EC should be oriented to have an influence in the AMSP design and associated aid delivery instruments (e.g. financing agreements, performance assessment framework). Recommendations may include specific indicators to be incorporated, use of general or specific conditions to promote good environmental performance, specific

[38] For example: pesticide use in a given area; hectares of forest cleared.
[39] For example: % of groundwater samples meeting quality standards.
[40] For example: number of annual environmental inspections carried out by local authorities in industrial facilities.

projects to be supported, or specific technical assistances. In view of the on-going preparation of AMSP 2011-2013, recommendations should also be made to support the overall assessment of the AMSP 2007-2011. If the assessed programme includes projects, recommendations should be made on the need to carry out Environmental Impact Assessments (EIA) of those projects.

The limitations of the SEA and its assumptions should be presented. The recommendations should take into account the views presented by the stakeholders and explain how these were integrated. In the case of concerns that were not integrated in the final recommendations, the reasons should be given.

The findings of the SEA will be presented in a workshop to all relevant stakeholders, including media coverage.

5. Working plan

The working plan should include but is not necessarily to be limited to the activities listed in 5.1 and 5.2. **On this basis, the companies must provided a detailed workplan in their offer.**

5.1 Scoping study

- Fact finding/data collection
- Literature review (relevant policies, plans, strategies, legislation…)
- Review of prior public consultations, identification of key stakeholders
- Engagement/education of stakeholders
- Possible site visit(s)
- Analysis/preparation of recommendations and Scoping Report
- Workshop to present results of scoping phase

5.2 SEA study

- Fact finding/data collection
- Literature review
- Field trips
- Formal stakeholder consultation meetings
- Identification and detailed analysis of the potential environmental impacts
- Preparation of recommendations to mitigate negative environmental effects (and constraints) and optimise positive effects (and opportunities)
- Preparation of recommendations and draft SEA report
- Workshop to present findings of the SEA Study
- Preparation of the final SEA report

6. Expertise required

The consulting company must specify the qualifications and experience of each specialist to be assigned to the SEA study (see section 6.1 below). The company should indicate if/how they intend to use local experts and how they will contribute to the transfer of know-how throughout the study.

For each specialist proposed, a *curriculum vitae* must be provided of no more than (*four*) pages setting out the relevant qualifications and experience.

6.1 Number of experts required per category and number of man-days per expert

- A Category I Expert - Team Leader – Environmental Expert : 66 days
- A Category II Expert – Agronomist: maximum 52 days
- A Category III Expert – Socio-economist : maximum 30 days

The specific time input for the Category II and Category III experts will be refined at the end of the scoping phase.

6.2 Expert profiles and expertise required

Common features for all experts:

- Full working knowledge of English;
- Excellent report writing and communication skills;
- Experience in the country and sector concerned is an asset, as well as knowledge of EC procedures.

Specific expertise requirements per expert:

One of the following expert will need to have demonstrated knowledge of and recent experience in the Zambian Sugar Industry.

i. Category I Expert - Team Leader – Environmental Expert

- Master's degree in environment or natural resource management or any other relevant field;
- Extensive and relevant postgraduate experience, including experience in conducting SEAs and/or similar environmental assessment assignments in the past 5 years;
- Demonstrated experience as a team leader;
- Conversant with the EC project cycle management and aid delivery methodologies – including sector support programmes;
- Demonstrated experience with the financial and monitoring implications of environmental sector policies and regulations.
- Experience in Eastern and/or Southern Africa.

ii. Category II Expert – Agronomist

- Relevant academic qualification in agricultural economics, rural development or a related field of study;
- Relevant recent experience in Eastern/Southern Africa with the sugar industry and its agronomic, processing and labour characteristics and requirements including environmental issues;
- Practical recent experience in Environmental Impact Assessment is an added value.

iii. Category III Expert – Socio-economist

- Relevant academic qualification in socio-economic or related field of study;
- Demonstrated experience **in Zambia** in participatory rural appraisal and stakeholder consultation, including organisation of workshops;
- Experience in the last 5 years in HIV/AIDS and gender issues;
- Experience in migration and resettlement issues is an advantage;
- Relevant experience with environmental stakeholder consultations is an advantage.

