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"Strategic Environmental Assessment (SEA) of the Implementation of the Multi-annual Adaptation Strategy 2006-2015 of Jamaica"

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Strategic Environmental Assessment (SEA) of the implementation of the Multi-annual Adaptation Strategy 2006-2015 to Jamaica

SEA Study Report - draft

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ACRONYMS

ACP	Africa, Caribbean, Pacific
ADP	Area Development Programme
AIJCFA	All-Island Jamaica Cane Farmers' Association
AMS	Accompanying Measures for Sugar
BCH	Burnt Cane Harvesting
BITU	Bustamante Industrial Trade Union
BOD	Biological Oxygen Demand
CARICOM	Caribbean Community
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CIB	Coconut Industry Board
CMS	Concentrated Molasses Solubles/Solids
COD	Chemical Oxygen Demand
DNA	Designated National Authorities
DO	Dissolved Oxygen
EBA	Everything But Arms (initiative)
EC	European Commission
EIA	Environmental Impact Assessment
EDC	Economic Diversification Component (of the SADP)
ENSO	El Niño Southern Oscillation
EPA	Economic Partnership Agreement
ESC	Environmental Sustainability Component (of the SADP)
ESP	Electrostatic Precipitator
EU	European Union
FLO	Fairtrade Labelling Organizations
FY	Fiscal Year
GBS	General Budget Support
GCH	Green Cane Harvesting
GDP	Gross Domestic Product

GoJ	Government of Jamaica
HOA	Heads of Agreement
HDI	Human Development Index
IBE	Infinity Bio Energy Limited
JaNEAP	Jamaica National Environmental Action Plan
JAST	Jamaica Association of Sugar Technologists
JCS	Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015
JIPO	Jamaica Intellectual Property Office
JMO	Jamaica Meteorological Office
JPSCo	Jamaica Public Service Company Ltd
JRCS	Jamaican Recoverable Cane Sugar
JSIF	Jamaica Social Investment Fund
LDC	Least Developed Country
MIP	Multi-Annual Indicative Programme
MoA	Ministry of Agriculture
MoE	Ministry of Energy
MTBE	Methyl tertiary-butyl ether
MTSEPF	Medium Term Socio-Economic Policy Framework
NCST	National Commission on Science and Technology
NEPA	National Environment and Planning Agency
NGO	Non-Governmental Organisation
NIC	National Irrigation Commission
NIDMP	National Irrigation Development Master Plan
NRCA	Natural Resources Conservation Authority
NWA	National Works Agency
NWU	National Workers Union
PATH	Programme for Advancement Through Health & Education
PCA	Pesticides Control Authority
PCCD/Fs	Polychlorinated Dibenzo-p-Dioxins and Furans
PIOJ	Planning Institute of Jamaica

POP	Persistent Organic Pollutant
PPA	Power Purchase Agreement
SADP	Sugar Adaptation Development Programme
SBS	Sector Budget Support
SCJ	Sugar Company of Jamaica
SDA	Sugar Dependent Area
SEA	Strategic Environmental Assessment
SIA	Sugar Industry Authority
SIRI	Sugar Industry Research Institute
SME	Small and Medium Enterprise
SSC	Social Services Component (of the SADP)
STU	Sugar Transformation Unit
TSS	Total Suspended Solids
UAWU	University and Allied Workers Union
UN	United Nations
UNFCCC	United Nations Framework Convention for Climate Change
USD	United States Dollars
VOC	Volatile Organic Compounds
WRA	Water Resources Authority
WUA	Water Users' Association

0. Executive Summary

Jamaica had benefitted from the provisions of the European Union's Sugar Protocol, allowing it to export a quota of sugar to the EU market at a guaranteed price. In compliance with a WTO decision, and starting in 2006, the EU has reduced the price at which it purchases sugar. This will inevitably have an impact on the competitiveness of the sugar industry in Jamaica.

The EU will help Jamaica adapt to the new situation by supporting the **Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015** (JCS). The EC's Multi-Annual Indicative Programme 2007-2010 (MIP) for Jamaica has two main components:

- A programme to support the sugar cane sector in Jamaica and diversification in Sugar Dependent Areas, in the form of Sector Budget Support;
- A Macroeconomic Assistance Programme in the form of GBS, in support of Objective 3 of the JCS (maintaining progress towards macro-economic goals).

As the implementation of the JCS may have impacts on the environment, the GoJ and the EC decided to carry out an SEA with the specific objective to *"confirm and complete the findings and recommendations of the JCS pertaining to environmental issues"*; in addition it is expected for the SEA to *"provide decision-makers in the Government, the EC and other donors with relevant information to be integrated into the implementation processes associated with the JCS"*. This SEA was commissioned by the Ministry of Agriculture (MoA) Sugar Transformation Unit (STU) and the EC Delegation in Jamaica. The STU is responsible for JCS implementation.

As part of the adaptation efforts, the STU has prepared a **Sugar Adaptation Development Programme** (SADP), aimed at mitigating the anticipated economic, social and environmental effects of the sugar reform, also addressed in the SEA.

In order to address the problems that Jamaica's sugar industry is facing, the JCS promotes actions in a range of aspects, including privatisation of government-owned sugar estates, closure of two sugar factories, expansion of sugar cane cultivation, expansion of production of molasses for the rum industry, promotion of more efficient field and factory operations, and promotion of biofuels production, amongst other. The main areas covered by the JCS are summarised below.

Component 1: Sustainability and competitiveness of the sugar cane industry

- Increased role of the private sector
- Increased efficiency of field production
- Reduction in overhead costs
- Rum production
- Ethanol production
- Human resources development
- Rationalisation of the sugar industry
- Increased efficiency of factory production
- Molasses production
- Renewable energy
- Other sugar cane based products

Economic, social and environmental sustainability of sugar-dependent areas

- Alternative uses of sugar cane lands
- Rural infrastructure
- Compensation of displaced sugar workers
- Economic development and diversification
- Social services
- Land use and environmental management

Macro-economic goals

- Macro-economic stability
- Research and innovation

A scoping phase was carried out from 12-23 January 2009, which identified the key environmental concerns of the sugar industry and of JCS implementation, based on literature review and consultations with stakeholders. The four key concerns identified are:

1. **Pressure on groundwater resources**, due mainly to: over-abstraction of groundwater; inefficient irrigation; inadequate drainage of fields, particularly poor

regional drainage networks; and possibly to be exacerbated by effects of climate change.

2. **Land degradation**, due mainly to: inadequate drainage of fields; abandonment of land taken out of cane; salinisation of land from irrigation with high conductivity groundwaters.
3. **Water contamination**, due mainly to: discharge of industry wastewaters into the aquatic environment; increase in production of vinasse with planned increase of ethanol production.
4. **Atmospheric pollution**, due to: sugar cane burning practices and stack emissions from sugar factories.

Other – lower priority - environmental aspects identified included: water contamination due to application of fertilisers and agrochemical products, aerial spraying and use of personal protection equipment in the field.

The SEA Study made a more detailed assessment of the extent of the environmental problems around the key issues identified, the state of the environment, the pressures and trends. The expected contribution of JCS implementation to these problems was assessed, and options put forward to address concerns. Finally, recommendations are made both to the GoJ and the EC on how to enhance environmental performance of the JCS. The assessment was carried out based on extensive literature search and stakeholder consultations. A one-day workshop to explore options around the key issues identified was held on 19 February in Mandeville, to which around 50 stakeholders attended.

Key issue 1: Pressure on groundwater resources

The sugar areas of Clarendon and St. Catherine face problems of water-stress and saline intrusion. This is especially relevant to the sugar sector, as this is where the irrigated cane fields are concentrated. Moreover climate change is expected to further contribute to water stress, through increasing irrigation water demand in currently rain-fed areas (decreased rainfall) and decreased water availability (decrease in aquifer recharge).

Although part of the salinity is natural, salt-water intrusion is thought to have increased since the 1960's due to over-pumping of deep wells. In some cases salinity exceeds levels suitable for use in irrigation, and a number of wells have had to be abandoned. Irrigation with salt water is also a contributing factor to reduced sugar cane yields. In Jamaica presently about 25% of the sugar cane lands are irrigated, although the tendency is to increase (potentially up to 35%) as a measure to improve yields.

The key factors contributing to unsustainable water use in the sugar sector, especially in irrigated areas are: (1) conveyance losses in irrigation water distribution systems; (2) predominance of water-inefficient irrigation methods; (3) increased groundwater demand to satisfy urban expansion; and (4) negative water saving incentives through subsidies to irrigation costs.

There are two main reasons why the sugar sector should seek to increase its water efficiency: to contribute to reducing pressure on the groundwater resources, especially in the Clarendon plains and St. Catherine, and to improve yields by reducing irrigation with salt water.

The JCS envisages a net expansion of some 12,000 ha under cane, which will largely be obtained from the Southern irrigated plains. The main limitation to expansion on any available land is an absolute shortage of any new ground- or surface water sources of good quality.

Upgrading of irrigation works on the private estates is expected to continue with improvement in the management of pivot systems and installation of drip systems. It is also planned to upgrade off-farm irrigation works to ensure adequate delivery of water to estate lands. This is expected to have a positive impact on the pressure of groundwater resources, as in reducing line losses will improve water delivery to the fields.

There are opportunities for the sugar sector to reduce water stress and its contribution to groundwater salinisation, as well as to minimise the detrimental effects of irrigation with saline water. This can be achieved specifically by reducing reliance on groundwater, through: (1) improving the surface irrigation schemes; (2) the use of more water-efficient irrigation methods (especially drip irrigation and centre-pivot); (3) seeking alternative sources of irrigation water (e.g. use of treated waste-waters, storage for seasonal high river flows); and (4) minimising negative incentives for water efficiency.

Although water-efficiency should be sought throughout the sugar industry, efforts should be prioritised in the sensitive areas of Clarendon and St. Catherine.

Land degradation

Land degradation and abandonment is primarily a problem in the irrigated sugar cane growing areas of Southern St. Catherine and Clarendon. Some of these areas have shown consistent yield declines to the point of becoming so unproductive that they have been taken out of any form of agriculture. There is also the problem of increasing salinisation of land due to the use of high conductivity waters for irrigation, coupled with inadequate drainage. This has left some areas in such a state as to make any reclamation very challenging.

The predominant soil types in the irrigated plains are heavy cracking clays which, in their saturated state, do not allow downward water movement and salt flushing through the profile. Since restoration is so problematic the use of saline irrigation waters should be avoided in these soils. The vegetation remaining on abandoned lands is a further degrading factor; a consequential problem of salinisation and drought is the development of an aggressive weedy grass which is difficult to control.

The JCS requires some 12,000 ha of additional land being available for cane, therefore the main challenge will be the reclamation of large areas of degraded and abandoned land. The abandoned and degraded estate lands on the southern irrigated plains offer the largest potential for such additional expansion. Measures will have to be taken to bring these lands back into sustainable production through redirection and conservation of current non-saline water sources and the efficient use and management of irrigation and drainage systems. Sugarcane culture would represent optimal use of the most of the available abandoned land. Environmental benefits would be of a highly efficient carbon sink, a source of renewable energy, protection of the land and aesthetic value.

For the sugar industry some capacity-building will be necessary in the most appropriate implementation of the newer irrigation technologies and their management in the context of marginally saline water sources, recycled water and lands vulnerable to saline degradation

The JCS is concerned that any lands going out of cane should be put back into productive use in the shortest possible time. However, the areas likely to go out of sugar cane do not represent large areas of productive land. It appears that mostly small and marginal farmers and some saline lands will be affected. Between SIRI and STU these farmers can be identified and SIRI has been trialling various alternative crops as alternatives. For saline lands alternatives such as coconuts and fisheries seem most feasible, but may need prior assessment of environmental feasibility (e.g. shrimp farms). Environmental impacts from the small farmers cropping would have to be monitored as erosion and higher levels of pesticide use could result.

Water contamination

The main source of water pollution by sugar factories and rum distilleries is related to the high levels of organic content (BOD) of the wastewaters produced, especially the cane wash waters and dunder. Industrial waste water discharges have to comply with Trade Effluent Standards, but the industry is overall non-compliant; key parameters of non-compliance are DO, BOD, COD, nitrates, phosphates, TSS and coliforms (faecal and total). To date no sugar factory or distillery has a licence from NEPA, and no environmental Compliance Plans have been finalised.

The actions envisaged under the JCS are expected to have both positive and negative impacts on the environment. On the positive side, the closure of mills will imply a reduction in discharge points for waste waters; however, based on interviews it is not clear if factory closures will take place at all, as the decision will rest with the new owners. Also, the acquisition of mechanical harvesters will facilitate GCH, and with the possible introduction of dry cleaning plants, reduce the amounts of extraneous material arriving to the factory, thus potentially reducing the wash water requirements.

The main negative environmental impacts on water quality resulting from JCS implementation is the large increase of dunder production, which is expected from the growth in rum production and the production of 70 million litres of ethanol annually. An annual additional production of around 1,050 million litres of dunder is expected from ethanol production alone. This may prove to be a conservative estimate, as IBE's targets aimed at an annual production of around 135 million litres per year, which would generate up to 2,025 million litres of dunder.

Currently dunder produced is generally used for irrigation of the cane fields (although still not under a license from NEPA). Much needed actions to improve water efficiency will reduce the potential to dispose of all dunder produced through fertigation, and the current restriction that distilleries must shut down during rainfall if dunder is applied on the fields, are further constraints to fertigation.

Adequate management of dunder should be ensured, either through controlled fertigation (and under a NEPA licence), or seeking alternative treatment methods (e.g. anaerobic digestion). Also, the ethanol plant(s) should require a detailed EIA, to ensure it will be fully compliant with all applicable environmental standards. The EIA will particularly have to determine the generation of liquid effluents and ensure the proposed design and operational practices can guarantee safe disposal and treatment of dunder.

Cane wash waters (and other factory effluents which mix with it) should be treated to a sufficient degree so they are compliant with trade effluent standards. The JSC compliance plan envisages a series of actions, mainly through the use of settling ponds; however, these are unlikely to lead to compliance and full scale waste water treatment plants may be required.

Atmospheric pollution

The main sources of atmospheric pollution from the sugar industry are: sugar cane burning and stack emissions from factories sugar (especially particulate emissions from burning of bagasse).

Sugar cane burning is a common practice and has been identified as a key concern due to the emission of contaminants, health effects and nuisance to communities. Burnt Cane Harvesting (BCH) is normally practiced for its immediate economic benefits: harvesting being faster, it allows lower cost per ton, lower haulage costs and thus greater payloads in haulage vehicles.

However, BCH has adverse effects on the processing quality of cane, soil properties and the atmospheric environment. From an environmental point of view, the key adverse impacts include: (1) release of Persistent Organic Pollutants (POPs) into the atmosphere, including certain dioxins and furans; (2) health impacts through breathing of POPs and particles emitted as aerosol, as well as carbon monoxide, ozone, particulate matter and volatile organic compounds; and (3) smoke nuisance (incompatible with urbanisation and tourism). Sugar cane burning was identified as one of the main sources that contribute to poor air quality in Jamaica. Also cane burning is an important source of dioxins and furans, which Jamaica has an obligation to control under the Stockholm Convention on Persistent Organic Pollutants.

There is increasing pressure against cane burning, stemming from communities that see it as a nuisance, as well as researchers and environmental authorities, and there is an unofficial commitment to eradicate cane burning by 2010.

The use of the Air Quality Regulations to regulate cane burning seems to be a poor choice due to its unnecessary complexity, and unfair burden on small scale farmers. Instead sugar cane burning could be better regulated in a more straightforward manner, by requiring all cane farmers to gradually reduce cane burning, setting intermediate targets leading to minimisation, and mandating cool burning where GCH is not technically feasible.

Although the JCS promotes GCH and includes actions (provision of mechanised harvesters) that will be conducive to GCH, it would do well to spell out how it will do so, especially amongst small scale farmers. GCH requires more labour time than BCH and farmers would need to increase their access to mechanical harvesters, as well as receive capacity-building on effective GCH (e.g. preparation of the fields) and/or cool burning.

As for stack emissions, sugar factories are generally non-compliant with the Air Quality Regulations. Bringing them to compliance will imply the installation of pollution abatement equipment, some of which is already foreseen. However, it will be necessary also to improve combustion efficiencies by upgrading boilers (e.g. installing high pressure boilers, as foreseen in the JCS).

The JCS will have positive effects in reducing stack emissions through the upgrading of combustion equipment, but does not emphasise the need to install pollution abatement technologies. Stack emissions from boilers in sugar factories need to comply with the standards in the Air Quality Regulations, something which the JCS would do well to emphasise and promote.

Finally the substitution of MTBE by ethanol, which will be supported by the JCS, will have an important indirect positive effect on air quality in Jamaica.

Analysis of indicators

In overall terms the proposed indicators largely neglect the key environmental concerns in the sugar sector. If performance of the JCS is measured exclusively with these indicators, not only will the set of indicators not encourage addressing the key environmental concerns in the sector, but may actually promote further environmental degradation.

The following indicators are particularly conducive to aggravate the already pressing environmental problems in the sugar sector:

- *"200,000 tonnes of raw sugar produced annually by 2020"*
- *"70 million litres of ethanol produced annually from locally grown cane"*
- *"All released sugar lands fully utilised within 3 years"*

The only environment-specific indicator, *"no violations of zoning and environmental regulations on existing and former sugar lands"* is likely to be insufficient to act as a safeguard to possible negative effects. In terms of zoning, as discussed above there are currently no land use zoning plans in place for sugar areas, and the degree of environmental integration (use of environmental criteria in determining acceptable land uses) of any new zoning plans will have to be ascertained.

It is also not clear if the component on *"no violation of environmental regulations on existing and former sugar lands"* covers operations at sugar, rum and ethanol factories, or only field operations. It definitely does not, however, address issues of water use efficiency and minimising cane burning.

- It is recommended that the above indicator be reformulated to ensure it covers factory operations.

Recommendations

Recommendations are provided for the Government of Jamaica and for the European Commission. Recommendations for the GoJ are oriented to improve the environmental

performance of JCS implementation, under the understanding that the JCS is a completed document, but that the GoJ has the willingness and commitment to improve its implementation so as to ensure its environmental sustainability.

The following general recommendations are addressed both to the GoJ and the EC:

- It is highly recommended that a follow-up of this SEA is carried out, in order to assess its effectiveness and learn lessons for future SEAs. This is relevant to the EC for future SEAs in the context of sectoral and budget support to environmentally sensitive sectors, and to the GoJ in the context of the further development and implementation of their SEA Policy.

- It is recommended that this SEA Study report received wide circulation amongst all key stakeholders, and is made publicly available through relevant web sites (e.g. those of the EC, NEPA, SIA, STU).

<u>Recommendations to the GoJ</u>

- The GoJ should recognise that for the JCS to be environmentally sustainable it must address the key environmental concerns that the sugar industry faces, mainly: (1) pressure on groundwater resources, especially in Clarendon and St. Catherine; (2) land degradation; (3) contamination of aquatic systems by trade effluents; and (4) atmospheric emissions from point (stack emissions) and non-point (cane burning) sources.

- The privatisation process is a major opportunity for the GoJ to promote the environmental sustainability of the sugar sector. Plans originally made by IBE allegedly addressed many of the concerns identified in this SEA; however, these are not binding commitments and the privatisation process is still open.

- The GoJ should ensure that divestment plans require the new company to:
  - Comply with all environmental regulations and standards, including the trade effluent standards and the air quality standards. This will imply making licence applications within a reasonable period of time and regularise permits with the WRA.
  - Maximise water efficient irrigation, by installing drip irrigation systems where possible, and using centre-pivot irrigation as a second option. That wherever furrow irrigation is to remain, actions are carried out to upgrade irrigation schemes and all possibilities explored and used to maximise water efficiency (e.g. alternate furrow irrigation, land forming and re-blocking).
  - Eradicate cane burning in their lands, and actively promote GCH by farmers that sell their cane to their mills (e.g. providing awareness-raising on the benefits of GCH and capacity building). That where GCH cannot feasibly be practiced (e.g. topographical constraints for harvesters or super-humid areas), cool burning practices are adopted.
  - Minimise water consumption in the sugar mills, by minimising wash waters and maximising recycling.
  - Environmentally sound management of dunder generated, either through fertigation according to a NEPA licence and a Nutrient Management Plan, and/or through treatment of dunder (e.g. anaerobic digestion and lagooning).
  - The new company is encouraged to implement an Environmental Management System.

- As most government-owned facilities are considered to be “existing facilities” under the environmental regulations, NEPA may allow gradual compliance with trade effluent and air quality standards (max 7 years) according to Compliance Plans, which have to be agreed with the JSC before privatisation, and are urgent. This means that the new company will be bound to these Compliance Plans, unless new ones are proposed and agreed with NEPA.
  - Compliance Plans with JSC should be based on interim standards (yearly) and not only on implementation of activities. Burden of compliance should remain on the polluter.
  - NEPA licences for JSC must be secured for disposal of dunder through fertigation, based on a Nutrient Management Plan.

- It is recommended that treatment of dunder is explored (e.g. anaerobic treatment, ideally coupled as a CDM project), as a means to allow flexible distillery operations (i.e. not having to shut down during rainy periods), minimise run-off and leaching on the fields, and recover energy.

- NEPA, the MoA and WRA must be involved in the evaluation of any applications for land use changes (from agricultural land to other uses), and environmental criteria taken into account, especially guaranteeing that the new land use will have a sustainable water supply (requiring an EIA if necessary).

- An EIA is carried out as part of the application for the new ethanol plant. Such an EIA should especially address: management of dunder produced, transport of dunder, and energy efficiency (fuel mix).

- Eradication of cane burning should be established as official policy and objective, and a plan elaborated to achieve it (coordinated with key stakeholders, e.g. SIA, SIRI, Cane Farmers' Association). In certain exceptional areas where GCH is unfeasible cool burning should be done.

- Regulation of cane burning should be done based on a policy commitment and an associated action plan, and *not* through the Air Quality Regulations as a fugitive source of emissions. Regulation through the Air Quality Regulations is bound to be complex and time consuming, when the issue can be addressed up-front through a firm policy commitment and action plan.

- Modifications to the Air Quality Regulations are recommended so small-scale farmers do not fall under the "major facility" category, putting them under a time consuming and onerous obligation to secure a NEPA licence and produce regular monitoring reports. In line with the point above, minimisation of cane burning should be addressed in an up-front manner.

- The action plan for the minimisation of cane burning should address, *inter alia*, capacity-building and awareness-raising of farmers on the benefits and techniques of GCH, and support for the acquisition of necessary machinery and equipment.

- The schedule of charges for irrigation water should be revised, in line with the Water Policy and Action Plan, in order to introduce incentives for water conservation (e.g. volume-base charging, reducing subsidies) whilst ensuring irrigation remains feasible. Any such changes should be accompanied by support to farmers to implement and operate water efficient irrigation technologies and practices.

- The GoJ could consider promoting fair trade sugar production as a means to promote alternatives to small scale farmers in a way that would provide them access to new markets and promote social and environmental sustainability.

- It is recommended the GoJ (Ministry of Environment) encourages the use of the Clean Development Mechanism to enhance environmental performance of the sector and generate carbon credits. This can especially be pursued for co-generation and energy recovery from vinasse treatment.

- The JCS indicator matrix should be revised so it promotes environmental sustainability. More specifically it could add indicators on: area of cane fields under centre-pivot and drip irrigation; area of cane fields under green cane harvesting.

- It is recommended that the current indicator on compliance with environmental regulations be reformulated to ensure it explicitly covers factory operations, e.g. "no violations of zoning and environmental regulations on existing and former sugar lands, including of operations of sugar, rum and ethanol factories"

Recommendations to the EC

Recommendations are made to the EC on: specific conditions that could be integrated in its Financial Agreements under the budget support aid delivery modality (SBS or GBS); performance indicators (also under budget support); and specific projects that could be supported.

- The environmental performance of the JCS, supported by the findings of this SEA, as well as any other relevant issues that may arise, should be part of the policy dialogue with the GoJ. Environmental sustainability should always be seen as an integral component of the JCS.

- Key environmental indicators should be included for performance assessment (however they may be used, e.g. linked to disbursement of budget support variable tranches). Key indicators include:
    - Green cane harvesting
        - Area under green cane harvesting (with associated targets showing increase in GCH)
        - Approval of formal policy commitment and action plan to minimise cane burning (in line with recommendations of SEA, e.g. use of cool burning where GCH is not practicable)
    - Water use efficiency
        - Area of irrigated cane fields under centre-pivot, drip or higher efficiency surface irrigation (with associated targets showing increase of area)
        - Average water use efficiency for the pool of sugar areas (with associated targets showing increase). However this indicator would require clear measurement procedures and criteria to ensure consistency and trustworthiness.
    - Atmospheric emissions from point sources
        - % compliance of stack emissions from sugar and rum factories with air quality standards/targets (as applicable) (specific indicator should be elaborated)
        - % compliance of sugar and rum factories with trade effluent standards (specific indicator should be elaborated)
        - Number of sugar and rum facilities in possession of NEPA air quality licences
    - Management of trade effluents
        - Number of sugar and rum facilities in possession of NEPA trade effluent licences
    - % compliance of trade effluents with trade effluent standards (specific indicator to be elaborated)

- The following specific projects and actions could be supported (under project modality):
    - Awareness-raising and capacity-building of small farmers on green cane harvesting and water efficient irrigation
    - Research and development of a system for the treatment of vinasse, coupled with an application for registration under the CDM to generate CER
    - Support in upgrading of NIC irrigation schemes (Rio Cobre and Clarendon), to maximise efficiency in delivery and use of water
    - Support to the GoJ in updating the scheme of charges for irrigation water in order to introduce incentives for water savings. Such activity must be accompanied by support to farmers on implementation and management of water efficient irrigation technologies and techniques
    - Development of capacities within the Ministry of Environment and the sugar sector on access to the Clean Development Mechanism
    - Technical assistance for the management of marginally saline water in irrigation of cane fields

PART I: BACKGROUND AND GENERAL CONTEXT

1. Description of the Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015 and the EC support strategy

1.1. Background

Jamaica is a country that had benefitted from the provisions of the European Union's Sugar Protocol, allowing it to export a quota of sugar to the EU market at a guaranteed price. In 2003 and due to a complaint to the World Trade Organisation (WTO) stemming from Australia, Brazil and Thailand, the EU was obliged to reduce the price at which it purchases sugar. The reform of the Sugar Protocol will have the effect of reducing the price paid for sugar by a total of 36% by 2009. This will inevitably have an impact on the competitiveness of the sugar industry in Jamaica.

As part of the sugar reform, the EU has agreed to help affected countries adapt to the new situation, by supporting sugar adaptation strategies prepared by the governments concerned. In the case of Jamaica the adaptation strategy is reflected in the **Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015** (JCS), prepared by the Planning Institute of Jamaica (PIOJ). The JCS will be supported by the European Commission (EC) through its Multi-annual Adaptation Strategy (MAS) through the General Budget Support (GBS) and the sector support aid delivery approaches.

The EC's Multi-Annual Indicative Programme 2007-2010 (MIP) for Jamaica allocations of the Accompanying Measures for Sugar (AMS) was developed based on the JCS and the EC Response Strategy. It has two main components, with a total allocation of 77.547 M€:

- A programme to support the sugar cane sector in Jamaica and diversification in Sugar Dependent Areas (SDA), in the form of Sector Budget Support (SBS), to support Objectives 1 and 2 of the JCS (development of a sustainable private sector-led sugar cane industry; and strengthening of economic diversification, social resilience and environmental sustainability of SDAs);
- A Macroeconomic Assistance Programme in the form of GBS, in support of Objective 3 of the JCS (maintaining progress towards macro-economic goals).

As the implementation of the JCS may have impacts on the environment, the Government of Jamaica (GoJ) and the EC have decided to carry out a Strategic Environmental Assessment (SEA) with the specific objective to *"confirm and complete the findings and recommendations of the JCS pertaining to environmental issues"*; in addition it is expected for the SEA to *"provide decision-makers in the Government, the EC and other donors with relevant information to be integrated into the implementation processes associated with the JCS"*. This SEA was commissioned by the Ministry of Agriculture (MoA) Sugar Transformation Unit (STU) and the EC Delegation in Jamaica. The STU is responsible for JCS implementation.

It should be highlighted that JCS was prepared in 2006 and the EC's support has already begun (through Financing Agreements for 2007 and 2008). This inevitably limits the opportunities for the SEA to have an influence in the contents of the JCS, as well as components already supported. Nevertheless opportunities still remain to enhance the environmental performance of JCS implementation if the government has the willingness to study and integrate recommendations that this SEA makes, as well as enhance the environmental dimension of upcoming Financing Agreements between the EC and the GoJ.

As part of the adaptation efforts, the STU has prepared a **Sugar Adaptation Development Programme** (SADP), aimed at mitigating the anticipated economic, social and environmental effects of the sugar reform, its development objective being *"improved living standards for poor marginal and small households in sugar dependent areas through improved social services and provision of alternative sustainable livelihoods"*.

1.2. Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015 (JCS)

The sugar industry in Jamaica remains important for its economy, in spite of the historical decline it has suffered since the mid-1960's.The export of raw sugar earns an average of 75 million USD annually in foreign exchange, representing 36% of export earnings from agriculture and 6% of total export earnings of the country. The export of rum now generates 29 million USD in export sales annually. The industry employs up to 38,000 persons directly.

Sugar production is centred on seven (7) large estates, each one currently with its own mill; five of them are government-owned and two are private. These estates account for some 60% of the total land area under cultivation. The remaining 40% is farmed by over 9,600 cane farmers, including small farms (less than 2 ha) and larger farms (over 300 ha), 60% of the farms being small.

The sugar industry in Jamaica faces a number of challenges, including:

- Adverse market trends. Not only the EU sugar reform, but also the fact that under the Everything But Arms (EBA) Initiative trade arrangements, the Less Developed Countries (LDC) will enjoy unlimited duty-free access to the EU market from 2009/10 for most goods including sugar. Nevertheless, under the Economic Partnership Agreement (EPA) between CARICOM and the EU, CARICOM countries will be able to export sugar to the EU duty-free and quota-free. Another adverse trend is the planned expansion of output by major raw sugar producers in the world markets and the continued growth of sugar substitute products.
- High production costs. The production costs of the sugar industry in Jamaica are amongst the highest within ACP countries.
- Other industry weaknesses, including structural and institutional weaknesses, run-down capital assets, road network in bad condition, shortages of field workers and high turn-over of professional staff, apart from the physical limits of the island which prevent Jamaica from attaining economies of scale such as those enjoyed by large world producers.

The JCS addresses the following problems in the industry:

- Insufficient production of raw sugar to meet domestic and export markets consistently
- Low average output and yield in cane cultivation
- Inefficient cane processing in mills
- Narrow revenue base of industry
- Vulnerability of sugar-dependent areas

In doing so, the JCS has established as its overall goal: *"To achieve an effective transition to a sustainable sugar cane industry over the period 2006-2015".*

In order to fulfil the goal, the following strategic objectives were identified:

1. Develop a sustainable private sector-led sugar cane industry;
2. Strengthen the economic diversification, social resilience and environmental sustainability of sugar-dependent areas;
3. Maintain progress towards macro-economic goals.

The elements of the JCS are summarised in Table 1 below.

Table 1. Summary of JCS elements

Component 1: Sustainability and competitiveness of the sugar cane industry
1.1. Increase role of the private sector In the first instance the government will seek private sector participation in the production facilities it currently owns, including the lands and factories at the five government-owned sugar estates. In addition the role of the existing private sector producers will increase, providing them with access to additional sugar cane lands within proximity to their estates that will enable them to increase their annual production of raw sugar to 75,000 tonnes, and to expand their output of other sugar cane based products including rum. Also private cane farmers will receive assistance to become more competitive.
1.2. Rationalisation of the sugar industry Increasing capacity utilisation at specific factories by reducing the total number of factories and re-allocating production between them. It will include: (1) Closure of raw sugar production at the government-owned factories of Bernard Lodge and Long Pond; (2) Lands for cane cultivation to support raw sugar production may be reduced by up to 5,000 ha (2006-2010); (3) Allocation of remaining lands to sugar cane cultivation seeking to minimise necessity to transport harvested cane over long distances to factories that remain in production; (4) Grouping of farmers in clusters of 200 ha or more to achieve economies of size. This will require centralised services, provided by a private contractor or large estate assigned responsibility for a number of blocs to carry out operations such as tillage, cultivation and harvesting; (5) Provision of technical and financial assistance to small cane farmers with viable landholdings to upgrade efficiency and profitability of sugar cane production.
1.3. Increased efficiency of field production Increase of efficiencies to targeted levels of around 8 tonnes of sugar per hectare. This will imply increasing cane yields from current average of 65 tonnes/ha to 77 tonnes/ha. This component will entail a series of integrated measures encompassing all major activities of cane production including land preparation, planting, fertilisation, irrigation and harvesting, as well as strengthening management of government estates. <u>Accelerated replanting programme</u> Renewal of over-aged cane stands by an accelerated replanting programme in all cane lands supplying the estates at Frome, Monymusk and St. Thomas. A special maintenance programme for the ratoons resulting from the replanting will be required. During the fifth year, the improved estates and farms will resume normal renovation at 16% of area per annum. <u>Irrigation and drainage</u> In the predominantly rain-fed cane areas of Frome and St. Thomas, an area of about 6,300 ha has been identified as suitable for irrigation through construction of new systems fed from rivers and wells, while an existing system on 3,000 ha at Monymusk will be improved. A long deferred programme of drainage maintenance on 3,500 ha at Frome, St. Thomas, and Monymusk will be implemented. Upgrading of irrigation works on the private estates. Upgrade of off-farm irrigation works, particularly in the South Clarendon area, to ensure adequate delivery of water to estate lands. <u>Upgrading of agricultural equipment</u> Replacement and upgrading of agricultural equipment to meet the needs of the estates at Frome, Monymusk and St. Thomas and the respective private cane farms. This will require procurement of heavy and light tractors, cultivators, mechanised harvesters, and cane leaders, trucks and trailers to ensure efficient cane transportation to mills.
1.4. Increased efficiency of factory production Efficiency targets for the industry (by 2010) include: increase efficiency of extraction rate of sucrose from cane at mills from current average of 90% to 94%; retention of sucrose as

commercial sugar after clarification, evaporation and the boiling process, to increase from current average of 80% to 87%; overall efficiency of the process to increase the recovery rate from around 70% to 81.8%.

Management of cane supply
Improve the efficiency of the harvesting and hauling operations to ensure even flow of fresh cane to the factory. This will entail: limitation of the "kill-to-mill" interval to less than 24 hrs; steady flow of vehicles to mill; reduction of extraneous material and soil loaded with the cane.

Upgrading of factory equipment
Replacement and upgrading of major processing equipment and application of deferred maintenance in general. This includes cane handling and milling equipment.
Energy recuperation from bagasse to be enhanced by installing new boilers and turbo-generators at all factories. Investments at Frome and St. Thomas to improve configuration of multiple effect evaporators and increase efficiency of exhaust steam use and fuel.

1.5. Reduction in overhead costs
Costs to be reduced may include corporate and estate administration, financing and depreciation costs, industry administration, and marketing and distribution costs. Such efforts may imply reduction of staff levels and social benefits.

1.6. Molasses production
Under the JCS the annual production target of raw sugar is 200,000 tonnes, which will produce 67,000 tonnes of molasses as co-product. But since annual demand of molasses for the rum industry will rise to 130,000 tonnes by 2010, the JCS envisages increasing production of high-grade molasses through operation on two boilings only in some factories for part of the season.

1.7. Rum production
Rum production is carried out almost entirely by two entities: J. Wray & Nephew Ltd. (private, operating 2 distilleries) and National Rums of Jamaica Ltd. (private with government participation, operating 2 distilleries). In addition there is smaller-scale production by the Sugar Company of Jamaica (SCJ), and a new operation at Worthy Park Estate.
Rum production represents and important value-added industry based on the sugar cane industry, and has projections of a strongly growing export market. The private sector is assumed to provide for the expansion of plant capacity required for growth, and the growth in the rum industry will support the expansion of cane and molasses production under the JCS.

1.8. Renewable energy
The JCS seeks to establish a favourable policy and market environment for the sugar cane industry to contribute to the production of renewable energy through biomass conversion and ethanol production. These measures would be in line with the GoJ's energy policy.
Improving the efficiency of the technology for bagasse incineration, through installation of high-pressure boilers within sugar factories will be necessary.
Cogeneration plants with capacity to generate electricity for export to the national grid would require an alternative fuel source to ensure continuous supply of energy. Under its energy policy framework the GoJ will provide a protocol that will govern the purchase of electricity by JPSCo from private producers, under power purchase agreements (PPAs).
The JCS will also take opportunity of the energy policy's requirement to replace MTBE in gasoline by ethanol up to 10% volume of gasoline, creating a local market for up to 70 million litres of anhydrous ethanol annually.

1.9. Ethanol production
The production of up to 70 million litres of ethanol to meet the local market for substitution of MTBE in gasoline will require up to 13,000 additional hectares of cane cultivation.
An additional ethanol plant may be established, its location and technology to be decided.

1.10. Other sugar cane based products
The industry will continue to engage in research and development of viable products and derivatives for diversification in the sector until commercialisation is feasible. As well, it will increase production and marketing of branded sugar as part of the strategy for the

development of value-added products.
The JCS also calls for a return to a managed import regime for refined sugar to prevent refined sugar imported duty-free for use as a raw material being diverted to the retail trade.

1.11. Human resource development

The transition in the industry will require a change in the mix of skills and expertise in the work force of the industry. This will require recruitment of new workers with skills that may currently not be available in the industry, as well as retraining of existing workers and training of new ones.
An audit of existing skills profile in all areas of the industry will be undertaken, as well as a training needs assessment based on future requirements of the industry.
Greater flexibility will be introduced in the labour market by developing multi-tasking and flexible work teams in field and factory operations, and restructuring contracts for seasonal and long-term employment to reduce costs and set basis for performance-linked incentives.

Component 2: Economic, social and environmental sustainability of sugar-dependent areas

The adaptation of the industry may involve changes in the structure and location of cane cultivation and sugar production that will lead to contraction of output and employment in areas which are highly dependent on the sugar industry, with the most vulnerable areas including communities around the Long Pond estate (Trelawny) and the Bernard Lodge estate (St. Catherine), where production of raw sugar is due for closure.
The JCS foresees actions to ensure the protection of the welfare of those dependent on the industry. The measures for affected regions will be formulated under Area Development Programmes (ADP).

2.1. Alternative uses of sugar cane lands

It is foreseen that some 6,000 less hectares will be required for raw sugar production, but about 5,000 ha will be needed for the increase in production of molasses for the rum industry, albeit expected in lands surrounding factories that would remain in raw sugar production. As well some small farmers with landholdings below viable threshold for sugar cane production may change to alternative livelihoods, including production of other crops.
The MoA has prepared economic models for a range of alternative uses of sugar cane lands. The JCS calls for an integrated approach to assist farmers to make the transition to alternative activities.

2.2. Economic development and diversification

Economic diversification of sugar-dependent areas will not be limited to alternative uses of cane lands, but will also include encouraging the growth of other industries and sectors. Research and surveys of business opportunities and risks will be carried out to provide a basis for the design of training programmes for business and vocational skills of workers and enterprises in sugar areas, and to establish business start-up programmes for SMEs.

2.3. Rural infrastructure

The ADPs will also plan for improvement of key rural infrastructure to support economic development and diversification in SDAs. Such actions may include repair of farm roads, repair and upgrading of selected agricultural feeder roads in target areas and improvements in rural water supply and irrigation systems.
Provision has also been made for lining and improvements to the main canals in the Rio Cobre Irrigation Scheme in St. Catherine.
The rural infrastructure improvement plan will also seek to provide power to communities in proximity to sugar areas that remain without access to electricity, and expand on Internet and broadband access in key rural towns and communities.

2.4. Social services

One of the highest priorities is that residents of communities in SDAs do not suffer from lack of adequate social services during the process of rationalisation of the industry. Health and educational institutions will be strengthened to fill gaps in social infrastructure now provided or supported by the sugar industry.

2.5. Compensation of displaced sugar workers The planned closure of raw sugar production at Long Pond and Bernard Lodge will involve termination of employment of factory staff (over 2,500 workers), and may lead to reduction of the permanent and seasonal field work force. This will involve redundancy payments. Worker compensations will be negotiated by the employers with the trade unions and relevant government agencies. For many displaced workers a programme to provide access to housing and farm lands on a concessional basis on available lands in proximity to their former estates will be considered.
2.6. Land use and environmental management ADPs will seek to ensure that any alternative uses of sugar cane lands are in conformity with existing land use zoning for these areas. The JCS will support the implementation of the Environmental Code of Practice on lands that remain under sugar cane cultivation within the targeted sugar dependent areas. Green cane harvesting will be promoted in suitable areas. Environmental guidelines will be also followed for lands that may be taken out of cane cultivation, including conformity with watershed management practices and undertaking EIAs as required for alternative uses.
Component 3: Macro-economic goals
3.1. Macro-economic stability The JCS must ensure the policy goals and targets of the Medium Term Socio-Economic Policy Framework (MTSEPF) continue to be met through the adaptation process. The JCS places additional demands on a wide range of ministries and agencies, and thus additional resources will need to be provided. The JCS also seeks resources to compensate for loss of foreign exchange earnings under the sugar reform.
3.2. Research and innovation The JCS will seek to support the activities of the National Commission on Science and Technology (NCST). The JCS will include the development of the strategic planning capacity of the government at the national level and at the local government level within relevant parishes that are now dependent on the sugar industry. The process of commercialisation of new technology-based products will be improved and enhanced by increasing the awareness and linkages with institutions and programmes.

The JCS was drafted in 2006 and since then, implementation has begun. An account is given of the progress implementation to the end of November 2008, according to the progress report produced by the STU.

The privatisation process began in 2006 and the Brazilian company Infinity Bio Energy Limited (IBE) was selected. However to date a final agreement has not been reached and privatisation has not materialised.

Some of the advances include the establishment of a Sugar Transformation Unit (STU) in the MoA to coordinate the effective implementation of the JCS, the role of which was expanded to include implementation of the SADP to mitigate social, economic and environmental effects of the EU sugar regime. The STU is currently undertaking preliminary studies for the social mitigation component of the SADP. A Sugar Transformation Steering Committee has been set up with representatives from the EU Delegation; All-Island Jamaica Cane Farmers Association (AIJCFA); Sugar Manufacturing Corporation of Jamaica; Trades Unions (BITU, NWU, UAWU); Sugar Industry Authority (SIA); Jamaica Cane Products Sales; Planning Institute of Jamaica (PIOJ); Ministries of Finance and the Public Service; Energy, Mining and Telecommunications; Agriculture; Foreign Affairs and Foreign Trade; and the National Irrigation Commission (NIC). This Steering Committee meets quarterly and guides the work of the STU.

In March 2007, the first Financing Agreement between the EU and Jamaica under the AMS was signed and provided for a grant to Jamaica in the amount of 5.218 M€. Of this amount part was earmarked for technical assistance and capacity building in support of implementation of the JCS and the balance of 4.4 M€ for delivery by budget support. The budget support component of the 2006 funds was used by the MoA to support rehabilitation, cane replanting and maintenance loans to the sugar industry, fertilizer price stabilization measures for farmers and operations of the STU.

The technical assistance and capacity building component of the 2006 funds has so far been used to finance employment of the Head of the STU, preparation of the Identification Study for Phase II of the Accompanying Measures for Sugar (Action Plan), study for Institutional Strengthening of the All-Island Jamaica Cane Farmers Association, and a Design Mission for ADPs in Jamaica.

The 2008 Draft Indicator Matrix was also finalized and approved. The Draft Indicator Matrices for 2009 and 2010 have been prepared and will be the subject of consultations with sugar stakeholders prior to approval by the Sugar Transformation Steering Committee.

The expenditure approved by the GoJ for 2008/09 includes expenditures for:

- Supplementing the cost of redundancy of SCJ employees;
- Supporting achievement of JCS target of 3.5 M tonnes cane (use of drip irrigation, cane expansion loans, etc);
- For start-up phase of the SADP;
- For a Public Awareness Campaign focused on the JCS;
- Supporting institutional strengthening of AIJCFA.

Some deviations from the wording of the JCS and the EC's MAS have already been taking place, in adapting to new situations. On the one hand, the closure of the Bernard Lodge and Long Pond factories (as indicated in the JCS) will not necessarily take place; the decision will lie with the new owners. As well the EC is widening the scope of its support, beyond merely the social components.

1.3. The Sugar Adaptation Development Programme (SADP)

The JCS is complemented by the SADP, prepared by the STU (and approved by Cabinet in September, 2008), aimed at mitigating the economic, social and environmental effects of the JCS. The SADP consists of three components: social, economic and environmental.

Social Services Component (SSC)

Social interventions under this component will include community awareness exercises, strengthening health and educational services and poverty alleviation actions to ensure that the most vulnerable groups including children and the elderly are protected.

IBE had committed to maintaining health, educational and recreational facilities operated by SCJ and have been requested to provide a provisional period of not less than 12 months after handover of sugar assets, during which the provision of water and electricity will not be disrupted. In the case of estate housing, those units not immediately required by IBE to house workers essential to operations will continue to be occupied by existing SCJ employees pending relocation. During the provisional period action will be taken to regularize or provide alternative sources of water and electricity. However now IBE take-over is on hold, so these advances are not guaranteed.

The repair and upgrading of selected rural roads, improvements in rural water supply, rural electrification and telecommunications in informal settlements are within the scope of the Social Services Component of the SADP.

Economic Diversification Component (EDC)

The EDC will identify alternative economic activities such as greenhouse production of high-value vegetable crops, tree crops for processing into value-added exportable products, livestock, heritage and community tourism. Displaced SCJ employees will be facilitated to

access training programmes in preparation for alternative employment or self-employment. Support will be provided through upgrade of pension benefits for unemployed pensionable SCJ employees, job search and placement, as well as assistance in setting up small business enterprises. Small cane farmers will be eligible to participate in the Programme.

Environmental Sustainability Component (ESC)
The ESC intends to involve the National Environment and Planning Agency (NEPA) as a partner with the MoA in ensuring the adherence to good environmental practices and observance of applicable environmental laws and regulations in the process of implementing the SADP.