6.3 Working language

The working language for this study will be English.

7. Reporting

7.1 Scoping study

The scoping study will be presented in the format given in Appendix 1.

The detailed stakeholder consultation plan (maximum 12 pages) must be presented one **week** after the kick-off meeting, to the MCTI, the EC and Sugar Accompanying Measures Steering Committee.

The draft scoping report is to be presented within **sixteen (16) days** from the kick-off meeting, to the MCTI, the EC and the Sugar Accompanying Measures Steering Committee. Comments will be consolidated by MCTI/EC and sent to the consultants within 14 days.

The final Scoping Study Report will be submitted within **seven (7) calendar days** after receiving the consolidated comments on the draft report.

7.2. SEA study

The SEA Study will be presented in the format given in Appendix 2. The underlying analyses are to be presented in appendices to this report.

The draft SEA Study Report will be presented within **22 calendar days** of the SEA Study start-up meeting, to the MCTI, the EC and the Sugar Accompanying Measures Steering Committee. Comments will be consolidated by MCTI/EC and sent to the consultants within 14 days.

The final SEA Study Report will be submitted within **seven (7) calendar days** after receiving the consolidated comments on the draft report.

8. Work plan and timetable

8.1 Starting period

The study is expected to commence **1st September 2009**.

8.2 Foreseen finishing period or duration

The maximum total duration is 150 calendar days including start-up period, performance period, reporting, submission of comments and submission of final report and final payment. **Estimated date of submission of final report is 15th December 2009**.

8.3 Timetable

The specific time input for the Category II and Category III experts will be refined at the end of the scoping phase.

The company should indicate in their proposal how they intend to organise the work on the basis of this time schedule.

Activity	Experts (person-days)			Location
	Team Leader/ Environmentalist (Cat I)	Agronomist (Cat II)	Socio-economist (Cat III)	
1. Scoping study				
1.1 Review of key documents and preparation of stakeholder engagement strategy	4	3	1	Place of residence
1.2 Travel to Zambia	1	1	1	
1.3 Briefing with EC and GRZ	1	1	1	Lusaka
1.4 Preparation and submission of Draft Scoping report	14	14	10	Zambia
1.5 Presentation to the Steering Committee and relevant stakeholders	1	1		Lusaka
1.6 Travel to place of residence	1	1	1	
1.7 Finalisation of scoping report	5	3	1	Place of residence
Sub-total	27	24	15	
2. SEA Study				
Preparation of material for SEA Study	4			Place of residence
2.1Travel to Zambia	1	1	1	
2.2 Start-up meeting with key stakeholders	1	1	1	Zambia
Organisation of workshops and travel	6	6	8	Zambia
2.3 Preparation and submission of draft SEA report	15	13	3	Zambia
2.4 Presentation to the Steering Committee and relevant stakeholders	1	1		Zambia
Travel back to place of residence	1	1	1	
2.5 Finalisation of final SEA report	10	5	1	Place of residence
Sub-total	39	28	15	
Total	**66**	**52**	**30**	

Appendix 1. Standard format for the SEA scoping report

Maximum length of the main report (without appendices): 25 pages.

The following text appears on the inside front cover of the report:
This report is financed by the European Commission and is presented by the [*name of consultant*] for the … [*National Institution*] and the European Commission. It does not necessarily reflect the opinion of the … or the European Commission.

1. Executive summary
2. Description of the sector programme under consideration
3. Overview of the policy, institutional and legislation framework
4. Description of key stakeholders and their concerns
5. Description of key environmental aspects to be addressed in the SEA study
6. Description of the scope of the environmental baseline to be prepared in the SEA study
7. Recommendations on specific impact identification and evaluation methodologies to be used in the SEA study
8. Proposal of time frames and resources needed for the SEA study
9. Technical appendices
    - I. Stakeholder engagement methodology
    - II. List of stakeholders engaged or consulted
    - III. Records of stakeholder participation.
    - IV. List of documents consulted

Appendix 2. Standard format sector SEA report

The following text appears on the inside front cover of the report:
This report is financed by the European Commission and is presented by the [*name of consultant*] for the … [*National Institution*] and the European Commission. It does not necessarily reflect the opinion of the … or the European Commission.