Implementation of the SADP is being managed by the STU. At the territorial level, the Sugar Area Advisory Committees will provide oversight to Programme implementation in their respective areas. The Programme will run for five (5) years from 1 October 2008 to 30 September 2013.

1.4. The European Commission's Multi-Annual Assistance Strategy and Multi-Annual Indicative Programme 2007-2010 (MIP)

The purpose of the Multi-Annual Assistance Strategy is to *"sustainably strengthen the rural economy and social resilience in sugar dependent areas"*. The Assistance Strategy seeks to maximise the long-term poverty reducing impact of policies set out in the JCS. The results of the Multi-Annual EC Assistance Strategy are stated as follows:

1. Sources of income and employment in sugar-dependent areas diversified and level of income improved;
2. Economic and social conditions in sugar dependent areas improved;
3. Government supported in the implementation of the JCS.

The main mechanism foreseen for implementing the Assistance Strategy is untargeted budget support, mixed with project support. Although the scope of EC assistance may be expanded, the Assistance Strategy originally foresees centring its support around objective 2 of the JCS, in particular:

- establishing sustainable alternative uses for lands released from sugar cane;
- developing sustainable alternative economic activities in sugar areas;
- improving rural infrastructure in target areas;
- ensuring adequate social services are delivered in rural sugar areas;
- strengthening land use and environmental management in sugar cane areas;
- equitably supporting displaced sugar workers.

The Multi-Annual Indicative Programme (MIP) for Jamaica for the 2007-2010 allocations of the Accompanying Measures for Sugar Protocol countries further defines a combination of General Budget Support (GBS) and Sector Budget Support (SBS), the former to help maintain macro-economic stability and cushion the impact of the sugar reform, and the latter to aid in the privatisation process by shifting some of the social costs from the estates to the public sector and creating new market opportunities for sugar producers by the creation of local market for bio-ethanol and/or by the development of alternative economic activities.

1.5. The Head of Agreements between Infinity Bio Energy and the GoJ

A key element of the JCS is the privatisation process, which was due to be completed by the start of 2009. An agreement had already been reached with the Brazilian company Infinity Bio Energy Limited (IBE); however, with the turn in the world economic situation, IBE had to step back to ratify support to the deal with its own shareholders. Although IBE is still interested, due to the delays the GoJ has opened the possibility for other companies to bid. At the time of writing privatisation has not yet been brought to term.

Nevertheless, as a framework agreement (called the Head of Agreements, or HOA, signed 27 June 2008) had already been reached between IBE and the GoJ, it becomes an important

reference document, as it gives a general indication of the GoJ's expectations. For this reason, a general outline is given here of key elements of the HOA relevant to this SEA.

Some commitments of the GoJ include the passing of certain laws or regulations. These include laws to require a cleaner fuel matrix, starting at a mandatory E10 (starting 1 October, 2008 and phased in by 1 April, 2009), and providing that E25 use will be required of all vehicles that are E25-compatible on 1 July 2009, and the balance of vehicles phased in over a period of time to be agreed. Also the GoJ would have to pass appropriate laws to put in place enforceable long term Power Purchase Agreement(s); these would be necessary for the production of renewable energy to be sold to the national power grid.

Key commitments by IBE of relevance to this SEA include:

- Introducing methods aimed at improving agricultural productivity and developing the local sugar cane industry, including:
  - Assisting farmers, through a farmers development programme; providing them with associated services such as cane cultivation, harvesting, loading and transportation;
  - Developing new varieties of sugarcane;
  - Increasing mechanisation and irrigation when appropriate to levels that maximise financial returns.
- Investing in modernisation and expansion of the industrial facilities, including replacement of obsolete equipment; improving cane upload and preparation, improving efficiency of steam and energy consumption; automation systems.
- A commitment to transfer technical management skills and best practices from the Brazilian sugar industry in order to upgrade and develop such skills in Jamaica.
- Diversifying the range of products, including to sugar, ethanol, molasses, co-generation of energy from bagasse and bagasse pellets.
- Promoting the acceleration of the GoJ's strategy of implementing a cleaner fuel matrix, including: replacing MTBE for ethanol; guaranteeing the supply of ethanol; providing renewable energy to the grid by investing in co-generation facilities, creating a cleaner use for the by-products and making the facilities self-sufficient in terms of energy consumption.
- Promoting and supporting the following social programmes in the communities surrounding the Estates: provision and maintenance of clinics, housing and sports facilities; provision of financial support to schools and churches; provision of medical and dental assistance.

Development targets include:

- Total cane crushed: 1,417,771 tons by the end of FY2009, gradually increasing to a total of 2,558,130 tons by the end of FY2013;
- Sugar production: 125,693 tons by the end of FY2009, gradually decreasing to a total of 62,000 tons by the end of FY2013;
- Ethanol production: 79.395 million litres by the end FY2010, gradually increasing to a total of 135.358 million litres by the end of FY2013 (produced at Bernard Lodge, Frome and Monymusk);
- Molasses production: 63,800 tons by the end of FY2009, gradually increasing to a total of 26,989 tons by the end of FY2013;
- Energy generation: starting with a production of 138 GWh by the end of FY2011, gradually increasing to a total of 168 GWh by the end of FY2013, produced at Bernard Lodge, Monymusk and Frome (it is expected for there to be only one cogeneration facility for both Bernard Lodge and Monymusk).

This agreement clearly differs from the JCS in terms of production targets. Especially relevant is that ethanol will be produced within existing industrial sites (Bernard Lodge, Frome and Monymusk), and that the amount of ethanol production will be in the order 79-135 million litres annual production instead of the 70 million litres foreseen in the JCS (implying a production of up to 2,025 million litres of dunder, instead of the approximate 1,050 expected under the JCS).

2. Policy, institutional and legislative framework

2.1. Key relevant government and other institutions

For the purposes of studying the potential environmental effects of the JCS on the environment, the most relevant government (and semi-governmental) institutions and key stakeholders are:

- Ministry of Agriculture (MoA), including the Sugar Transformation Unit (STU)
- National Environment and Planning Agency (NEPA)
- Water Resources Authority (WRA)
- Sugar Industry Authority (SIA)
- Sugar Industry Research Institute (SIRI)
- National Irrigation Commission (NIC)
- Ministry of Energy (MoE)
- Planning Institute of Jamaica (PIOJ)
- Jamaica Meteorological Office (JMO)
- Pesticides Control Authority (PCA)
- National Works Agency (NWA)
- Town and Country Planning Authority
- All-Island Jamaica Cane Farmers Association (AIJCFA)

Ministry of Agriculture (MoA) and Sugar Transformation Unit (STU)

The Ministry of Agriculture has ultimate policy responsibility for the sugar industry and regulates and provides research services through the SIA and its research arm the SIRI. The Chairman of the SIA reports directly to the Minister and Permanent Secretary. By virtue of its ownership of 5 sugar estates GoJ also appoints the Board of Directors of the SCJ.

The Sugar Transformation Unit (STU) is an agency within the Ministry which was created to ensure the implementation of the JCS. It is also in charge of its monitoring as well as of developing and implementing the SADP.

National Environment and Planning Agency (NEPA)

NEPA is an executive agency created in 2001 as a merger between the Natural Resources Conservation Authority (NRCA), the Town and Country Planning Department, and the Land Development and Utilisation Commission. It is the main environmental authority in Jamaica and operates under the following Acts:

- The Natural Resources Conservation Authority Act;
- The Town and Country Planning Act;
- The Land Development and Utilisation Act;
- The Beach Control Act;
- The Watershed Protection Act;
- The Wildlife Protection Act;
- The Endangered Species Act.

It is guided by the following policies and plans:

- Jamaica National Environmental Action Plan (JaNEAP) 2006-2009 ;
- National Physical Plan;
- Policy for Jamaica's System of Protected Areas, 1997;
- Biodiversity Strategy and Action Plan (draft);
- Watershed Management Policy (draft);
- Beach Policy for Jamaica (draft);
- Environmental Management Systems Policy and Strategy (draft).

The key activities of NEPA are:

- Monitoring the natural resources assets and the state of the environment in Jamaica;

- Preparing National Environmental, Planning and Developmental Strategies and Action Plans, and monitoring the implementation of related programmes/initiatives;
- Processing applications for Environmental Permits and Licences for, *inter alia*: construction and operation of industrial facilities listed on the Prescribed Categories Project List; sewage discharge; and industrial waste discharge, including discharge into the atmosphere;
- Preparing Town and Parish Development Orders;
- Enforcement of environmental and planning laws and regulations.

NEPA works closely with the Water Resources Authority (WRA) and the National Irrigation Commission (NIC) with regards to the monitoring of water quality and use.

Water Resources Authority (WRA)

The WRA was created under the Water Resources Act 1995. As part of its functions, it is its duty to regulate, allocate, conserve and otherwise manage the water resources of Jamaica. In doing so it engages, *inter alia*, in the following activities:

- Obtaining, compiling, storing and disseminating data concerning the water resources;
- Exercising planning functions in relation to the Master Plan and Water Quality Control Plans;
- Allocating water resources;
- Controlling the quality of water resources;
- Providing technical assistance to any department or agency of the GoJ in respect to any projects, programmes or activities which relate to the development, conservation and use of water resources.

The WRA grants permits for the drilling of wells and their exploitation, establishing the sustainable levels of water abstraction and thus defining permissible volumes of abstraction (which are metered and compliance ensured through inspections). In a similar fashion it regulates abstraction of surface waters. Water Quality Control Areas may be declared for those areas where a plan of coordinated measures is necessary for the protection of the water resources in the public interest.

Sugar Industry Authority (SIA) and the Sugar Industry Research Institute (SIRI)

The SIA was established under the Sugar Industry Control Act, and its main role is to ensure the implementation of the Act. It has advisory functions to the GoJ on matters of, *inter alia*, general policy with respect to the operations and development of the industry, and redundancy due to mechanisation of the industry. The SIA also analyses and reviews existing practices, new developments or issues that importantly affect the industry; and organises and promotes scientific studies relevant to the sector.

SIRI is part of the SIA, covering the research component. SIRI has engaged in environmental research and monitoring in the sugar sector, including research related to: application of fertilisers; weed control; irrigation and drainage; reduced tillage technology; and monitoring of effluent and atmospheric emissions.

SIRI has also been a key actor in the development of the Environmental Code of Practice for the Sugarcane Industry, and has promoted the establishment of Local Environmental Committees at all factories, which are supported and facilitated by SIRI.

National Irrigation Commission (NIC)

The NIC aims to facilitate the development, co-ordination and expansion of the irrigation sub-sector in Jamaica, by developing and managing irrigation schemes. It is a government company that manages and develops irrigation schemes and sells irrigation water to farmers. As far as the sugar sector is concerned, there are two NIC irrigation schemes that provide water to sugar cane fields: the Rio Cobre Scheme in St. Catherine and the Mid-Clarendon Scheme in Clarendon.

Ministry of Energy (MoE)

The mission of the MoE is *"to formulate policies, systems and processes to effectively manage the sustainable development of the energy sector in support of economic development and improved standards of living"*. The MoE is particularly relevant to this SEA as it plans and regulates on the generation of electricity from bagasse in the sector, as well as the possibility of generating excess electricity to be sold to the national power grid. As well the MoE has a biofuels policy that is directly relevant to the JCS, which foresees the construction of an ethanol plant in Jamaica.

The Energy Policy 2006-2020, and its accompanying Energy Conservation and Efficiency Policy 2008-2022 are the key policy documents guiding the energy sector.

Planning Institute of Jamaica (PIOJ)

The PIOJ has responsibility for the national planning, including the JCS, Vision 2030 National Development Strategy and the Medium Term Socio Economic Development Framework 2009-2012.

Jamaica Meteorological Office (JMO)

The JMO is the national focal point to the UNFCCC, so it has responsibility for the preparation of the national communications. The initial National Communication was prepared in 2000, and the second one is being completed (2009). The actors in the sugar production sector need to pay close attention to the findings of the work done under the UNFCCC, as climate change may have detrimental effects on the sector, as already pointed out in a preparatory study for the second National Communication.

Pesticides Control Authority (PCA)

The PCA has the mandate (under the Pesticides Act, 1975) to carry out regulation and control of pesticide use in Jamaica, and it is made up of representatives from public sector organisations that are concerned with pesticide use and regulation. It sets policies for the control and regulation of the industry, including matters related to registration, importation, manufacture, retail, use and disposal of pesticides.

National Works Agency (NWA)

The mission of the NWA is to plan, build and maintain a reliable, safe and efficient main road network and flood control system which protects life and property; supports the movement of people, goods and services; reduces the cost of transportation; promotes economic growth and quality of life; and protects the environment. The NWA is relevant to the sugar industry insofar as flood control is concerned, as well as in relation to the upgrading of rural infrastructure.

All-Island Jamaica Cane Farmers Association (AIJCFA)

The AIJCFA is an independent grouping of cane farmers funded by a voluntary cess on cane delivered to the factories. They represent independent cane farmers' interests *vis-à-vis* the manufacturers and government, and sit on the board of the SIA. Each factory area is served by a cane farmers' representative group and organising officer from the association.

Town and Country Planning Authority

The Town and Country Planning Authority falls under NEPA and issues permits for land use changes that imply clearance of more than 20 hectares. Other changes in land use (in and out of agriculture) may also require a permit, which is discussed between NEPA and the MoA.

2.2. Key relevant policies, legislation and environmental standards

The key policies, plans, legislation and standards of more relevance to the environment and the sugar sector are briefly described below. Only those which are relevant to the purposes of this SEA are addressed, and the table is not meant to be a comprehensive catalogue of all policies, plans, legislation and standards applicable to the sector.

Table 2. Summary of key policies, plans, legislation and standards relevant to the SEA

Policy / Plan / Legislation / Standard	Remarks on link to sugar sector
Policies and Plans	
National cross-sectoral planning	
Vision 2030 Jamaica, National Development Plan	Under this document, there are three National Outcomes associated to the environment, and which are also relevant for the sugar sector. National Outcome 13 is *"sustainable use and management of natural resources"*. The following national strategies are defined: integrate environmental issues in economic and social decision-making policies and processes; develop and implement mechanisms for biodiversity conservation and ecosystems' management; develop efficient and effective governance structures for environmental management; and manage all forms of waste effectively. National Outcome 14 is "hazard risk reduction and adaptation to climate change". The following national strategies are defined: improve resilience to all forms of hazards; develop measures to adapt to climate change; contribute to the effort to reduce the global rate of climate change; and improve emergency response capability. National Outcome 15 is *"sustainable urban and rural development"*. The following national strategies are defined: create a comprehensive and efficient planning system; create an appropriate framework for sustainability planning; create sustainable urban centres, including urban renewal and upgrading; create vibrant and diversified rural areas; and ensure safe, sanitary and affordable shelter for all. The National Development Plan also addresses the environmental impacts of the energy sector; promotion of energy efficiency; promotion of environmental management in industry and agriculture.
Medium Term Socio-Economic Policy Framework 2009-2012	This document embodies the GoJ's development strategy for the period 2009-2012. It supports the overall vision, goals and outcomes of the long term Vision 2030 Jamaica National Development Plan and is the vehicle that transforms the long term goals and outcomes into short term priorities, strategies, programmes and projects over the next three years. It concentrates on the strategies of the public sector. Unfortunately it does not identify the environmental sustainability component either as priority outcome or a supporting outcome (except for adaptation to climate change, which is a supporting outcome).
Development Orders	Development Orders define land use at the Parish level. So far they have only been prepared for St. Ann and Manchester (neither of them sugar areas). The process has been initiated for St. Catherine and Trelawny.
Environment	
Jamaica National	JaNEAP outlines the environmental issues facing Jamaica and gives

Environmental Action Plan 2006-2009 (JaNEAP)	an overview of the present state of the environment and economic implications. It summarises progress made towards addressing the issues, and presents a plan for the main actions to be undertaken over the 2006-2009 period. A list of indicators is also included. It includes goals related to, *inter alia*, regulation of industrial effluents, regulation of pesticides, regulation of atmospheric emissions, studying impact of rum distilleries on water systems and promotion of co-generation.
Biodiversity Strategy and Action Plan, 2003	The policy and action plan to address the conservation of biodiversity and addressing degraded areas will necessarily imply co-ordination with the agricultural sector. The strategy foresees, for example, a review of the current agricultural policies to determine impediments to sustainability, and establishing and enforcing land zoning and control measures to prevent expansion of agriculture into inappropriate areas (amongst other actions).
Environmental Management Systems Policy and Strategy (draft)	Policy for the promotion of Environmental Management Systems in Jamaica. It will support NEPA efforts to promote environmental stewardship in the sugar factories.
Policy for Jamaica's System of Protected Areas, 1997	Policy for planning and managing protected areas, some of which may be affected by the sugar industry.
Water and irrigation	
Watershed Management Policy (draft)	Foresees a series of initiatives for the monitoring and control of watersheds. These initiatives will necessarily imply inter-institutional and inter-sectoral coordination. Direct relevance to the sugar sector is not evident, but may translate in regulations and control over water use and agricultural practices.
Energy	
Energy Policy 2006-2020	Three policy recommendations are especially relevant to the sugar industry: establishment of protocols to guide contractual arrangements between independent power producers and any dominant players in the industry, including arrangements for co-generation; introduction of ethanol as an octane enhancer to replace MTBE (initially 10% to be increased incrementally within five years to 15%); and contribution from renewable sources to the electricity sector to be increased from current level of 6% up to 10% by 2010 and 15% by 2020.
Energy Conservation and Efficiency Policy 2008-2020	Document supporting the Energy Policy 2006-2020.
Acts	
Environment	
Natural Resources Conservation Authority Act, 1993	Created the NRCA (later merged with other government bodies to create NEPA), and determines its mandate and functions, which include definition of environmental standards and permitting.
Water and irrigation	
Water Resources Act, 1995	Established the Water Resources Authority to regulate water resources, based on their availability and quality.
Watershed Protection Act, 1963	Its purpose is to provide for the protection of watersheds (declared under NEPA recommendation) and adjoining areas, and promote conservation of water resources. It makes provision for conservation through provisional improvement schemes.
Flood Water Control Act, 1958	Provides for the designation of flood-area control zones, for which flood water control schemes should be developed. Currently full responsibility lies with the WRA.
Irrigation Act, 1949	Sets the framework for government irrigation schemes, now managed by the NIC.
Town and country planning	
Land Development and	Establishes a land management agency, now merged into NEPA. It

Utilisation Act, 1966	defines provisions for the adequate use of agriculture land.
Town and Country Planning Act, 1958	Establishes the Town and Country Planning Authority, now merged into NEPA. It defines provisions for land use planning.
Other	
Pesticides Act, 1975	Establishes the Pesticides Control Authority to register and regulate the importation and use of pesticides.
Regulations	
Environment	
Natural Resources Conservation (Wastewater and Sludge) Regulations, 2005	Establish regulations governing the disposal of sewage, trade effluents and industrial sludge (including disposal of treated effluents). It defines the obligation to hold a license for effluent and sewage discharge, and sewage sludge disposal and the requirements to obtain it. It also defines requirements for setting up and operating treatment plants as well as for monitoring of discharges. Distinction is made between “existing facilities” (existing prior to the regulations) and “new facilities”, which are treated differently.
Natural Resources Conservation Authority (Air Quality) Regulations, 2006 (amended in 2006)	Establish a requirement for “major facilities” or “significant facilities” to hold an air pollutant discharge license. It also makes provision for: monitoring of emissions and establishment of emission fees; in the case of non-compliance it establishes provisions for the definition of compliance plans; regulation of fugitive emissions (in the case of the sugar industry, cane burning); and regulation of sulphur content of fuels. Distinction is made between “existing facilities” (existing prior to the regulations) and “new facilities”, which are treated differently.
Standards	
Environment	
Sewage Effluent Standards, 1996	Defined in the Wastewater and Sludge Regulations, 2005
Trade Effluent Standards, 1995	Defined in the Wastewater and Sludge Regulations, 2005
Air Quality Standards	Defined within the Air Quality Regulations, 2006
Guidelines	
Environment	
Ambient Air Quality Guideline Document, 2006	Designed to provide owners and operators of facilities requiring air pollutant discharge licences with information that will assist them satisfy the requirements for applications and conditions for air pollution discharge licences. It can also be used by those conducting ambient air quality assessments, and outlines requirements for the management of ambient monitoring data to be compiled by NEPA.
Ambient Air Quality Staff Guidance	Provides NEPA staff with performance based standards for processing Air Pollutant Discharge Licence applications and addressing the ongoing requirements of conditions attached.
Guidelines for Conducting Environmental Impact Assessments, 2007	Guidelines that guide users through the EIA process.

3. Approach and methodology

The SEA Study was preceded by the preparation of a Stakeholders’ Engagement Strategy and a scoping stage, where the key environmental concerns were identified, and the approach to the SEA Study proposed.

A scoping phase was carried out from 12-23 January 2009, which identified the key environmental concerns of the sugar industry and of JCS implementation, based on literature review and consultations with stakeholders. The four key concerns identified are:

1. **Pressure on groundwater resources**, due mainly to: over-abstraction of groundwater; inefficient irrigation; inadequate drainage of fields, particularly poor regional drainage networks; and possibly to be exacerbated by effects of climate change.
2. **Land degradation**, due mainly to: inadequate drainage of fields; abandonment of land taken out of cane; salinisation of land from irrigation with high conductivity groundwaters.
3. **Water contamination**, due mainly to: discharge of industry wastewaters into the aquatic environment; increase in production of vinasse with planned increase of ethanol production.
4. **Atmospheric pollution**, due to: sugar cane burning practices and stack emissions from sugar factories.

Other – lower priority - environmental aspects identified included: water contamination due to application of fertilisers and agrochemical products, aerial spraying and use of personal protection equipment in the field.

The main activities carried out in the SEA Study included:

- Definition of the environmental baseline. The environmental baseline gives a general overview of the sugar sector as well as of the state of the environment in the sugar areas, focusing on the key environmental aspects; for these it provides:
  - A description of the state of the environmental aspects;
  - A description of the key drivers (causes that determine their state, be them causes of degradation or of improvement);
  - A description of the trends in the state of the environmental aspects;
  - A description of how the environmental aspects are expected to change in the future, independently of the JCS.
- An evaluation of the likely effects that the JCS will have on the key environmental aspects and other significant environmental impacts it may generate, including the degree to which the JCS addresses the key environmental concerns of the sector. This analysis takes into consideration technical, institutional and regulatory dimensions.
- Leopold-type matrices were prepared to visually illustrate the key environmental concerns in the sugar sector, as well as the degree to which the JCS has an incidence on them.
- A review of JCS and MAS indicators to ensure their environmental consistency, i.e. that application of indicators will not lead to negative environmental impacts and ensuring key environmental aspects receive due attention.
- Recommendations to the GoJ for improvement of the environmental performance of the JCS, as well as to the EC for improvement of environmental performance of its aid delivery.

The compilation of necessary information for the analysis was done through a more extensive (focused) literature review, focused semi-structured interviews with key actors and field visits, all complementary to the review already done during scoping. Dedicated questionnaires were sent to key stakeholders in advance of the SEA Study mission, in order to compile as much relevant data as early as possible, based on the information and data needs identified during scoping.

Further relevant documents and information were obtained from stakeholders; WRA's resource centre was visited; field visits were organised at the Monymusk and Bernard Lodge sugar estates, and further interviews were held with representatives from the STU, IBE, NEPA, and the Environmental Management Division (Office of the Prime Minister). Various other stakeholders were contacted to obtain and/or corroborate data and relevant information.

A one-day workshop was held on 19 February in Mandeville, attended by 48 participants representing a wide range of stakeholders (see Annex 3), to discuss the key environmental concerns of the sector and explore options to address them. The workshop was organised under the auspices of the Jamaica Association of Sugar Technologists (JAST) and the EC, and chaired by the Director of Research of SIRI (Dr Earle Roberts); key actors from relevant agencies were invited to make a short presentation on the key concerns (see the workshop's Agenda in Annex 2) prior to opening discussions on the subject.

Figures 1 and 2 below (matrices) synthesise the findings of the scoping phase and show the key environmental concerns in the sugar industry, as well as the key potential environmental impacts of implementing the JCS.

Limitations of the SEA Study

The conducting of this SEA faced a number of obstacles and limitations, which should be taken into account when interpreting the findings. Before describing them the authors should like to stress that the findings are sound, and that any necessary words of caution needed (e.g. important assumptions) are emphasised in the text. The key constraints faced by the team were: time limitations, old and/or incomplete data, and limited response of some stakeholders to requests of information and data.

Time-wise, this SEA was under a tight timing, allowing for only 67 man-days between both experts. This obliged the team to focus on key issues and options, and wider or more detailed analyses was not possible (e.g. analysing consistency of JCS and proposed recommendations with a wider range of policy instruments and objectives; more detailed institutional needs assessment). As well only three sugar estates were visited, and no time was available to carry out further interviews on the field (e.g. small-scale farmers and local authorities).

For several of the aspects studied, the available sources of information are old (e.g. 1980's), and newer information is either not compiled or dispersed, but in any case of difficult access when it exists. Some of the areas where this problem was faced include monitoring of surface and groundwater quality, quantification of wastewater production from industry per source, and stack emissions from sugar factories. Personal interviews and the knowledge of the local expert helped fill this gap and validate reliability of older sources.

Some requests for information were not forthcoming, or responses were incomplete. More time would have allowed to chase responses and obtain more detailed information, but was not available. The implications of any data gaps are explained in the text as necessary.

Figure 1. Summary of key current impacts of Jamaica's sugar industry on the environment

SUGAR INDUSTRY	Water balance	Org. cont. of groundwater	Inorg. cont. of groundwater	Saltwater intrusion	Org. cont. of surface water	Inorg. cont. of surface water	Soil salinisation	Soil erosion	Soil compaction	Other soil characteristics	Ambient air quality	Greenhouse gas emissions	Protected areas	Biodiversity	Terrestrial flora and fauna	Aquatic flora and fauna	Coastal waters	Coral health	Landscape	Human health	Energy efficiency	Employment	Social services	Rural infrastructure
Field operations																								
Field preparation																								
Mechanised planting																								
Mechanised harvesting																								
Use of organic fertilisers																								
Use of inorganic fertilisers																								
Use of agrochemical products																								
Groundwater abstraction																								
Surface water abstraction																								
Irrigation																								
Fertigation; irrigation w/washwaters																								
Sugar cane burning																								
Transport of sugar cane to factories																								
Sugar factories																								
Wash water disposal																								
Milling water disposal																								
Disposal of water from evaporators																								
Filter cake disposal (slurried)																								
Boiler ash disposal																								
Fly ash disposal																								
Boiler operations																								
Burning of bagasse																								
Co-generation																								
Ethanol production																								
Disposal of vinasse																								

Colour key: Yellow: negative, low significance; Orange: negative, medium significance; Red: negative, high significance; Light green: positive, low significance; Dark green: positive, high significance

Figure 2. Summary of potential environmental impacts of JCS implementation

JCS COMPONENTS	Water balance	Org. cont. of groundwater	Inorg. cont. of groundwater	Saltwater intrusion	Org. cont. of surface water	Inorg. cont. of surface water	Soil salinisation	Soil erosion	Soil compaction	Other soil characteristics	Ambient air quality	Greenhouse gas emissions	Protected areas	Biodiversity	Terrestrial flora and fauna	Aquatic flora and fauna	Coastal waters	Coral health	Landscape	Human health	Energy efficiency	Employment	Social services	Rural infrastructure
1. Sustainability and competitiveness																								
1.1. Increase role of the private sector																								
1.2. Rationalisation of the industry																								
1.3. Increased efficiency of field prod																								
- Accelerated replanting programme																								
- Irrigation and drainage																								
- Upgrading of agricultural equipment																								
1.4. Increased efficiency of factory prod																								
- Management of cane supply																								
- Upgrading of factory equipment																								
1.5. Reduction in overhead costs																								
1.6. Molasses production																								
1.7. Rum production																								
1.8. Renewable energy																								
1.9. Ethanol production																								
1.10. Other sugar cane based products																								
1.11. Human resources development																								
2. E+S+En sust of sugar-dpendt areas																								
2.1. Alternative uses of sugar cane lands																								
2.2. Economic dev and diversification																								
2.3. Rural infrastructure																								
2.4. Social services																								
2.5. Compensation of displaced workers																								
2.6. Land use and env management																								
3. Macro-economic goals																								
3.1. Macro-economic stability																								
3.2. Research and innovation																								

Colour key: Yellow: negative, low significance; Orange: negative, medium significance; Red: negative, high significance; Light green: positive, low significance; Dark green: positive, high significance

PART II: STATE OF THE ENVIRONMENT AND IMPACT ANALYSIS

4. The sugar sector in Jamaica[1]

For the purposes of this SEA, the sugar sector is understood in a wide sense to include: sugar cane farming; sugar cane processing (sugar factories); rum distilleries; and ethanol production.

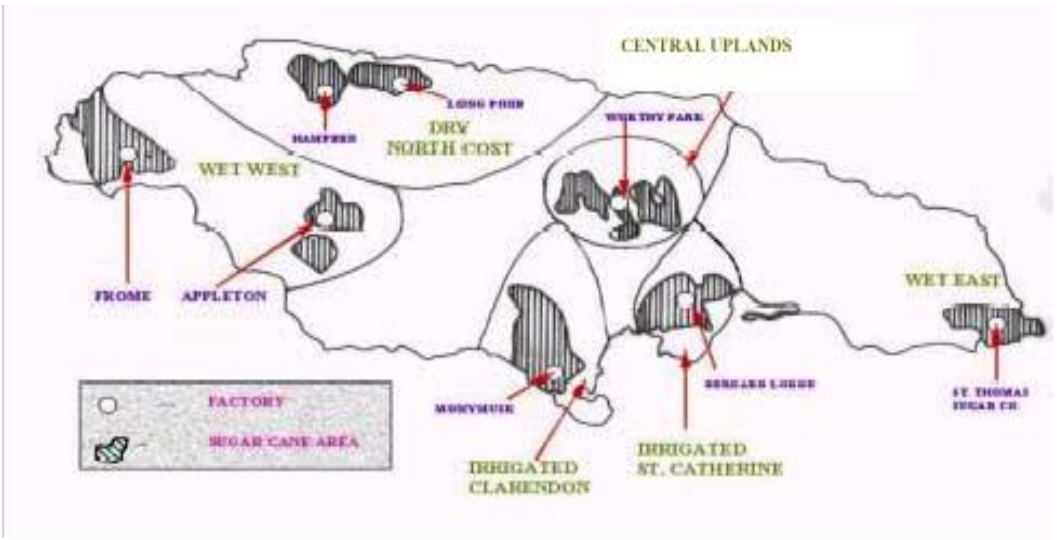
The Jamaican sugar industry has occupied a central position in the island's economy for over three hundred years. Production of sugar cane has shown a historical decline from the peak of the industry in 1966 (when over 4.8 million tonnes of cane were harvested), to the most recent decade during which the annual output of sugar cane has fluctuated between 2.0 and 2.6 million tonnes. The amounts of raw sugar produced over the past decade have shown similar fluctuations, between 150,000 to 237,000 tonnes annually, along with an average of 80,000 tonnes of molasses. Rum production based on local and imported molasses has increased from 19.8 million litres in 2000 to 24.8 million litres in 2004, about half of which is exported. The other products of the sugar cane industry include bagasse, which is largely consumed within the sugar factories as fuel.

In Jamaica there are currently two main groups of producers for sugar cane:

a. Seven large estates each with a mill. Five are government owned (owned and operated by SCJ) while two are privately owned and operated. These estates account for some 60% of the total land area currently under sugar cane (approximately 18,000 ha).
b. Over 9,600 sugar cane farmers that represent 40% of the total area under sugar cane (12,000-14,000 ha). The farmer category includes individuals operating less than 2 ha as well as larger farms over 300 ha in size, with over 60% of farms being less than 2 ha in size.

The production of sugar cane is concentrated in a number of well defined regions, including both the eastern and the western tips of the island, the northern as well as the southern coast, and a portion of the central uplands (Figure 3). Table 3 below provides an outline of the sugar production areas.

Figure 3. Map showing disposition of sugar cane growing areas in Jamaica



[1] Based largely on information contained in the JCS.

Table 3. Outline of sugar areas

Estate / Farms	Ownership	Parish	ha planted (2008)
Appleton/Hol/Yarmouth	Private	St. Elizabeth	4,296
Frome	SCJ	West Moreland	4,500
Bernard Lodge	SCJ	St. Catherine	3,323
Long Pond	SCJ	Trelawny	1,200
Monymusk	SCJ	Clarendon	3.006
St Thomas	SCJ	St. Thomas	1,277
Worthy Park	Private	St. Catherine	1,200
Independent growers	Private	All of the above	12,000 - 14,000
Total			**30,802 - 32,802**

Rum production is carried out mainly by J. Wray & Nephew Ltd, which operates two distilleries (one at Appleton Estate and the other at New Yarmouth), and National Rums of Jamaica Ltd (private company with government participation), which operates a distillery at the Monymusk sugar factory and another one at Long Pond. These two companies produce approximately 96% of the rum in Jamaica (58% by J. Wray & Nephew Ltd and 38% by Jamaica National Rums Ltd). In addition, the Sugar Company of Jamaica (SCJ) operates a distillery at Hampden, accounting for 1% of national production, while Worthy Park Estate has recently started operations with a new pot still distillery.

Table 4. Production of rum in Jamaica's distilleries (source: National Rums, questionnaire response and other sources – Appleton estate, Worthy Park estate)

Rum distillery	Production (laas/yr) (2008)	Parish
Appleton Estate	8,265,238	St. Elizabeth
New Yarmouth Ltd.	6,598,036	Clarendon
Clarendon Distillers (Monymusk)	6,685,025	Clarendon
Long Pond	474,756	Trelawny
Hampden	227,716	Trelawny
Worthy Park	~400,000	St. Catherine
Total	**22,650,771**	

Ethanol is currently not produced in Jamaica, although hydrated ethanol is imported from Brazil and processed at dehydration plants located at Rockfort, Port Esquivel and Petrojam in Kingston.

5. General state of the environment in Jamaica[2]

5.1. General state of the environment

Jamaica is a small island developing state located in the North-western Caribbean Sea. It has an elongated shape, approximately 230 km long by 80 km at its broadest; it has a total area of 10,991 km^2. Administratively it is divided into three counties: Cornwall, Middlesex and Surrey, and further subdivided into 14 parishes.

Jamaica has a population of 2,641,950 inhabitants (2004 data). Although over 50% of the population lives in urban areas, most of the parishes are in fact predominantly rural. Also, the majority of Jamaicans live near the coast, resulting in higher pressures over the coastal environment.

[2] Based mainly on Underground Water Authority (1990); Statistical Institute of Jamaica and NEPA (2001); Statistical Institute of Jamaica (2006) and NEPA (2006).

Figure 4. Map of Jamaica with administrative boundaries (source: US Army Corps of Engineers, 2001)

About 68% of the dwellings have access to piped water (1999 data), which is treated prior to distribution. The great majority of households (99.5%) have either flush toilets or pit latrines, and over 80% (1999 data) have electricity connections.

Jamaica has seen a declining trend in incidence of poverty, standing at around 15.9% by 1998, with the highest incidence being in the rural areas (19.5%), and mainly concentrated in the parishes of St. Mary (38.2%), Westmoreland (33.3%), St. Ann (22.5%), Portland (18.3%) and St. Elizabeth (18.4%) (1998 data). The Human Development Index (HDI) for Jamaica is 0.771 (2006), and is classified as a medium human development according to the UN. Life expectancy at birth stands at 72.3 years; adult literacy rate (above 15 years of age) at 85.5% and GDP per capita at 6,409 USD (2006 data).

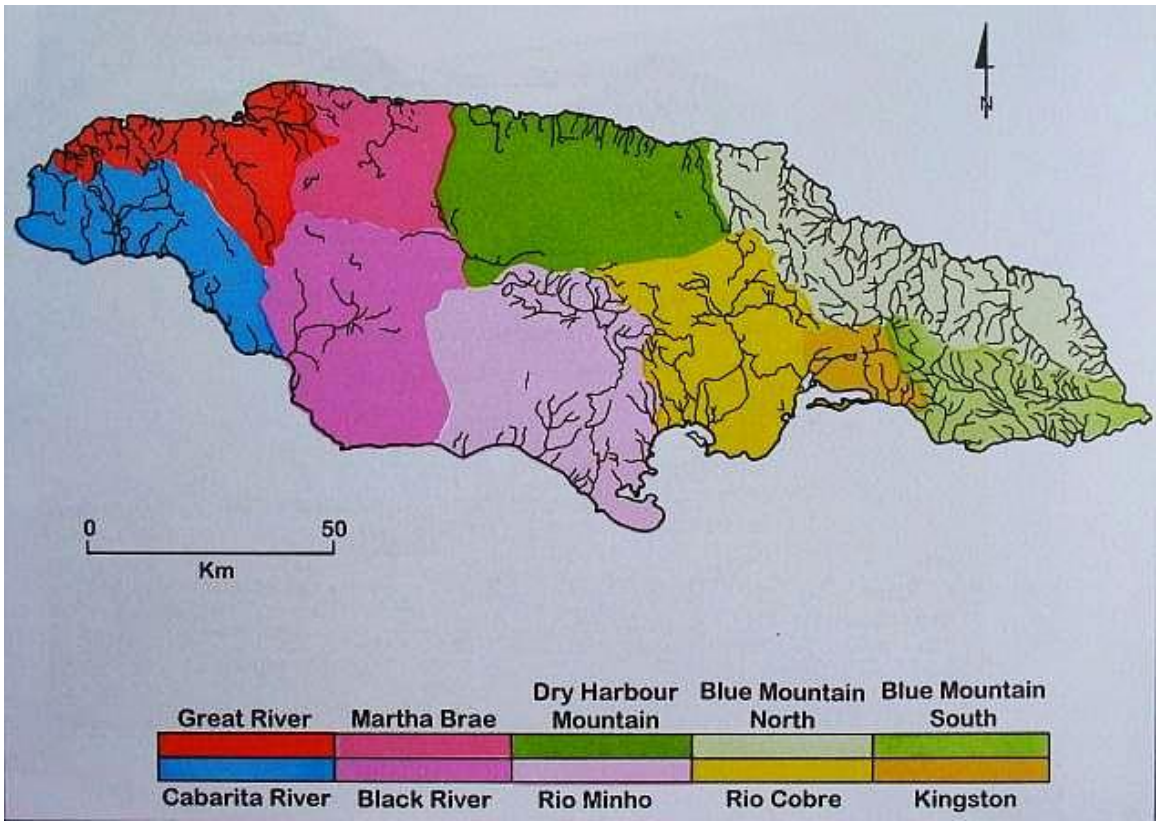
The surface geology of the island consists of:

- Quaternary alluviums of moderate permeability, occupying approximately 15% of the land area, and located mainly in the coastal plains and in the floors of interior valleys;
- Tertiary limestone with variably developed karstification and moderate to high permeability, occupying about 60% of the land area; and
- Cretaceous volcanoclastics of low permeability, occupying about 25% of the land area, mainly in inliers along the upland axis.

Jamaica has a series of mountain ranges along the major WNW-ESE axis of the island. In the E these mountains generally exceed elevations of 1,000 m, the highest peak being at 2,257 m. Major alluvial lowlands occur in the South of the island, often associated with coastal swamps.

Jamaica is subdivided into 10 hydrographical basins (see Figure 5). Surface runoff predominates on the outcrops of basement rocks and interior valley alluviums, whereas groundwater is the dominant water resource associated with the karstic limestone and coastal alluviums. Surface water resources are markedly seasonal.

Figure 5. Hydrographical basins of Jamaica (source: Statistical Institute of Jamaica, 2006)



Jamaica has a tropical maritime climate. Mean daily temperatures range from a seasonal low of 26ºC in February to a high of 28ºC in August. Long term mean annual rainfall is about 1,980 mm, mostly originating in the North. Rainfall on the NE slopes of the Blue Mountain range is generally 3,000 to 5,000 mm per year, whereas in the S coastal plains of St. Catherine and Clarendon it is normally less than 1,500 mm per year. Island-wide long-term mean annual rainfall has a characteristic pattern, with the primary maximum in October and the secondary in May. The main dry season lasts from December to April.

Jamaica is regularly hit by tropical storms and hurricanes between July and November, characterised by flood-producing rainfall of high intensity and magnitude. Mean monthly relative humidity on the S coast is near constant throughout the year, ranging from 71% in August to 77% in October.

Table 5 summarises the key issues associated to the main environmental components in Jamaica, according to the GoJ's state of the environment reports.

Table 5. Key state of the environment issues (source: Statistical Institute of Jamaica & NEPA, 2001)

Solid and liquid waste	Land and mineral resources
- Substantial proportion of household solid waste often dumped in open areas - Illegal dumping in gullies, rivers and open lots, increasing vector population and extensive flooding in urban areas due to blocked drains - Littering very common	- Considerable rural-urban migration, leading to squatting, uncontrolled land development, lack of infrastructure and social and environmental problems - Deforestation and watershed deterioration where valuable land is ruined and soil is washed off to the ocean - Inadequate land information

- Most waste disposal sites are dumps without any treatment - Sewage treatment facilities can only deal with approximately 50% of sewage produced, and not always adequately - Hazardous waste inadequately regulated and managed - Liquid wastes insufficiently treated and finding their way to watercourses	- Too many agencies with responsibility for land management and lack of co-ordination between physical and economic planning - Loss of natural environment where large areas are used for open pit mining
Agriculture	**Forestry and watershed management**
- Under-utilisation of large tracts of arable land and negative social attitudes towards working in agriculture - Praedial larceny, insecurity of tenure, lack of credit and small, inefficient farms located on low productivity lands makes it difficult for small farmers to make a living from agriculture - Over-intensive cultivation and misuse of steep slopes for agriculture common, often resulting in serious soil erosion - Misuse of agricultural chemicals - Leakages of fertilisers contribute to water pollution - Outdated technology, inadequate marketing and poor roads infrastructure	- Deforestation, particularly clearing of steep unstable slopes for cultivation and illegal settlements, and conversion of forests to other uses. Deforestation leads to problems such as watershed and water quality degradation, loss of biodiversity and wildlife habitats **Protected areas** - Inadequate financing to apply conservation and protection management in protected areas - Insufficient public understanding of benefits from conservation and protection - Data for effective management of biological resources are sketchy and incomplete
Biological resources	**Coastal zone and marine resources**
- 14 animal endemic species and over 200 plant endemic species classified as critically imperilled or especially vulnerable to extinction - Much habitat destruction through deforestation, wetland and reef decrease - Inadequate public awareness of the urgency for protection of ecosystems - Baseline data on biological resources lacking - Some plants and animals have been introduced accidentally or intentionally and may be responsible for extinction of some native species	- Integrated coastal management is a necessity, in view of competing interests and complex influences - Development in coastal areas without due regards to increased pressure created - Pollution, beach erosion and illegal sand mining threaten beaches, affecting tourism and near-shore fishing - Wetland areas are decreasing - Degradation of coral reefs threatens fishing and tourism - Jamaican waters have been declared the most over-fished in the CARICOM area
Freshwater	**Air**

- Water quality threatened by human activities in several areas: - Seawater intrusion of coastal aquifers by over-pumping of aquifer, pumping below sea level and poor well design - Caustic soda contamination of ground and surface water from alumina plants - Organic and bacteriological contamination of ground and surface water by wastewater from agro-industrial waste (sugar, rum, dairy) - Nitrate and bacteriological contamination of groundwater by seepage from soak-away pits built for sewage disposal - Groundwater contamination by seepage from unlined solid waste dump sites and leaking underground petroleum storage tanks - Poor land use and inappropriate construction practices leading to flow reduction in some rivers, increased erosion and higher levels of turbidity in streams. High turbidity beyond capacity of treatment plants and during periods of heavy rainfall some treatment plants have to shut down	- Atmosphere impacted negatively by industrial and vehicle emissions, burning of waste and use of ozone depleting substances - Air quality has been affected by the increased amounts of emissions from different pollutants - Lack of routine monitoring programme for air quality and hazardous materials - Inadequate regulation and control of pollution from motor vehicles and other non-point sources - Costs and time required for installing and implementing pollution control equipment and changing commercial and industrial processes are a major challenge
	Natural disasters and environmental accidents
	- Expanding urbanisation of reclaimed land in the narrow coastal fringe and on steep slopes increases risks from natural disasters and requires large-scale hazard mapping and improved site selection - Excessive soil erosion raises levels of stream beds, contributing to flooding. In extreme rain storms sediments can fill up stream channels and cause sudden shifts in course of streams

5.2. Expected effects of climate change on the sugar sector and water availability[3]

Depending on models and scenarios, the effects of climate change in Jamaica differ. According to Jamaica's first National Communication to the UNFCCC, temperature and sea level changes are expected to be in the ranges described below. Temperature is expected to increase by 0.70-0.79ºC; 1.13-1.57ºC; and 1.80-3.64ºC by 2025, 2050 and 2100 respectively. Sea level rise is expected to increase in the order of 18 cm, 30-34 cm and 58-84 cm by 2025, 2050 and 2100 respectively. Changes in precipitation are also uncertain, but expected to change from a low of -0.9 mm/day for the month of August, to a high of +0.6 mm/day for the month of December.

The first National Communication to the UNFCCC identifies agriculture and water resources as two major sectors that could be affected, apart from the vulnerability of coastal regions to sea level rise.

Even if there are no changes on total rainfall, changes in rainfall patterns could still have significant effects on water resources. For example, if rainfall is received in short intensive events, this leads to high runoff and low percolation, resulting in little recharge of groundwater aquifers and lower quality surface waters. Reductions in rainfall will lead to reduced availability through insufficient recharge and reduced stream-flows, but also indirectly by increasing potential for

[3] Information mainly based on the report: *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 draft.

saline intrusion due to reduced groundwater storage, and potential degradation of water quality through saline intrusion from over-pumping. Further, reduced rainfall will affect rain-fed agriculture and increase pressure on water for irrigation.

Severe weather events, such as the 1997/1998 El Niño (ENSO) events, have shown the effects that climate change can have over water sources and water supply, which in that occasion led to extensive drought.