Maximum length of the main report (without appendices): 100 pages.

1. Executive summary
2. Scope
3. Background
    - 3.1 Sector programme justification and purpose
    - 3.2 Alternatives
    - 3.3 Environmental policy, legislative and planning framework
4. Approach and methodology
    - 4.1 General approach
    - 4.2 Geographical or environmental mapping units
    - 4.3 Assumptions, uncertainties and constraints
5. Environmental baseline study
6. Impact identification and evaluation
7. Analysis of alternatives
8. Mitigation or optimising measures
9. Indicators and institutional capacities
10. Conclusions and recommendations
    - 10.1. General conclusions
    - 10.2. Recommendations for SPSP formulation
    - 10.3. Recommendations for sector programme enhancement

11. Technical appendices
    - Maps and other illustrative information not incorporated into the main report
    - Other technical information and data, as required
    - List of stakeholders consulted/engaged
    - Records of stakeholders' participation

11. Other appendices
    - Study methodology/work plan (2–4 pages)
    - Consultants' itinerary (1–2 pages)
    - List of documentation consulted (1–2 pages)
    - *Curricula vitae* of the consultants (1 page per person)
    - Terms of Reference for the SEA

Appendix 3: Terms of Reference of the 'Sugar Accompanying Measures' Steering Committee

The ***Sugar Accompanying Measures Steering Committee*** (hereafter: the Steering Committee), is created to provide guidance to the 'Accompanying Measures for Sugar Protocol Countries' funded by the European Community in support to Zambia.

Article 1
Responsibilities of the Steering Committee

The Steering Committee has the following responsibilities:

a) reviewing the progress of the programme implementation;
b) providing guidance and recommendations for the programme's strategy and implementation taking into consideration the Zambian National Sugar Strategy and in coordination with all relevant stakeholders in the sector;
c) reviewing draft report studies and endorsing final reports;
d) agreeing on the work plan of activities.

Article 2
Composition of the Steering Committee

The Steering Committee is composed of core members:

a) Delegation of the European Commission;
b) Ministry of Agriculture and Cooperatives;
c) Ministry of Commerce, Trade and Industry;
d) Ministry of Energy and Water Development;
e) Ministry of Science and Technology and Vocational Training;
f) Ministry of Tourism, Environment and Natural Resources;
g) Environmental Council of Zambia;
h) Ministry of Transport and Communications;
i) Ministry of Works and Supply;
j) National Authorising Officer;
k) Road Development Agency;
l) Zambia Development Agency.

The Steering Committee can be extended to other members, when required, such as:

a) Private sector;
b) Farmers' Associations;
c) Relevant Non-Governmental Organisations;
d) Zambia National Farmers Union;
e) Chamber of Commerce and Industry;
f) Business Forum.

Article 3
Chair

The Ministry of Commerce, Trade and Industry and the Delegation of the European Commission co-chair the Steering Committee.

Article 4
Secretariat

The Ministry of Commerce, Trade and Industry will provide operational and administrative support for the activities of the Steering Committee, including:

a) convoking the meeting upon seven days notice;
b) submitting relevant documents for the session to all Members no later than seven days prior to the date of the session;
c) in consultation with other members of the Committee as appropriate, setting the Committee agenda;
d) recording and circulating the Steering Committee meeting minutes;
e) maintaining an up-to-date list of Committee members.

Article 5
Frequency of meetings

The Committee meets no less than twice per calendar year. The Steering Committee meets on an as-needed basis to carry out its responsibilities as specified in article 1.

Article 6
Place of meetings

In general, the meeting is be held at the Ministry of Commerce, Trade and Industry office.

Article 7
Decision making procedures

Decisions are taken by consensus, under the guidance of the Chair and co-Chair.

Article 8
Quorum

A session of the Steering Committee can take place if at least six core members are represented including the relevant ones for the topic covered.

Article 9
Amendment

The Terms of Reference may be amended by the Steering Committee as it deems required.