Sea level rise, exacerbated by possible reduced rainfall, will also affect groundwater quality, by reducing the fresh water head and causing salt-water intrusion (moderate in alluvium aquifers and higher in limestone aquifers).

The agriculture sector may also be affected as a result of changes to water quality and availability, but also directly through possible changes in rainfall, temperature, humidity and changes on soil quality.

Sugar cane is a water-intensive crop and its growth is directly related to rainfall, temperature and water availability. Considering that about 70% of sugar cane in Jamaica is entirely rain-fed, any reduction in the amount of rainfall received will directly affect yields. Sugar cane requires between 1100 and 1500 mm of annual rainfall, but its distribution should be adequate: abundant in the months of vegetative growth followed by a dry period for ripening. Also growth is closely related to temperature: optimum temperature for sprouting of stem cuttings is 32-38ºC, slowing down below 25ºC, reaching plateau level between 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.

Sugar cane productivity and juice quality are influenced by weather conditions prevailing during the various 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. 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.

Climate modelling projections for 2050 indicated both increased temperatures (approximately +1.3ºC) and reduced rainfall (approximately -6%). The impacts of this are likely to be increased water/irrigation requirements under higher temperatures and reduced rainfall, and thus increased competition for water resources, as well as the increased incidence of pest and disease outbreaks.

Increased incidence and/or intensity of hurricanes may also affect the sector, through destruction of crops, but also damage to irrigation structures. Droughts (e.g. caused by climatic events such as ENSO) also affect the sector, through drops in yields and quality of crop. A review by Chen *et al* (2005), cited in the preparatory report to the second National Communication to the UNFCCC, reports on the effects of droughts on sugar cane yields in the Worthy Park estate (upper St. Catherine), which is rain-fed. The four climate-related stresses leading to poor harvest were: below normal July-September precipitation affecting sugar cane growth; below-normal November-May precipitation resulting in poor establishment of plantings and retardation of early growth (with possible recovery in yields with above-average July-September precipitation); above-normal temperatures and excessive precipitation during November-March (in 4-6 weeks before harvest), unfavourable to ripening of cane; and excessive spring rains in poorly drained, flood-prone areas. These changes were associated to El Niño and La Niña events.

6. Key issue 1: Pressures on groundwater

6.1. Current state, pressures and trends

Jamaica is divided into ten hydrographical basins, which are used by the Water Resources Authority for planning purposes. Table 6 below provides an indication of the groundwater yield and the total freshwater resources for each of them.

Table 6. Groundwater and total freshwater resources by hydrological basin (source: Statistical Institute of Jamaica, 2006)

Hydrographical basin	Groundwater yield (Mm^3)	Total fresh water resources (Mm^3)
Blue Mountains, south	291	1,141
Kingston	68	208
Rio Cobre	338	1,150
Rio Minho	732	1,962
Black River	707	2,339
Cabarita River	302	927
Great River	314	1,338
Martha Brae River	90	624
Dry Harbour Mountains	369	1,584
Blue Mountains, north	514	3,482

Although groundwater is still abundant in Jamaica in general terms (it is estimated that only 25% of groundwater resources are being utilised (Statistical Institute of Jamaica, 2006), in specific locations the pressure on the resource is increasing and groundwater becoming a scarce resource. This is particularly the case in the Clarendon and St. Catherine parishes (which roughly correspond to the Rio Minho and Rio Cobre basins, respectively). WRA has already indicated that no further licenses are going to be issued for agriculture in the Clarendon and St. Catherine plains, as sustainable extraction levels are already committed.

Table 7 below shows the pressure on water resources per hydrographical basin.

Table 7. Annual water resources, surpluses or deficits by basin (Mm^3/yr) (source: Statistical Institute of Jamaica, 2006)

Basin	Resources			Demand			Surplus
	Surface	Ground	Total	Irrigation	Other	Total	
Blue Mountains, South	83.9	290.4	374.3	6.8	31.5	38.3	336.0
Kingston	5.4	69.1	74.5	0.1	87.5	87.6	-13.1
Rio Cobre	146.0	337.7	483.7	189.9	115.3	305.2	178.5
Rio Minho	31.6	732.5	764.1	212.9	70.1	283.0	481.1
Black River	287.3	706.5	993.8	12.4	156.7	169.1	824.7
Cabarita River	118.8	302.7	421.5	3.0	32.7	35.7	385.8
Great River	70.9	315.1	386.0	0.9	51.4	52.3	333.7
Martha Brae River	149.8	89.4	239.2	6.6	49.7	56.3	182.9
Dry Harbour Mountains	273.1	368.7	641.8	3.2	156.2	159.4	482.4
Blue Mountains, North	323.3	512.4	835.7	3.0	121.9	124.9	710.8
Total	**1,490.1**	**3,724.5**	**5,214.6**	**438.8**	**873.0**	**1,311.8**	**3,902.8**

Irrigation is one of the main freshwater uses, accounting for 39% of total water demand, and 70-80% of the irrigated land is in sugarcane (Organisation of American States *et al*, 2002). These irrigated cane lands are mainly concentrated in St. Catherine (8,103 ha) and Clarendon (9,918 ha) and to a lesser extent in St. Elizabeth (450 ha), Westmoreland (300 ha) and Trelawny (350 ha) (1997 data, cited in Organisation of American States *et al*, 2002). A significant portion of the

irrigation of cane lands in St. Catherine is provided by the NIC irrigation scheme (Rio Cobre). The Mid-Clarendon scheme also supplies water to approximately 15% of the sugarcane area in Clarendon. Deep wells are the main source of irrigation water in this area (Figure 9 shows that Clarendon and St. Catherine have the largest concentration of wells).

While the overall irrigation water balance appears positive in the table above there are significant regional water shortages caused by poor distribution networks, poor water quality (saline water) and recent de-commissioning of many wells in South Clarendon.

Different economic activities and urban expansion are increasingly exerting pressure over the groundwater resources. In the sugar cane areas, urban pressure is particularly important in St. Catherine (urban sprawl of Spanish Town), where it is also expected to take over some lands currently under sugar cane. Moreover climate change is expected to further contribute to water stress, through increasing irrigation water demand in currently rain-fed areas (decreased rainfall) and decreased water availability (decrease in aquifer recharge).

Degradation of water quality has resulted in the loss of some 104.3 m^3/yr or 10% of exploitable groundwater as a result of pollution or saline intrusion; an additional 241.2 Mm^3 have been affected but continue to be used for restricted purposes (First National Communication to the UNFCCC, 2001).

Saline intrusion in Clarendon and St. Catherine account for about 75% of the affected groundwater. Although part of the salinity is natural (that which is closer to the coast), salt-water intrusion is also thought to have increased since the 1960's due to over-pumping of deep wells. In some cases salinity exceeds levels suitable for use in irrigation, and a number of wells have had to be abandoned. Irrigation with salt water is a contributing factor to reduced sugar cane yields (see discussion below on land degradation). Recent monitoring (1980's to present) has given mixed results for different wells (some where salinity has remained stable, some where it has increased and some where it has decreased, the latter normally following periods of heavy rainfall) (see Figure 6). In any case, salinity levels from many wells are above the limit (750 µmohs/cm) considered suitable for irrigation of the more permeable lighter soils and (<750 µmohs/cm, with careful management) for the heavy clays. Figure 8 shows that the NIC wells in Clarendon have medium to high conductivities, and the SCJ wells in Clarendon high to very high ones. It must be considered that water with electrical conductivities higher than 2000 µmohs/cm are unsuitable for irrigation purposes.

Fig 6. Average rainfall vs. electrical conductivity in the Clarendon Plains (source: White, 2009)

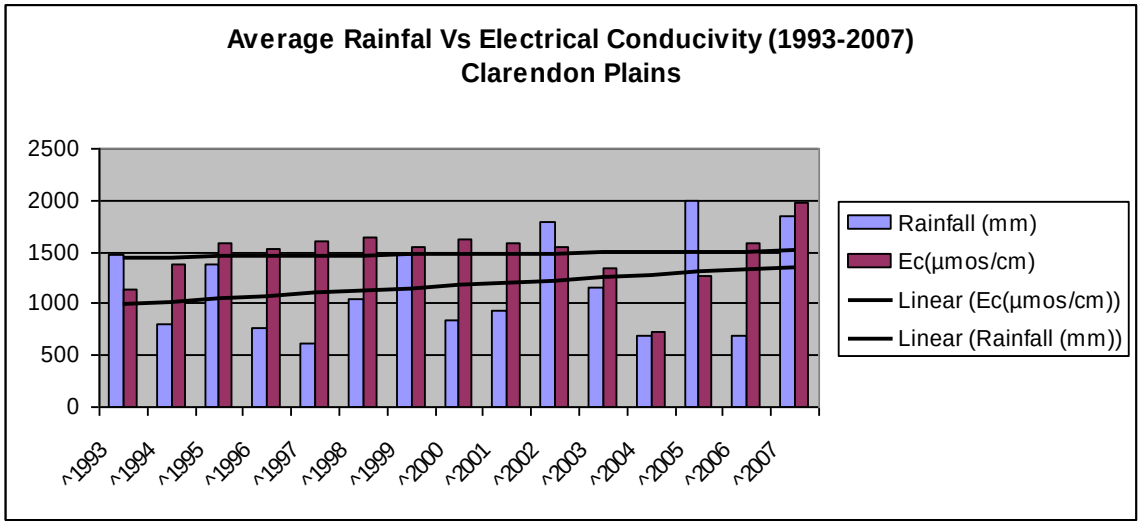


Figure 7. Electrical conductivity in groundwater in Clarendon (source: Karanjac and Fernandez, http://www.geocities.com/kkaranjac/)

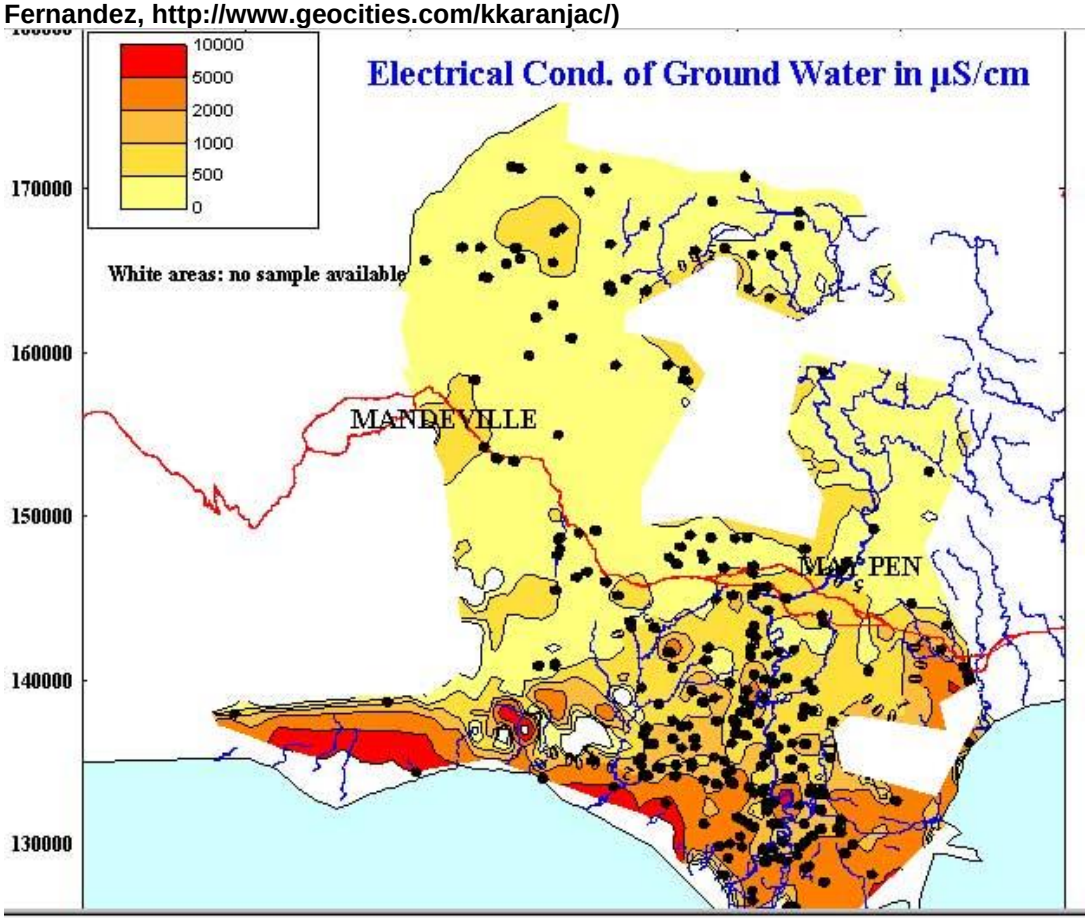
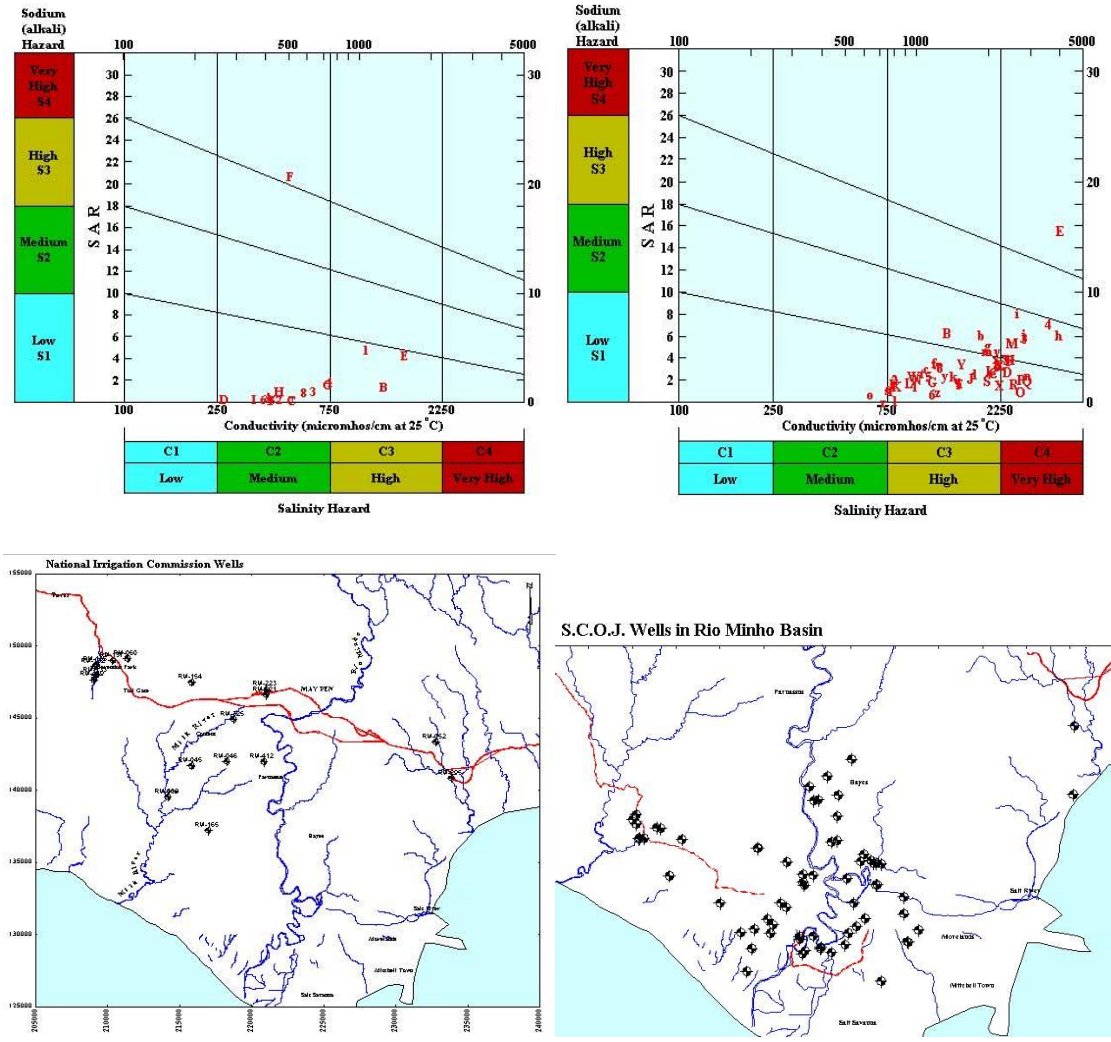


Figure 8. Conductivity in groundwater in NIC and SCJ wells in Clarendon (source: Karanjac and Fernandez, http://www.geocities.com/kkaranjac/)

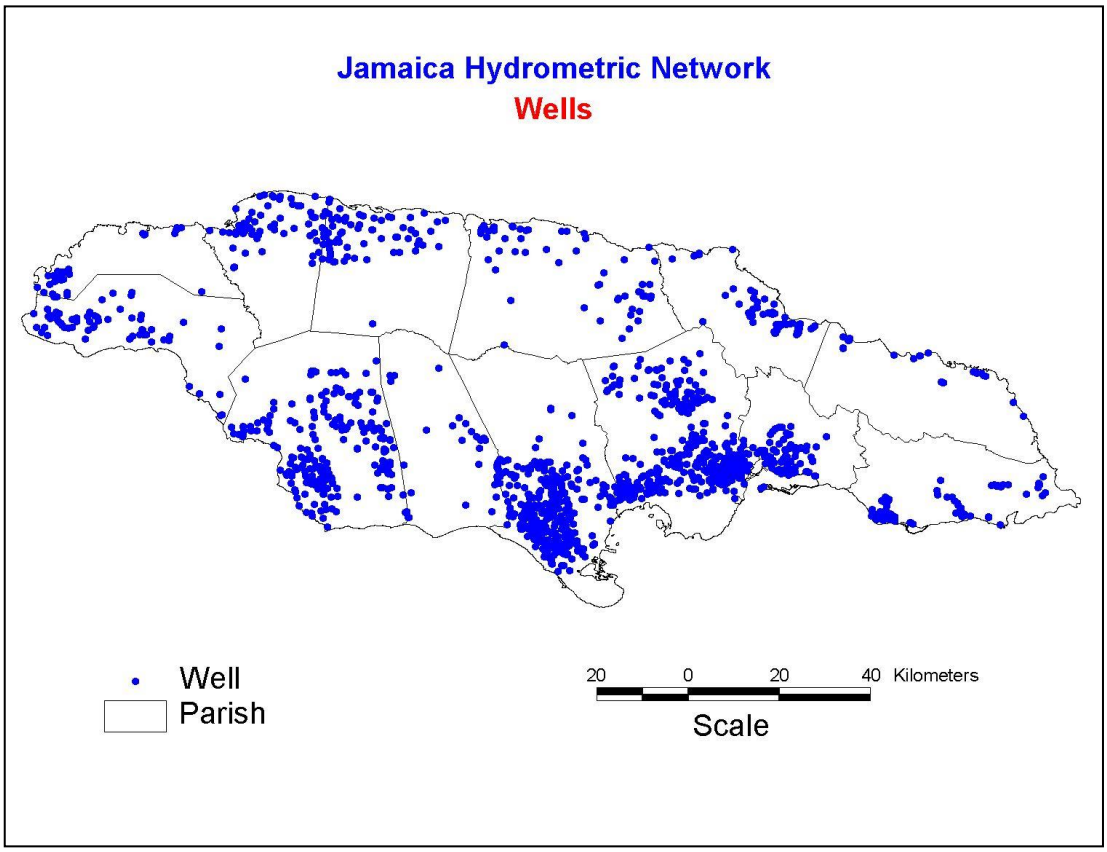


Sugar cane is noted as a water intensive crop. In Jamaica presently about 25% of the sugar cane lands are irrigated, although the tendency is to increase irrigation as a measure to improve yields. Groundwater is the main source of water for irrigation, and furrow irrigation (flooding of fields) is the main irrigation method used.

Water production by the NIC averages 1.15 Mm^3/day, but the water use efficiency is only of the order of 30%, when there is agreement that it should be around 60%, which is an efficiency that would allow doubling the land under irrigation with the same amount of water currently used. Thus in the water-stressed areas of St Catherine and Clarendon, additional requirements are expected to be met largely by increasing water use efficiency, and not by exploitation of any new primary water sources.

The irrigation schemes suffer from outdated irrigation systems and lack of maintenance of infrastructure, and cost recovery has been insufficient to cover operation and maintenance costs, especially as irrigation water is highly subsidised by the Government (Organisation of American States *et al*, 2002), in excess of 70% of the total cost.

Figure 9. Location of wells in Jamaica (source: WRA)



The WRA has responsibility for licensing the drilling of wells and groundwater abstraction, in a manner that ensures the sustainable use of the resource. Licenses are accompanied by specifications on water volumes that may be abstracted, and which are metered and monitored. In the case of NIC irrigation schemes, the WRA licenses are given to the NIC, which provides the water to farmers for irrigation. Most sugar farms obtained licences under an old (1959) law which required minimal monitoring or management. A new more stringent regulation which grants licences for five years took effect in 1995, and the WRC has requested the sugar farms to become compliant; some have but the majority have not.

The Jamaica Water Sector Policy (Ministry of Water and Housing, 2004) establishes a series of objectives for water resource management. The following are relevant to the present discussion:

- Ensuring integrated and informed management of the country's water resources (development of water resources will not be done sectorally);
- Ensuring the water for public supply will receive priority in the allocation of resources;
- Ensuring that water is used as efficiently as possible (including promotion of conservation). Where possible, the conjunctive use of surface and ground water will be implemented. Priority must be given to demand management; and
- Ensure that measures are implemented to restore and enhance the quality and quantity of usable water to protect the aquifers, watershed and other sources of water.

The Water Sector Policy also identifies the main challenges associated to water use in irrigation:

- Cost recovery is low, and the sector does not generate funds to finance its own expansion;
- Operating efficiency is also often low, with high levels of wastage due to the lack of funding to effect efficiency improvements, such as canal lining and leakage reduction from pressurised systems;
- In some cases farmers use inefficient irrigation techniques;

- Because of the above problems it is often difficult to respond to farmers' needs as desired, and furthermore there are sometimes harmful environmental effects;
- Critical areas of the country, which could benefit from irrigation, currently do not have access to this service.

In order to address the problems associated to irrigation, the Water Policy states that the Government will promote, *inter alia*:

- Achievement of cost-efficiencies;
- Mobilisation of additional sources of funding and investment support from the private sector and external sources;
- Introduction of cost recovery mechanisms to ensure the direct beneficiary pays and that the supply of services can be maintained and expanded;
- Encouragement of farmer participation in management and distribution of irrigation water;
- Introduction of conservation measures, including those to improve irrigation efficiencies and reduce system losses;
- Expansion of irrigation facilities on a phased basis.

Key actions foreseen include:

- NIC assuming a role of planning, regulating, monitoring and evaluating the irrigation sub-sector, whereas responsibility for irrigation systems would lie on Water Users' Association (WUAs), comprised of farmers who benefit from them. Formation of WUAs is being encouraged and transition will be progressive and include capacity-building and technical assistance components;
- Operation and maintenance costs of irrigation systems met with charges paid by users;
- For new systems under the National Irrigation Development Plan, users will be required to pay a reasonable proportion of capital costs;
- Subsidies to irrigation costs will be reassessed by relevant agencies, who will determine the circumstances under which subsidised irrigation water will be provided for farmers and define the minimum standards of services in such cases;
- Although assets will still be vested in the NIC, private sector and co-operative involvement in irrigation will be promoted through the WUAs as legal entities.

It should be mentioned that some of the projects foreseen in the Action Plan, relevant to the sugar areas of Clarendon and St Catherine, are contingent on the availability of funds. These include, for example, the rehabilitation of the NIC schemes. Most NIC developed schemes are internationally funded and are not directed to the sugar areas. However the NIC from its own resources is making some improvements in the Rio Cobre main canals to arrest leakage and flooding of certain areas in Spanish Town (M.Harrison, *Pers. Comm.*)

Figure 10. Groundwater contamination (source: WRA)

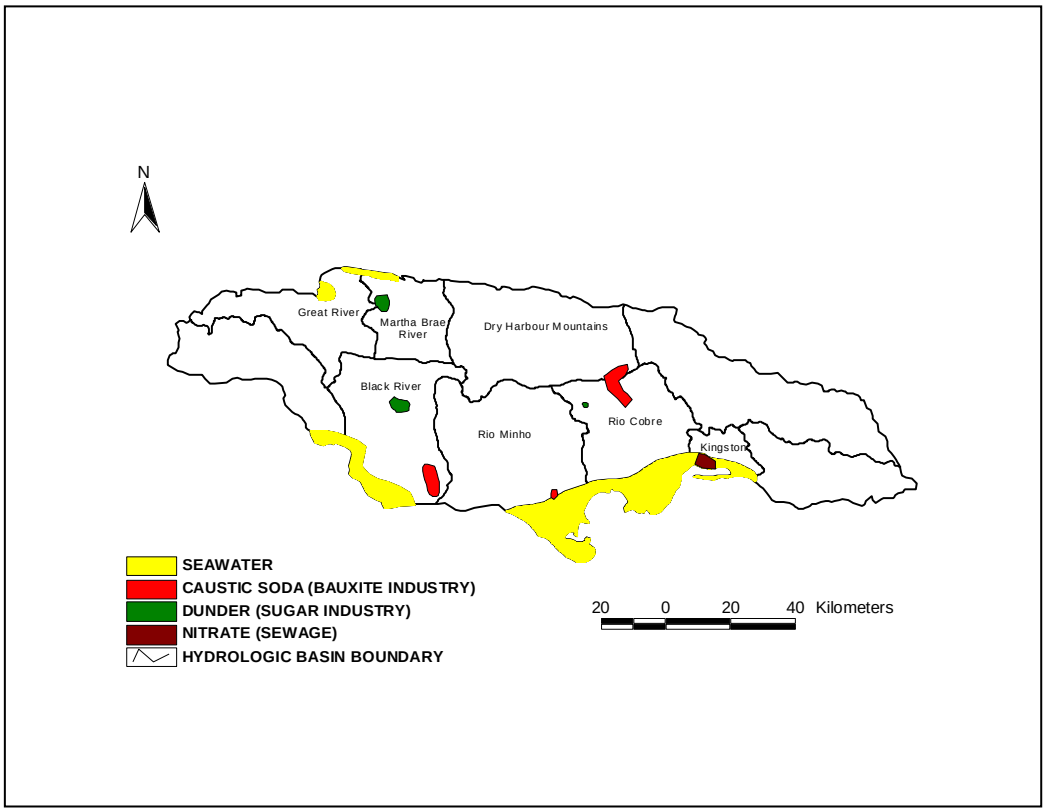


Table 8 below shows the irrigation methods used in sugar cane lands. Levels of water use efficiency realised by New Yarmouth Estate are 95% for drip systems, 75% for centre-pivot, 50% under travelling sprinklers and 50% under furrow irrigation. Many other farms show even lower efficiencies with furrow irrigation of the order of 30% as stated by the NIC. It can be seen that the main irrigation method used on the lands most affected by salinity is furrow irrigation - the most water-inefficient method.

Furrow irrigation as currently practiced also results in poor and uneven wetting. Drainage is often poor resulting in water logging, physiological drought, and aggravation of soil salinisation (where the predominantly high conductivity waters are used).

However for economic and other reasons it is not possible to move away entirely from furrow irrigation, but with appropriate land conformation and furrow stream sizes, much higher levels of efficiency can be obtained (Sugar Research Department, 1969, pp. 14-26). Options such as alternate furrow irrigation on appropriately levelled fields should also be considered.

Table 8. Irrigation methods for sugar areas

Sugar area	Total area under sugar cane (ha)	Area under irrigation (ha)	% irrigated area under flood irrigation	% irrigated area under overhead irrigation	% irrigated area under drip irrigation	Comment
Monymusk	3,006	3,006	90%	9%[4]	1%	
Bernard Lodge/Innswood	3,323	3,323	88%	12%	0%	
Long Pond	1,200	0	-	-	-	
Worthy Park	1,200	0%	0%	0%	100%	
Appleton and Farms	2,454	384	0%	90%	10%	Pivot on Newton, Vinasse disposal sprinkler & drip
Frome and Farmers	4548+5580	0	-	-	-	Only supplemental, sprinkler irrig.
New Yarmouth		1,842	29.4%	52.1%	18.5%	
Clarendon Farmers		1,600	92%	5%	3%	
St. Catherine Farmers		713	97%	0%	3%	

Table 9 below summarises the key factors that are contributing to unsustainable water use in the sugar sector, especially in the irrigated areas of Clarendon and St. Catherine.

Table 9. Summary of key factors contributing to unsustainable groundwater use in the sugar sector (especially in Clarendon and St. Catherine)

- Conveyance losses in irrigation water distribution systems
- Predominance of water-inefficient irrigation methods (furrow irrigation)
- Increased groundwater demand to satisfy urban expansion requirements
- Negative water saving incentives through subsidies to irrigation costs

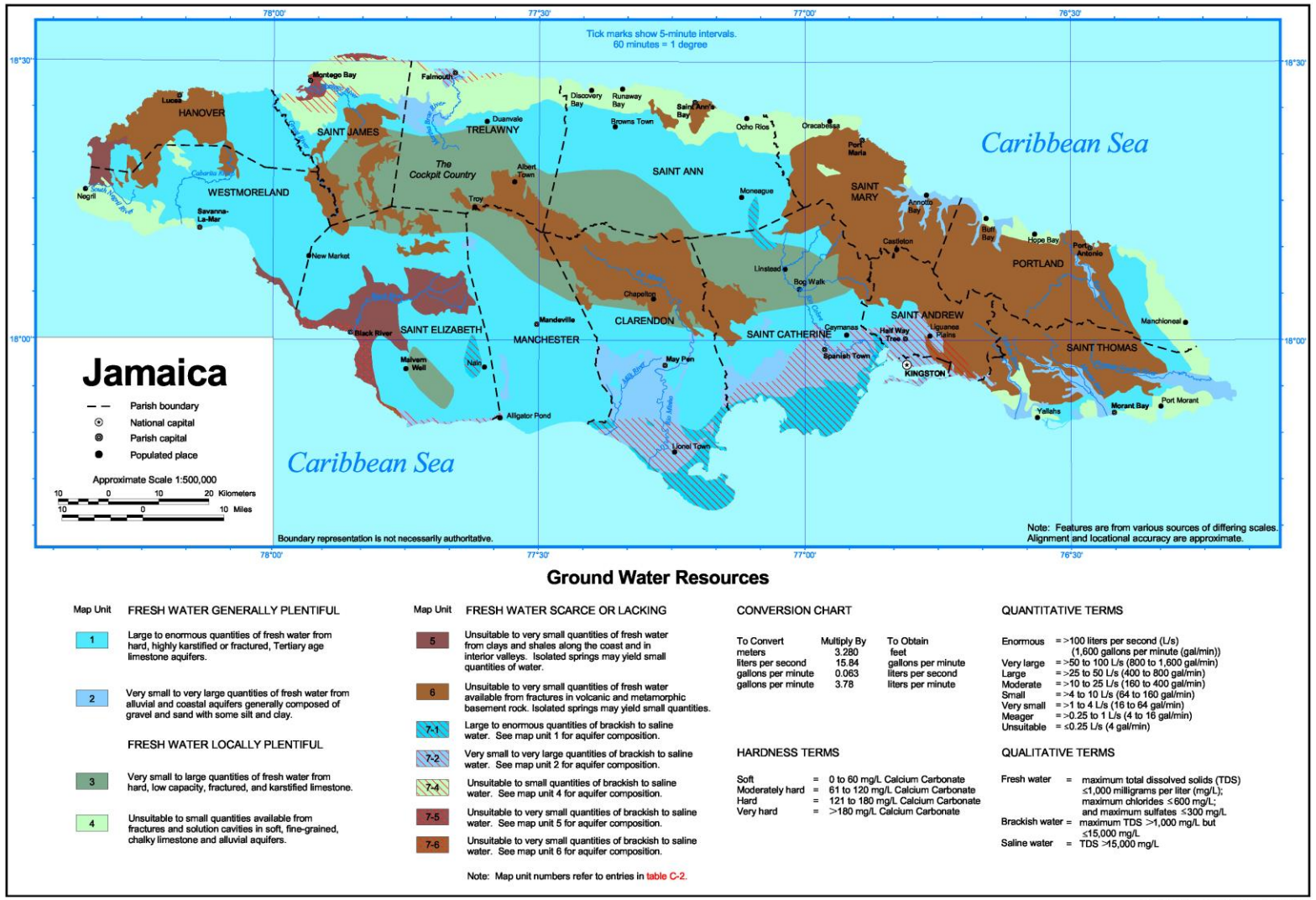
There are thus two main reasons why the sugar sector should seek to increase its water efficiency: to contribute to reducing pressure on the groundwater resources, especially in the Clarendon plains and St. Catherine, and to improve yields by reducing irrigation with salt water.

Pressure on groundwater resources can be relieved primarily by focusing on three aspects: (1) improving the efficiency of the irrigation schemes (irrigation infrastructure); (2) improving the water application efficiency in the field (i.e. moving into water-efficient irrigation methods); and (3) better irrigation scheduling based on accurate estimation of crop water requirements from properly equipped weather stations and soil moisture logging. In order to address these issues a series of measures – some already foreseen in the Water Policy – will be needed, including a mix of institutional, regulatory, policy and technical dimensions.

Water use can also be reduced in factory operations, especially by reducing sugar cane washing, and increasing water recycling within the process. Sugar cane washing can be reduced by reducing the amount of extraneous matter that arrives to the mill with the sugar cane, and which in turn can be effected by increasing green cane harvesting. Reduced water consumption in factory operations has a direct effect on reducing wastewater production, and is deal with under key issue 3 below (surface water contamination).

[4] Includes sprinklers, centre-pivot and travelling sprinklers.

Figure 11. Groundwater Resources of Jamaica (source: US Army Corps of Engineers (2001)



Ground Water Resources

Map Unit	FRESH WATER GENERALLY PLENTIFUL
1	Large to enormous quantities of fresh water from hard, highly karstified or fractured, Tertiary age limestone aquifers.
2	Very small to very large quantities of fresh water from alluvial and coastal aquifers generally composed of gravel and sand with some silt and clay.
	FRESH WATER LOCALLY PLENTIFUL
3	Very small to large quantities of fresh water from hard, low capacity, fractured, and karstified limestone.
4	Unsuitable to small quantities available from fractures and solution cavities in soft, fine-grained, chalky limestone and alluvial aquifers.

Map Unit	FRESH WATER SCARCE OR LACKING
5	Unsuitable to very small quantities of fresh water from clays and shales along the coast and in interior valleys. Isolated springs may yield small quantities of water.
6	Unsuitable to very small quantities of fresh water available from fractures in volcanic and metamorphic basement rock. Isolated springs may yield small quantities.
7-1	Large to enormous quantities of brackish to saline water. See map unit 1 for aquifer composition.
7-2	Very small to very large quantities of brackish to saline water. See map unit 2 for aquifer composition.
7-4	Unsuitable to small quantities of brackish to saline water. See map unit 4 for aquifer composition.
7-5	Unsuitable to very small quantities of brackish to saline water. See map unit 5 for aquifer composition.
7-6	Unsuitable to very small quantities of brackish to saline water. See map unit 6 for aquifer composition.

Note: Map unit numbers refer to entries in table C-2.

CONVERSION CHART

To Convert	Multiply By	To Obtain
meters	3.280	feet
liters per second	15.84	gallons per minute
gallons per minute	0.063	liters per second
gallons per minute	3.78	liters per minute

HARDNESS TERMS

Soft	=	0 to 60 mg/L Calcium Carbonate
Moderately hard	=	61 to 120 mg/L Calcium Carbonate
Hard	=	121 to 180 mg/L Calcium Carbonate
Very hard	=	>180 mg/L Calcium Carbonate

QUANTITATIVE TERMS

Enormous	= >100 liters per second (L/s) (1,600 gallons per minute (gal/min))
Very large	= >50 to 100 L/s (800 to 1,600 gal/min)
Large	= >25 to 50 L/s (400 to 800 gal/min)
Moderate	= >10 to 25 L/s (160 to 400 gal/min)
Small	= >4 to 10 L/s (64 to 160 gal/min)
Very small	= >1 to 4 L/s (16 to 64 gal/min)
Meager	= >0.25 to 1 L/s (4 to 16 gal/min)
Unsuitable	= ≤0.25 L/s (4 gal/min)

QUALITATIVE TERMS

Fresh water	= maximum total dissolved solids (TDS) ≤1,000 milligrams per liter (mg/L); maximum chlorides ≤600 mg/L; and maximum sulfates ≤300 mg/L
Brackish water	= maximum TDS >1,000 mg/L but ≤15,000 mg/L
Saline water	= TDS >15,000 mg/L

Figure C-2. Ground Water Resources
C-27

6.2. Expected contribution of JCS to pressures on groundwater

The JCS envisages both a contraction and an expansion of sugar cane lands. The rationalisation of the industry foresees the possibility of reducing sugar cane lands in 6,000 hectares over a four year period, especially around the Bernard Lodge and Long Pond estates, due for closure.

This has however been refuted in interviews with SIA, SIRI and the STU. It is expected that only a minority of small cane farmers will go out of cane. The main expansion areas will be in Frome, St. Thomas and S. Clarendon, as well as in St. Catherine, where re-commissioning of abandoned wells, improvement in conveyance structures and greatly improved water use efficiency is expected to restore over 9,000 ha into production. The Infinity Bio Energy plans have even more ambitious targets with the inclusion of assisted expansion on independent cane farmers' land.

The ethanol production component of the JCS will requires the production of up to 70 million litres of ethanol annually to meet the local market for the substitution of MTBE in gasoline, requiring up to 13,000 additional hectares for cane cultivation. It is also expected that up to 5,000 additional hectares of sugar cane may be necessary for the production of high-test molasses to supply the expansion of the rum industry. However with the reduction in sugar prices and factory closures, some small land holders may decide to move out of sugar cane.

An overall net increase of some 12,000 hectares under sugar cane is expected, and based on the proposed siting of the ethanol plants (Monymusk and Frome, e.g. under the IBE plan) it is expected that the cane supply will come largely from the Southern irrigated plains. Approximately 7,200 ha (some of it marginal by reason of salinity) could be available in the Monymusk area, and 8,200 ha in the Bernard Lodge/Inswood area - a net increase of approx 9,100 ha from the approximately 6,100 ha now in cane on those two estates. There could also be some increase in independent farmers' areas in areas adjoining these estates.

This expansion of lands under cane, especially in the irrigated and more water-stressed areas could result in increased water demand, i.e. in areas where it cannot be obtained from the current groundwater resources. Seemingly the main limitation to expansion on any available land is an absolute shortage of any new ground- or surface water sources of good quality. However based on the above and interviews with STU and IBE it does not seem that any significant land areas will be going out of cane in the irrigated areas. In fact the contrary is likely to be the case, which would imply radical improvement in overall water use efficiency.

Land likely to go out of sugar cane will most likely be small holdings of marginal viability, and from these there would be no impact on groundwater demand. In the Bernard lodge area the land proposed for urban development (North-East Caymanas farm) will probably be supplied from existing wells supplying the cane in that area. Any extra demand would probably come from sources other than South St. Catherine ground water (e.g. Tulloch Springs?)

Because there is still some uncertainty as to the precise locations and hectarages of new land going into cane the groundwater requirements for irrigation, similarly, cannot be too precisely estimated.

The JCS also expects to improve sugar cane yields through supplemental irrigation of rain-fed lands during periods of extreme drought and to promote improved germination on replanted fields. This expansion of irrigation is expected for approximately 6,300 hectares in the predominantly rain-fed cane growing areas of Frome and St. Thomas, using both surface- and ground-water sources. These areas largely have good quality abundant surface water flows which should be available for exploitation.

Upgrading of irrigation works on the private estates and farms is expected to continue with improvement in the management of pivot systems, installation of drip systems, and improvement

in surface irrigation design. It is also planned to upgrade off-farm irrigation works, particularly the conveyance system of the Rio Cobre scheme to S. St Catherine to ensure better delivery of water to estate lands. This is expected to have a positive impact on the pressure of groundwater resources, as in reducing line losses will improve water delivery to the fields.

As the privatisation process is still ongoing, it is difficult to know what impact it will have on improving irrigation practices. For example, the original divestment plan for the Monymusk Estate agreed with Infinity Bio Energy, foresaw an extension of drip irrigation to 80% of the cane lands. This would be a large improvement, but is now on hold.

Although the JCS has as one of its objectives to address the environmental sustainability of the sugar sector, it does not sufficiently address a key environmental sustainability concern of the sector: i.e. the pressure on groundwater resources to satisfy irrigation demand, especially in Clarendon and St. Catherine. Expected improvements in the NIC irrigation infrastructure will not be sufficient by themselves to deal with the problem, and significant increases in water use efficiency will be needed. Although it seems that the original divestment plans agreed between the Government and IBE included a commitment to expand more water-efficient irrigation, this is not a basic condition according to the JCS or the HOA, and thus improvements will depend on the divestment plans agreed with the new owners.

Opportunities for the JCS to address this concern are described in Part III below, addressing mainly the promotion of water-efficient irrigation methods and the improvement of water efficiency in field operations. Implementation of measures to improve water efficiency will also have indirect positive impacts on land quality and productivity.

7. Key issue 2: Land degradation

7.1. Current state, pressures and trends

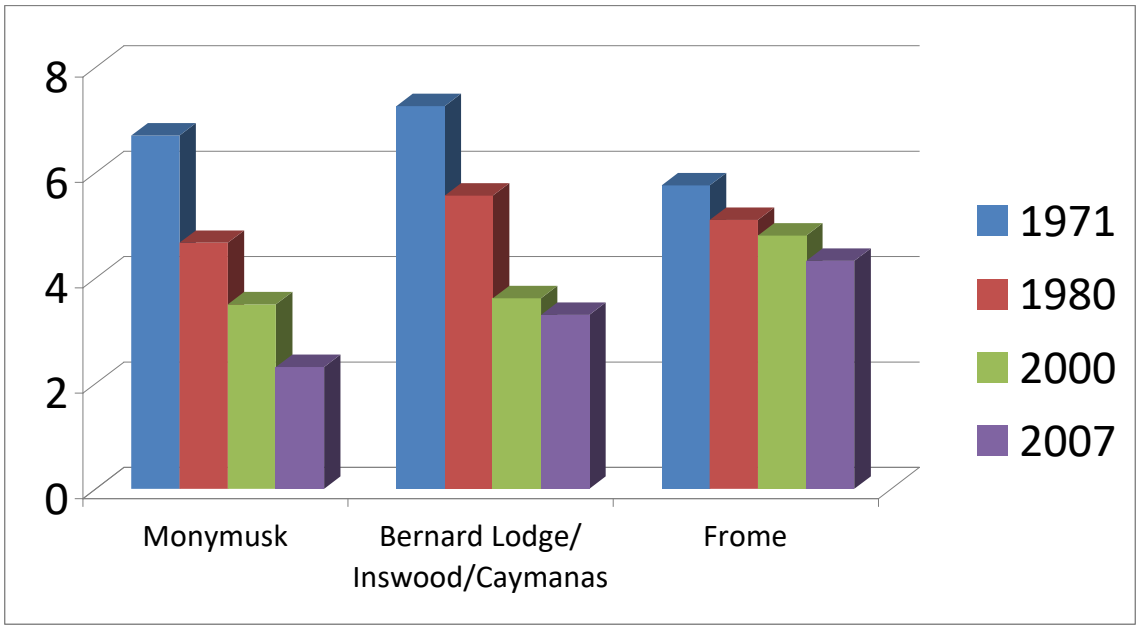
Land degradation and abandonment is primarily a problem in the irrigated sugarcane growing areas of Southern St. Catherine and Clarendon. Some of these areas have shown consistent yield declines to the point of becoming so unproductive that they have been taken out of any form of agriculture. These abandoned lands occur mainly in the Monymusk factory area; significant areas have also been abandoned due to the destruction and theft of power transmission lines to the wells on the West of the estate.

There is also the problem over recent decades of increasing salinisation of land due to the use of high conductivity waters for irrigation, coupled with inadequate drainage. This has left some areas in such a state as to make any reclamation very challenging (MoA RPPD, 1985). As a consequence of the above the area of cane harvested at Monymusk has been in consistent decline from a high of 7,500 ha during the period 1965-75 to 2,300 ha in 2005 and 2007 (Fig. 12).

This situation also occurs to a lesser extent on other irrigated estates and farms, but a more significant factor in the decline in the Bernard Lodge/Innswood/Caymanas area has been urbanisation and the infrastructure associated with highway 2000, which have interfered with water transport and accessibility for cultivation and harvesting across the highway. A further significant area on the East of Bernard Lodge was also taken out of cane for various other agricultural schemes which did not succeed and left the land unused and in scrub.

In relatively small areas, where cane is grown on slopes there is some soil erosion, this should be addressed by contour planting, conservation tillage, and green cane harvesting (GCH),

Fig 12: Hectares ('000) harvested at 3 government estates 1971, '80, 2000 and 2007 showing decline in hectarage over the period

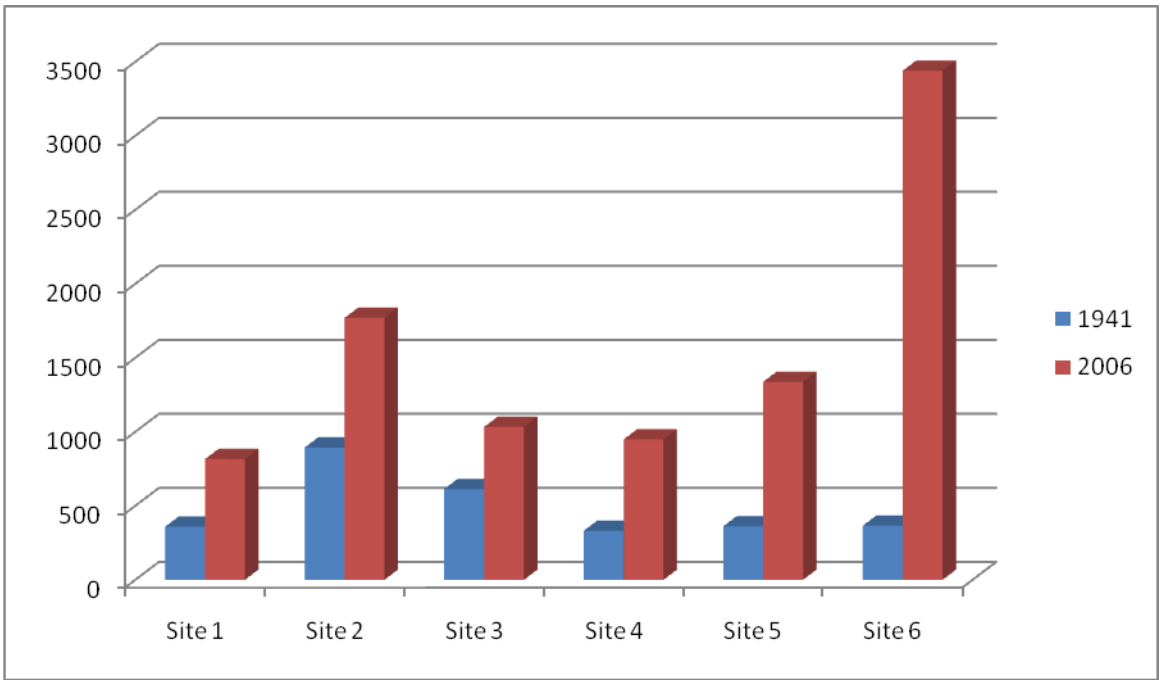


Soil types and salinisation

The predominant soil types in the irrigated plains are heavy cracking clays (Agualta, Rhymesbury, Sydenham clays etc) which, in their saturated state, do not allow downward water movement and salt flushing through the profile. Salt leaching occurs when these soils dry out, crack and the salts are flushed from the edges of the cracks, either down the profile or to a limited extent into any existing drains. Inadequate drainage therefore aggravates the saline degradation of these soils. Such soils are therefore not capable of being desalinised in the conventional 'textbook' manner by adding a leaching requirement to irrigation application. Since restoration is so problematic the use of saline irrigation waters should be avoided in these soils. The extent of the problem is illustrated in work by Shaw (1982, cited in MoA RPPD 1985) showing salinity increases of 1-2% per year between 1967 and 1982.

Periodic salinity surveys in the area by SIRI, (1978, 1983,) and by MoA RPPD (1985), Fearon (2006) have identified a worsening problem. More recent survey data (mainly of wells and groundwater by WRA) have shown a continuing problem despite increasing rainfall and some presumed aquifer recharge during the period 1999-2006.

Fig. 13. Sodium Chloride contents in 1941 as compared to 2006 (NaCl in ppm) at 6 selected sites at Monymusk estate (source: Fearon, 2006)



The vegetation remaining on abandoned lands is a further degrading factor. A consequential problem of salinisation and drought is the development of an aggressive weedy grass *Dicanthium annulatum*, which is difficult to control when it invades existing cane fields or fields taken up from previously abandoned areas.

7.2. Expected contribution of JCS on land degradation

The JCS requires some 12,000 ha of additional land being available for cane growing, therefore an important challenge will be the reclamation of large areas of degraded and abandoned land. The abandoned and degraded estate lands on the southern irrigated plains offer the largest potential for such additional expansion. Therefore measures will have to be taken to bring these lands back into sustainable production through redirection and conservation of current non-saline water sources and the efficient use and management of irrigation and drainage systems.

In the Frome area with improved drainage, possible improved harvesting techniques for small farmers and improved road access, additional lands could also become available to meet the JCS targets.

<u>Arresting and Mitigation of Land degradation</u>

In general, on the irrigated southern plains efforts must be better directed at arresting further advance of salinisation by improving and conserving the use of existing fresh water sources by radical improvements in irrigation efficiencies and ensuring adequate drainage.

In this respect the maintenance and possible augmentation of supplies from the fresh water schemes, in particular the Rio Cobre Scheme, is vital. The matching land areas available are in South St. Catherine. Also there is possible potential for the use of tertiary treated water from the Soapberry sewage treatment works, which means that South St. Catherine has good potential for increased sustainable cane production. However the conductivity of this water is in the order of

900-1120 µmohs/cm, which could only be used on the lighter soils, preferably diluted with fresh water; nevertheless a more detailed characterisation would be needed to ensure suitability.

Monymusk Estate has elaborated a plan for the reclamation of 3,700 ha of land using more efficient drip irrigation systems, improving fresh water availability from rivers and springs and limiting underground water uses to sources below 1,200 µmohs/cm conductivity. Water sources are identified at the range of 800 µmohs/cm capable of wetting approx 2,250 ha. Carefully managed to ensure drainage and flushing by periodic rainfall, sustainable production on these lands could be restored

The plans would rely on re-commissioning of wells and river sources with conductivities in the range of 800 µmohs/cm to the West of the estate. With adequate drainage, improved irrigation efficiencies and irrigation scheduling regimes which would take advantage of the flushing effect of rainfall sustainable economic cane production could be possible. This would bring in some 1,350 ha back into production.

A further 640 ha on farm 3 is also slated for reclamation but the well salinities range between 1500-1800 µmohs/cm, which would be probably unsustainable on those heavy soils. The possibility of rainwater storage and conveyance from sources further West could alleviate source salinities for a more sustainable situation. These lands and water sources need to be carefully managed and continuously monitored to avoid any deterioration in salinity status.

The reclamation of moderately salinised recent alluvial soils (Agualta loams in areas of Monymusk) is feasible with improved irrigation practice. Some 891 ha is identified and water quality in the range of 6-900 µmohs/cm is available. A trial drip irrigation plot of approx 60 ha wet with water of 800 µmohs/cm conductivity on sandy loam soil has maintained yields reasonably well over 15 years (despite deterioration of the tubes and piping).

On the easternmost farms there is only a small amount of moderate quality water available for about 460 ha, but for up to 1,300 ha land the only identified source is the Cockpit source with conductivity of 4000 µmohs/cm. Even after mixing, the conductivity remains above 2000, which is not suitable for sustainable sugarcane growing.

The salinised heavy clays will be difficult and expensive to re-claim (MoA RPPD, 1985). The mechanism of flushing of salts from these soils is described and the suitability of areas capable of desalinisition identified. These areas are best left to uses such as aquaculture.

On Monymusk estate and others serious attention must be given to drainage, both on-farm and regionally (major exit drains) in order to lower water tables, maximise opportunities for flushing, and avoid the further advance of salinisation on vulnerable soils. The estate has already begun to attend to its drainage problems and is in the process of restoring partially or completely a number of major drains

Bernard Lodge area

Areas to the east of Bernard Lodge consist of deep well drained sandy loams which, with adequate water supply are capable of high cane yields. However some of these lands have been abandoned due to inadequate water supplies and incapacities of persons to whom these lands were leased.

Further West on the Windsor and Innswood farm areas the predominant soil type is a heavy cracking clay. The northern parts of these farms receive good quality water from the Rio Cobre scheme and wells. Southern parts of the farm are salinised, and receive tail waters from the irrigation of the northern fields. Some of these lands have been abandoned because increasing salinisation but also because of interruption of their water supply by Highway 2000.

Rain-fed estates

On some of the rain-fed farms and estates, drainage needs improvement, but this has not led to the wide-scale abandonment and degradation of land as has occurred on the irrigated estates.

Alternative uses of salinised lands

For areas incapable of restoration to cane production because of shortage of water and soil salinisation, land use changes have been recommended (MINAG, RPPD 1985) as follows:

- Cotton (on areas with salinised subsoil and shallow layer of non-saline topsoil) and for which water is periodically available;
- Coconuts;
- Fish ponds with salt-tolerant fish species;
- Salt tolerant grasses or other vegetation suitable for extensive grazing;
- Some degree of salt tolerance exists in commercial sugarcane but these are not sufficiently tolerant. Possibilities exist among high fibre wild type canes bred for drought and salt tolerance and these could be used as sources of fuel.

Conclusions and recommendations are provided in Part III below.

8. Key issue 3: Water contamination

8.1. Current state, pressures and trends

The quality of the island's groundwater is usually adequate for human consumption without much treatment, although there are threats of pollution from sewage seepages, nutrients from agricultural waste and pollution from industrial waste (Statistical Institute of Jamaica and NEPA, 2001). Most of the wells that have been tested for quality by the Water Resources Authority meet standards for drinking water, irrigation and industrial use; however there are various wells in the Rio Cobre basin that exceed standards for industrial use (mainly due to excessive hardness, and excess sodium and nitrate), the majority of wells in Kingston are non-compliant with drinking water standards, and all basins have various wells exceeding some of the standards for ambient water. The problems in most cases are the excess of nitrate, sodium and chloride.

A sample survey of groundwater contamination by fertilizers and pesticides (Paragon Environmental Consultants, 2000) showed no contamination with the pesticides atrazine, paraquat and diazinon. Nitrates and chlorides were the main contaminants. While fertilisers probably contributed to the nitrate load, so did human and animal wastes. Chloride contamination was mainly the result of background salinities in the soils.

The quality of surface waters is generally considered to be relatively good (Statistical Institute of Jamaica and NEPA, 2001). However water quality readings in rivers in the 2000-2005 period showed instances of incompliance with freshwater standards in at least one sampling station, especially for BOD (in the Wag Water River, Salt River, Rio Cobre, Hope River, St Ann, Montego Bay and St Thomas), as well there was one station that was non-compliant with phosphate standards, in the Rio Cobre, and practically all rivers showed presence of faecal coliforms. However for some of the rivers that run close or across sugar estates, contamination levels are not reported in the State of the Environment Report, e.g. Black River (Appleton Estate), Cabarita River (Frome Estate), Rio Minho (Monymusk Estate), and Plantain Garden River (St. Thomas Sugar).

The sugar industry can affect the aquatic environment both through factory operations (wastewater discharges) as well as through cultivation (run-off and leaching of nutrients and agrochemicals). The scoping phase identified the contamination due to discharge of waste waters from factory operations as a key source of pollution, and did not identify run-off or leaching as a major concern. However past waste water disposal practices (including vinasse) through soak pits have resulted in groundwater contamination, especially around the Appleton and Long Pond Estates (see Figure 10).

The main source of water pollution by sugar factories and rum distilleries is related to the high levels of organic content (BOD) of the wastewaters produced, especially the cane washwaters and dunder (vinasse). Industrial waste water discharges have to comply with Trade Effluent Standards (1995), irrespective of their final destination (e.g. discharge to water bodies or onto land).

The main sources of waste water generation from sugar, rum and ethanol factories are (source: Cheesman, 2004):

- Sugar factories
    - *Cane wash waters*: waste water generated from sugar cane cleaning, producing a muddy effluent with high BOD.
    - *Cooling waters*: waters from the cooling systems of barometric condensers are produced in large quantities and may easily become contaminated by sugar ('sucrose entrainment') depending on the design and management of the equipment. These waters may be suitable for recycling depending on level of entrainment and contamination.
    - *Equipment cleaning waters*: produced in relatively small quantities.
- Rum factories and ethanol plants
    - *Production of vinasse (dunder)*: the main effluent arising from alcohol production and have a high BOD content. It is estimated that around 10-15 litres of vinasse are produced for every litre of ethanol.

A recent environmental audit of the government-owned sugar factories (EnviroPlanners Limited, 2008) indicates that the industry is generally non-compliant with the Trade Effluent Standards. As stated in the conclusions of the environmental audit:

"Trade effluents represent by itself the most significant environmental aspect facing the sugar factories followed by stack emissions from boiler furnaces to include both gaseous and particulate dusty (fly ash) emissions. In the absence of the appropriate conventional treatment systems at the factories they <u>are not</u> expected to fall within the limits set by the National Environment and Planning Agency (NEPA) governing the discharges. Some practices aimed at recycling are quite commendable but are not enough to satisfy the legal requirements".

Table 10 below summarises the main wastewaters produced at the different sugar facilities, their composition and the disposal practices. Information for the JSC are taken from the results of the environmental audit (2008), a more comprehensive account of which is given in Annex 4 (giving the maximum, minimum and average measurements of all samples taken as part of the audit). No information was obtained for Worthy Park, nor for composition of vinasse from any of the distilleries.

Table 10. Waste water quality and disposal in sugar factories

Sugar factory	Parameters non compliant with trade effluent standards[5]	Disposal practices
Appleton	Phosphates, BOD, COD	Serial settling ponds (8, unlined) and discharge into Black River
Bernard Lodge	DO, BOD, COD, NO_3^-, PO_4^{2-}, TSS, Faecal Coliform, Total Coliform	Washwaters go to settling pond/canal (unlined), leading to cane fields for irrigation Other wastewaters drain into settling pond
Frome	DO, BOD, COD, PO_4^{2-} ,TSS, Faecal Coliform, Total Coliform	Washwaters combined with main factory drain effluents. Settling pond (unlined) in need of maintenance, discharge into Cabaritta River near Big Bridge community
Long Pond	DO, BOD, COD, NO_3^-, PO_4^{2-}, TSS, Faecal Coliform, Total Coliform	No washwaters produced Factory wastewaters wash into main drain leading to settling pond (unlined), where it filters. Excess water pumped to natural pond
Monymusk	DO, BOD, COD, NO_3^-, PO_4^{2-}, TSS, pH, Faecal Coliform, Total Coliform	Washwaters are sent to an unlined settling pond, leading to an irrigation canal Main factory drain combined with dunder from refinery and used for fertigation in S of estate
St. Thomas	DO, BOD, COD, NO_3^-, PO_4^{2-}, TSS, Faecal Coliform, Total Coliform	No treatment of washwaters; they mix with main factory drain waters, drain through earth canal to mangrove system leading into Holland Bay
Worthy Park	no data could be obtained	76% of wash water recirculated, rest disposed on fields

As can be seen from the above tables, the degree of compliance with the trade effluent standards is very low. This is perceived to be having a significant impact on the surface water quality in Jamaica, as well as that of some of the coastal waters, either through direct discharge into the aquatic system or indirectly as run-off and through drainage channels when used for fertigation. Inadequate wastewater disposal practices are mainly affecting water quality in the following aquatic systems:

- Black River (Appleton Estate)
- Mangrove area around Black River nature protected area (Appleton Estate)
- Cabarita River (Frome)
- Rio Cobre (Bernard Lodge)
- Rio Minho (Monymusk)
- Plantain Garden River (St. Thomas Sugar)
- Holland Bay (St. Thomas Sugar)

Even though water pollution from field practices was not identified during scoping as a key concern in the sector, the wastewaters which are used for irrigation (mainly flood irrigation) are eventually drained into aquatic systems. The environmental audit (2008) identified this as a concern in Monymusk (pollution of coastal waters, mainly from application of dunder for irrigation in South part of the estate) and St. Thomas Sugar (pollution of Holland Bay and mangrove system). Trade effluents must comply with standards, even if discharged onto land for irrigation/fertigation purposes.

[5] Based on average values of samples taken in the environmental audit (for JSC factories), and the questionnaire response for data from Appleton Estate. The data provided for the environmental audit do not reflect all parameters covered by the Trade Effluent Standards, but cover some of the main ones relevant to the sugar industry.

However, fertigation is encouraged under the draft trade effluent and sewage sludge regulations as “incentives for the beneficial use of trade effluent”, but the trade effluent must not pose any risk to the environment. In the case that a facility wants to subscribe to the “incentives for the beneficial use of trade effluent”, they have to prepare a Nutrient Management Plan, and then the discharge fees for N, P and BOD are taken as a deposit if annual nutrient/fertiliser reporting (monitored through annual Nutrient Application Reports) is satisfactory. The Nutrient Management Plans provide information on the existing conditions of soils to which the trade effluent is to be applied as fertiliser and must indicate the savings of artificial fertiliser that will result.

At the moment no licence applications have been taken to term (and none received from the government-owned facilities), although Appleton, Worthy Park, Long Pond, Monymusk and New Yarmouth have a NEPA permit for fertigation (but still require the trade effluents licence).

Non-compliance with trade effluent standards is a concern for NEPA. Under the regulations, when applying for a licence from NEPA, existing facilities (i.e. those in place before the regulations) can propose and agree with NEPA on an environmental Compliance Plan, for gradual compliance. Under these Plans, compliance with the applicable standards must be attained within 7 years, with the possibility of a two year extension. To date no Compliance Plan has yet been finalised, although an outline has been submitted by the JSC, listing a series of activities deemed necessary to achieve compliance.

The outline of JSC’s Compliance Plan concerns all of JSC’s sugar estates and covers the period 2008-2011, by the end of which full compliance is expected. It covers the following elements:

Step 1. Develop an Environmental Policy at all factories

Step 2. Compliance with Trade Effluent Standards

Step 3. Compliance with NRCA Air Quality Regulations (2006)

Step 4. Compliance with Water Resources Authority Act

Step 5. Compliance with National Solid Waste Management Authority Act

Table 11 below compares the actions envisaged under the Action Plan for Environmental Compliance (JSC) and the recommendations made in the environmental audit (2008) to address pollution by waste water discharges.

Table 11. JSC outline compliance plan (2008) and recommendations of environmental audit (associated to waste water management)

Actions envisaged in Compliance Plan	Actions recommended by environmental audit
All factories	
• Develop an Environmental Policy	
• Improve quality of canes coming into factory (reduction in mud and trash)	
• Monitor waste streams from factory	
• Reduce spills and leaks within factory	
• Reduce washing of canes	• Reduce washing of canes (except Long Pond as no cane washing)
• Install grease traps on all drains with potential for oil contamination	• Grease traps recommended for Long Pond only
• Construct settling ponds for ash slurry	
• Develop system for maintenance of ponds	
• Develop emission monitoring programmes	
Frome	
	• Increase cleaner overflows from cooling tower to main drain (dilution)[6]
	• Apply some of the cane wash waters to fields through flood irrigation
	• Reconstruct/repair unit separating clean overflows from more polluted drains
• Dredge settling ponds	• Clean and dredge settling pond
• Clean Dutch Canal and other drains	
• Reduce water extraction from Blue Hole and increase water recycling	
• Further separate less polluted waste streams from highly polluted streams	
• Construct treatment facility to treat factory waste water	
Bernard Lodge	
	• Construct stabilisation ponds for waste water leaving factory via main drain
• Upgrade existing settling ponds for factory effluent	• Clean settling pond area
• Repair and maintain channels for waste streams going into irrigation system	
Monymusk	
	• Clean settling pond
• Construct settling ponds for factory effluent	• Construct waste water stabilisation ponds
• Install filter mud conveyor system	
• Transport and apply filter mud to cane fields	• Discontinue washing of filter mud down main factory drain
• **Long Pond**	
	• Construct oil and grease trap along factory drainage system
	• Reduce water consumption rate during crop
	• Construct full-scale waste water treatment plant
	• Reconstruct unit separating clean overflows from more polluted drains
• Construct waste water drain from factory to effluent pond	
• Dredge main effluent pond at back of factory	• Upgrade and clean settling pond
• **St. Thomas**	
• Construct treatment systems to meet environmental standards	• Construct stabilisation ponds for waste water leaving factory via main drain

[6] Note that the regulations prohibit dilution of trade effluents as a means to attain compliance.

As can be seen from the comparative table above, the compliance plan (outline) is generally more ambitious than the recommendations from the environmental audit. The main difference is that the audit recommends a full-scale waste water treatment plant for Long Pond. In any case it is possible that full scale waste water treatment may also be needed in other factories to comply with the trade effluent standards.

It must be noted that the proposed outline for the compliance plan only refers to activities which, if implemented, could result in the attainment of compliance. It does not specify interim commitment of compliance with the applicable standards/targets. However it is the intention of NEPA to base compliance plans on interim standards.

From a trade effluent point of view it must be considered that the plans to install wet scrubbers in the stacks of the sugar factories (as envisaged by the outline compliance plans, and discussed under Key Issue 4 below), will produce ash slurry, which is an additional stream of liquid trade effluents.

8.2. Expected contribution of JCS to water contamination

The implementation of the actions envisaged under the JCS is expected to have both positive and negative impacts on the environment. On the positive side, the closure of mills will imply a reduction in discharge points for waste waters; however, based on interviews it is not clear if factory closures will take place at all, as the decision will rest with the new owners. Also, the acquisition of mechanical harvesters will facilitate GCH, and with the possible introduction of dry cleaning plants, reduce the amounts of extraneous material arriving to the factory, thus potentially reducing the wash water requirements.

The expected reduction of 5,000 ha of sugar cane, as a result of the rationalisation of the industry, implies a reduction in water consumption (e.g. cane wash waters); however, this is offset by the expected increase in cane cultivation to satisfy the rum and ethanol industries.

The main negative environmental impacts on water quality resulting from JCS implementation is the large increase of dunder production, which is expected from the growth in rum production and the production of 70 million litres of ethanol annually.

Considering that for each litre of ethanol produced, there is an average generation of 10-15 litres of dunder (Cheesman, 2004), this means that the expected production of 70 million litres of ethanol per year will produce between 700 and 1,050 million litres of dunder annually (apart of the additional dunder that may be generated by the growth of the rum industry). This may prove to be a conservative estimate, as IBE's targets aimed at an annual production of around 135 million litres per year, which would generate up to 2,025 million litres of dunder.

Currently dunder produced at the rum factories is generally used for irrigation of the cane fields (although in most cases still not under a license from NEPA). This SEA has also identified groundwater consumption as a key issue, and is recommending an increase in water efficiency in cane field operations, mainly through promoting more water efficient irrigation methods (centre-pivot and drip irrigation). A shift to water efficient irrigation is already underway and expected to increase after privatisation. This implies that the options for disposal of dunder on the cane fields through fertigation may be limited. Also, dunder disposal options for irrigation (cane or other) will depend on the location of the ethanol plant or plants.

Finally, the JCS fails to secure environmental sustainability of the sugar sector by not addressing the waste water pollution concerns that the sector faces.

Options for addressing this key issue are described in Part III below. These mainly concern: ensuring adequate dunder management from the future ethanol plants; reduction of water

pollution from factory operations (sugar and rum); and reduction of pollution of aquatic systems from field operations.

9. Key issue 4: Atmospheric pollution

9.1. Current state, pressures and trends

The main sources of atmospheric pollution from the sugar industry are:

- Sugar cane burning (especially particulate matter, dust, CO, ozone)
- Stack emissions from sugar factories (especially particulate emissions from burning of bagasse)

Sugar cane burning

In Jamaica sugar cane burning is a common practice and has been identified by stakeholders as a key concern, due to the emission of contaminants, health effects and nuisance to communities. Burnt Cane Harvesting (BCH) is normally practiced for its immediate economic benefits: harvesting is approximately 50% faster with BCH than with GCH. BCH thus allows lower cost per ton 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 atmospheric environment[7]. From point of view of cane quality, 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.

Finally, from an environmental point of view, the key adverse impacts include:

- Release of Persistent Organic Pollutants (POPs) into the atmosphere, including certain dioxins and furans;
- 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);
- Smoke nuisance (incompatible with urbanisation and tourism);
- Exposure to high levels of pollutants (specifically dioxins) can lead to: persistent acne (chloracne), sarcoma, abnormality in children's teeth enamel and damage to the immune system. However there is no epidemiological evidence that cane burning *per se* produces such dire consequences (Echavarria, 1996), but some effects on health have been identified. For example, 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 the city of Piracicaba, Brazil.

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

Emission factors for particulates, CO and VOC have been calculated under different research studies. These are summarised in Table 12 below.

Table 12. Emission factors for cane burning (kg/ton) (source: Echavarria, 1996)

Pollutant		Darley *et al*, 1975[8]		Universidad Salle, 1992[9]	Jenkins, 1995[10]	US EPA, 1992[11]
		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

In the context of the Stockholm Convention on Persistent Organic Pollutants, which Jamaica has signed and ratified, Jamaica is committed to reduce the emission of dioxins and furans. Cane burning (both in the fields and burning of bagasse) is one potential, although little studied, source of PCCD/Fs (Polychlorinated Dibenzo-p-Dioxins and Furans). In Jamaica, the consultants' report for the preparation of the National Implementation Plan of the Stockholm convention (NEPA, 2005) identified cane burning as one of the main sources of dioxins and furans in the island. In Mauritius samples were taken of burnt fields and stack emissions, and only low levels were of PCCS/Fs were found to be present (except for fly ash that had not been water scrubbed); however, further research on emissions of PCCD/Fs from cane burning is part of their action plan (Ministry of Environment and National Development Unit, 2005).

In Jamaica there is increasing pressure against cane burning, stemming from communities that see it as a nuisance, as well as researchers and environmental authorities, and there is an unofficial commitment to eradicate cane burning by 2010. However various obstacles will need to be overcome for this to happen; technical, economic and social.

Table 13 below shows the levels of GCH in Jamaica, which are noticeable low.

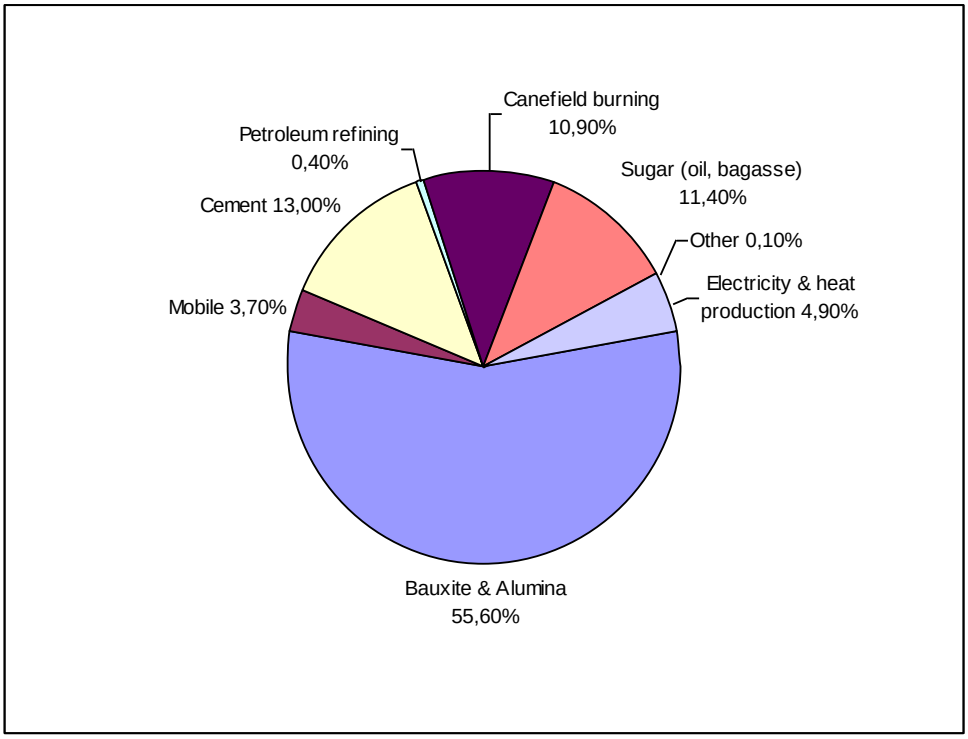
Table 13. % GCH per sugar area (source: Falloon, 2009)

Area	% GCH practiced
Worthy Park (total)	60%
Worthy Park (Estate)	25%
Worthy Park (hill farmers)	100%
Frome	9%
Long Pond	5-10%
Monymusk	Negligible
Bernard Lodge	Negligible
St. Thomas	Negligible
Appleton & Holland	Minimum (excess soil moisture)
New Yarmouth	Daytime GCH, night time BCH (BCH>GCH)

[8] 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).
[9] 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).
[10] Cited in Echavarria (1996).
[11] US EPA (1993) The plain English guide to the Clean Air Act, EPA 400-K-93-001. Cited in Echavarria (1996).

Sugar cane burning is identified as one of the main sources that contribute to poor air quality in Jamaica (RIAS for the Air Quality Regulations, 2003). Especially, sugar cane burning was found to contribute 10.9% of total particulate matter emissions, burning of bagasse and oil in the sugar industry contributing another 11.4%.

Figure 14. Jamaica's total particulate matter emissions (2000, preliminary data) (source: RIAS for the Air Quality Regulations, 2003)



Amongst the technical factors, increased mechanisation will facilitate the shift to GCH, but economic incentives must be in place for GCH to be profitable and social awareness must be raised amongst farmers and sugar companies of the added benefits of GCH as opposed to BCH. To do GCH farmers also need to prepare the fields to optimise harvesting, for which capacity-building may be necessary. GCH also allows mulching, which has the benefits of reducing weed growth and conserving soil moisture, thus reducing water requirements.

Although the idea is to maximise GCH, in some areas GCH may not be possible, either because the topography is not adequate for harvesters, or because the area is very humid (where the trash blanket limits ratoon re-growth). In such areas using such trash as fuel in the factories is a possibility which needs investigation. In the cases where GCH cannot be practiced, an alternative is the use of controlled 'cool burning'.

From a legislative point of view, cane burning is regulated by the Air Quality Regulations (2006) as a fugitive emission. It is unclear how sugar cane burning is regulated, both for fields that are part of the sugar estates, or fields belonging to small farmers. Under the Regulations a licence is required in both cases.

According to the Regulations operators of all "major facilities" and "significant facilities" need to apply for an air pollutant discharge licence. A "facility" is defined as *"any building, structure, establishment, installation, plant, works or activity that emits, or has the potential to emit, an air*

pollutant"[12]. Under this definition, cane burning can unequivocally be considered an "activity that emits…an air pollutant", and thus must be considered a facility.

Furthermore "Major facility" is defined as *"any facility having an air pollutant source that emits – (a) one hundred or more tonnes per year of any particulate matter (PM); (b) sulphur oxides measured as sulphur dioxide (SO_2); (c) carbon monoxide (CO); (d) nitrogen oxides (NO_x) measured as equivalent nitrogen dioxide…"* As cane burning emits NO_x and CO, then it must be considered a major facility. This implies that all "operators" involved in sugar cane burning must apply for a licence, including the sugar estates and the small farmers. This leads us to some practical problems of implementation, which are discussed below.

For the sugar estates and rum factories, operators are allowed to include fugitive emissions together with stack emissions under the same licence. For facilities currently non-compliant with stack emission targets (for existing facilities) or standards (for new facilities), a Compliance Plan must be agreed with the authorities (discussed below). For the case of fugitive emissions, operators must produce a Fugitive Emissions Compliance Plan, if: "*(a) the facility has a fugitive emissions sources operating with emissions in excess of 20% opacity…(b) the facility has a fugitive emissions source operating with visible emissions that are being transported, by air dispersion, off the property on which the source is located; or (c)… the ambient air quality standard for total suspended particulates or for PM10 specified in the…Regulations is being exceeded…"*. Again, sugar cane burning activities imply that a Fugitive Emission Compliance Plan is required.

The problem arises when small-scale farmers are considered to operate "major facilities", and have to be put through the permitting system, as this would put a heavy burden on them: e.g. licence application and renewal costs, monitoring and reporting requirements, preparation of compliance plan. Requiring licences for compliance with the Air Quality Regulations from small scale farmers has not occurred yet, and it is unlikely to occur based on discussions with NEPA; however, the possibility exists as it is foreseen in the Regulations.

Emissions produced by cane burning have undesired environmental and social effects and, in line with the informal policy commitment in Jamaica, should be minimised. The use of the Air Quality Regulations to approach this issue, however, seems to be a poor choice due to its unnecessary complexity, and unfair burden on small scale farmers. Instead sugar cane burning should be regulated in a more straightforward manner: by requiring all cane farmers to gradually reduce cane burning, setting intermediate targets leading to minimisation (total area where cane burning is to be banned to be determined on the adequacy of the fields for GCH). Such requirements are easier to implement, but should be accompanied by appropriate incentives to ensure they can be met (e.g. facilitating small-scale farmers access to appropriate GCH equipment). Such an approach is not alien to NEPA's thinking, but needs to be matured and regulations amended accordingly.

A major problem in implementation of GCH is the persistent and growing problem of illicit cane fires. Control of this problem will continue to be a major challenge for the sugar industry and law enforcement.

Stack emissions from the sugar factories

Boiler stacks are an important source of emissions from sugar factories. Normally bagasse is used to fire boilers, but supplementary fuels are also common in Jamaica (mainly oil). The main pollutants are particulate matter (which normally contain heavy metals), NO_x, and SO_2 (the latter especially when oil is used as a fuel). The burning of bagasse can also be a source of dioxins and furans. Also, high humidity levels in the boiler exhaust gas can cause an opaque white plume, which could infringe opacity standards.

[12] Emphasis added.

Table 14 below gives an account of the fuel sources, boiler characteristics, compliance with emission standards and pollution abatement systems in place for the different sugar factories (data for the JSC factories is taken mainly from the environmental audit, 2008).

Table 14. Fuel and stack emissions from sugar factories

Sugar factory	Fuel source	Boiler characteristics and efficiency	Compliance with emission standards	Pollution abatement systems
Frome	2.8 million litres bunker C oil 270,000 tonnes bagasse (bagasse approx. 34% of energy requirements)	7 boilers 40-50% efficiencies	No data available, but compliance highly unlikely in absence of pollution abatement equipment	None
Monymusk	Bagasse 1 million litres bunker C oil per crop	8 boilers 7 bagasse; 1 bagasse + bunker C oil	No data available, but compliance highly unlikely in absence of pollution abatement equipment	None, but wet scrubbers to be installed soon
Bernard Lodge	Bagasse Approx 1 million litres bunker C oil per crop	7 boilers 6 bagasse only; 1 oil boiler	No data available, but compliance unlikely with inefficient pollution abatement equipment	Wet scrubbers (inefficient and to be replaced)
Long Pond	Bagasse 1.7-1.9 million litres bunker C oil per crop	3 boilers	No data available, but compliance highly unlikely in absence of pollution abatement equipment	None, but wet scrubbers to be installed
St. Thomas	Bagasse	4 boilers	No data available, but compliance highly unlikely in absence of pollution abatement equipment	None, but wet scrubbers to be installed
Appleton	Bagasse	1 high pressure boiler*	Applied for air pollutant discharge licence	Wet scrubbers
Worthy Park	Bagasse	3 boilers	Applied for air pollutant discharge licence 2008	??

*Appleton also has 1 small oil-fired auxillary boiler which operates for the distillery out of crop.

The SCJ outline Compliance Plan with NEPA includes the following actions for the control of air pollution:

- Complete the application process for NRCA Air Quality license (by March 2009)
- Install wet scrubbers on boiler stacks
- Develop emission monitoring programmes at factories

Atmospheric emissions from boiler stack should be brought to compliance with the Air Quality Regulations (2006) standards and targets, for which it will be necessary to bring to term the installation of pollution abatement equipment (wet scrubbers) already foreseen. However, it will be necessary also to improve combustion efficiencies by upgrading boilers (e.g. installing high pressure boilers, as foreseen in the JCS).

9.2. Expected contribution of JCS to atmospheric pollution

Atmospheric emissions could increase proportionate to the increase of sugar production, as well as from ethanol plants. However the main impact from JCS implementation on atmospheric emissions is expected to be positive. The JCS component on "upgrading of factory equipment" foresees that energy recuperation from bagasse will be enhanced by installing new boilers and turbo-generators at all factories, as well as investments at Frome and St. Thomas to increase the efficiency of exhaust steam use and fuel in the sugar fabrication process. Also, the "renewable energy" component of the JCS foresees improvement of combustion efficiency by installation of high-pressure boilers in the sugar factories, which will reduce emissions of particulate matter.

Furthermore, the replacement of MTBE with ethanol up to 10% volume of gasoline will have a positive environmental impact, by reducing MTBE emissions from vehicle exhausts.

The JCS, in its component on "land use and environmental management", states that GCH will be promoted in suitable areas. This will contribute to address this key concern, although a more specific plan of action should be elaborated.

In spite of these positive effects expected from JCS implementation, the JCS still does not address the environmental concerns associated to stack emissions. The JCS is silent on ensuring appropriate atmospheric pollution abatement systems in the factories (although installation of wet scrubbers is foreseen as part of the outline Compliance Plan between NEPA and the JSC).

Options for addressing this key issue are described in Part III below.

10. Other environmental concerns

The scoping stage identified other environmental concerns in the sugar industry. These were not analysed in detail, as the priority should be on addressing the major concerns. Nevertheless, these are mentioned below, as often simple measures can be implemented to minimise adverse environmental impacts.

Less-important environmental concerns identified include:

- Contamination of groundwaters by runoff and leaching of agrochemical products
- Aerial spraying of ripeners
- Personal protection equipment for field workers

Contamination of groundwaters by runoff and leaching of agrochemical products

The sugar industry is the largest user of fertilizers, using some 15,000 – 18,000 tons per year of formulated product or approximately 500 kg/ha. This is generally lower than rates recommended by SIRI.

The private estates and some independent farmers are able to follow SIRI recommendations, which are solidly based on years of agronomic research. Fertiliser application in excess of the crop's agronomic need does not generally occur. Fertiliser deficits are more common, especially as the economic situation of the industry has declined in recent years.

Nevertheless there is the potential for both atmospheric and water contamination; atmospheric contamination by volatilisation of urea, and water contamination by dissolution and runoff in surface waters of nitrogenous potash and phosphatic compounds, as well as sulphates and chlorides. The survey previously mentioned (Paragon consultants, 2000) did not identify groundwater contamination as a major consequence of fertiliser use. Surface water contamination probably occurs but the data on the extent and effects were not available to us.

In order to avoid runoff and volatilisation SIRI recommends the burying of fertiliser using subsoil applicators; this increases availability to the plant and avoids run-off loss. Urea application is not recommended on alkaline dark coloured soils where volatilisation is more severe.

There is very little use of insecticides and virtually no fungicide used in the sugar industry; the main insect control strategies are bio-control through mass release of parasitoids for stalk borers and integrated control of a Hemipteran pest which appears only sporadically and appears increasingly to be kept below economic damage thresholds by its natural enemies.

Herbicides and ripeners are widely used. However, because of economic constraints weed control is sub optimal. From PCA data approximately 80-90 tons of active ingredients (a.i.) of herbicides are used by the sugar industry. Herbicide loads per ha are of the order of 3 kg a.i./ha (c.f. Mauritius at 4.1 kg a.i. after introduction of GCH). Herbicide use per ha is higher on the better funded private estates and is of the order of 5 kg a.i./ha. The PCA strictly regulates and controls the entry of pesticides into Jamaica and has been working consistently to reduce and eliminate the use of more toxic products.

Except where aerial spraying is done, the evidence for environmental contamination by pesticides used in the sugar industry is sparse. The report by Paragon Consultants (2000) did not detect any of the more commonly used herbicides in groundwater.

The JCS is likely to result in initially higher rates of use as more lands are replanted, but in the medium term there should be a reduction with increase in GCH (resulting in weed-suppressing trash blanket), and increasing use of more modern herbicides which are effective at lower doses.

Aerial spraying of ripeners

Aerial spraying of ripeners and growth regulators is done on 10-20% of the cane area, mainly on larger estates. The active ingredients used, glyphosate fluazifop-butyl and ethephon are of low mammalian toxicity and are used generally at sub-herbicidal rates. Nevertheless occasionally there is drift of over-spraying onto non-target crops and populated areas. Any drift onto populated areas is undesirable and some crop damage can occur on non-target crops. This causes disputes and the estate is usually asked to compensate.

Guidelines for aerial spraying which avoids such incidents should be implemented.

Personal protection equipment of field workers

Herbicides are applied manually by knapsack sprayers on a portion of fields usually at later growth stages of the crop where tractor mounted boom sprayers are inappropriate. Spraymen are frequently inadequately protected because the employer does not provide sufficient protective gear on a timely basis and/or the spraymen discarding protective gear (usually masks and gloves) because they become hot and uncomfortable whilst working.

There is a need for more frequent replacement of coveralls and rubber boots, as well as more comfortable masks and gloves. Workers also need regular training in the observance of safety precautions and the regular monitoring of their health status.

The JCS should result in greater use of mechanised spraying and less of manpower. With better levels of investment resulting in improved application technology and the use of more effective herbicides, the need for late season spraying and use of manpower should be lessened or eliminated. Such manpower as remains should be provided with clothing and protective gear which is more comfortable for use in hot conditions (e.g. light coloured coveralls, boots and gloves).

11. Positive environmental impacts and opportunities

11.1. Positive environmental impacts of JCS implementation

JCS implementation will bring about a series of positive effects on the environment, as outlined below.

- The privatisation process is expected to improve overall environmental performance, by bringing in external funds and capacities, and by linking the divestment agreements to eventual compliance of environmental standards. Nevertheless, this is contingent to the GoJ ensuring environmental performance is part of the privatisation agreements. The positive impact can range from low significance to highly significant, depending on the agreements reached; in the case of the original agreement with IBE, the positive impacts are expected to be of high significance.

- The accelerated replanting programme will bring about a renewal of the cane stands in Jamaica. Field efficiencies will increase and water requirements may decrease. The replanting programme will be accompanied by more efficient application of herbicides and fertilisers, reducing impact on the aquatic systems. These impacts are expected to be of low significance.

- The irrigation and drainage component, although it will increase water use by increasing the irrigated area, will also bring about an improvement in the efficiency of the irrigation system in the water-stressed areas of Clarendon and St Catherine. These impacts are likely to be of medium significance.

- The management of cane supply component will reduce the amount of extraneous material reaching the factory, and thus has the potential to reduce the requirements for wash water, and improve energy efficiency. These impacts are expected to be of low significance.

- The upgrading of factory equipment component will contribute to reduce atmospheric emissions by improving combustion efficiency. The effects are expected to be of medium significance, although they should be accompanied by more ambitious methods to curb polluting atmospheric emissions. However, STU's Multi-Annual Action Plan 2008-2010 (version 2 supplied to the consultants), does not make an explicit reference to this component, with the risk that this component will get neglected.

- The renewable energy component will have positive impacts by installing high-pressure boilers, which will further increase energy efficiency and reduce atmospheric emissions. Moreover, the substitution of MTBE by ethanol will bring about a significant improvement in air quality in Jamaica from vehicle exhaust emissions. However, STU's Multi-Annual Action Plan 2008-2010 (version 2 supplied to the consultants), does not make an explicit reference to the installation of high-pressure boilers, with the risk that this component will get neglected.

- The land use and environmental management component will bring about positive environmental effects by helping implement the Environmental Code of Practice of the sugar industry, promote green cane harvesting and promote environmentally sound alternative land

uses (for lands going out of cane). However for effects to be significant, a more concrete strategy should be worked out (addressed in the sections on land degradation and atmospheric contamination of this report). However, STU's Multi-Annual Action Plan 2008-2010 (version 2 supplied to the consultants), does not make an explicit reference to this component, with the risk that this component will be neglected.

- Other components, that imply an expansion of the industry will help generate employment (molasses production, rum production, ethanol production), but also the components on human resources development, economic development and diversification, and rural infrastructure). Social benefits are also expected (social services component).

11.2. Other opportunities to enhance environmental benefits

Two other important opportunities have been identified with the potential of enhancing the environmental benefits of the sugar sector: fair trade sugar production and generation of carbon credits. These are explored in Part III below.

PART III: ANALYSIS OF OPTIONS

12. Key issue 1: Pressure on groundwater

Although the JCS would increase the land area under permanent irrigation, this does not necessarily imply increased pressure on groundwater resources. In fact the opposite should be the case with improved irrigation efficiencies and better surface water distribution and capture.

Therefore pressures on groundwater and groundwater salinisation are not expected to be aggravated by the JCS provided efficiency targets are met and surface water availability improved. This is a key environmental sustainability problem of the sugar sector that the JCS does not address, and which is especially relevant as of the objectives of the JCS is to strengthen environmental sustainability.

There are opportunities therefore for the sugar sector to reduce water stress and its contribution to groundwater salinisation, as well as to minimise the detrimental effects of irrigation with saline water. This can be achieved specifically by reducing reliance on groundwater, through:

- improving the surface irrigation schemes,
- the use of more water-efficient irrigation methods, and
- seeking alternative sources of irrigation water.

Opportunities to reduce water consumption in factory operations are addressed under Key Issue 3 below (ground- and surface water contamination).

Although water-efficiency should be sought throughout the sugar industry, efforts should be prioritised in the sensitive areas of Clarendon and St. Catherine.

Table 15 below presents a synthesis of the main options available, and presents their strengths, opportunities, weaknesses and threats.

Promotion of water-efficient irrigation methods

The most common irrigation method in sugar cane lands is furrow irrigation, which is also the most water-inefficient. The JCS should make a clear emphasis in shifting to water-efficient irrigation methods. Emphasis should be placed in promoting the use of the most water-efficient irrigation methods: firstly drip irrigation, and secondly centre-pivot. For areas or circumstances where drip or centre-pivot irrigation cannot be implemented, other alternatives exist, such as land forming and reblocking to optimise infield water distribution and greatly improve the efficiency of surface irrigation. Also to be considered are alternate-furrow irrigation and enhancing moisture retention by mulching (mulching can be used to enhance water efficiency irrespective of the irrigation method used).

Changes in irrigation methods will face constraints, especially associated to increased installation and maintenance costs, as well as topographical conditions.

Currently there are over 1,700 ha of installed centre-pivot systems at New Yarmouth, Monymusk, Bernard Lodge and Newton Farms. The first installations at New Yarmouth in 1999 -2000 gave very positive results in terms of productivity and water use efficiency. However these initial results have not been entirely evident in larger scale extensions of the systems. The failure rate of components of the systems has been higher than expected. There is also the suggestion that scheduling of irrigation needs improvement. The systems operating on lighter soils with low conductivity waters at Bernard Lodge, Newton and sections of New Yarmouth also seem to produce more consistent yields than on the heavier salinised soils. The suitability of centre-pivot for use on salinised soils with poor quality water is questionable and may in fact aggravate

salinsation even faster than other methods. There are therefore still problems with the systems necessitating further research and refinement.

Although the advantages of centre-pivot and (especially) drip irrigation are evident in terms of water savings, there are a series of obstacles that need to be overcome if these methods are to become more widespread, especially cost considerations.

Improved water efficiency in irrigation schemes

Improve irrigation infrastructure

The irrigation infrastructure is itself water inefficient. Problems are associated to lack of maintenance, obsolete equipment, leakages, etc. These problems have not been addressed to a large extent as cost recovery is insufficient to fund operation and maintenance, mainly due to the large Government subsidies it involves.

The improvement of the irrigation schemes is foreseen in the Water Policy Action Plan as well as National Irrigation Development Master Plan (NIDMP). The specific objective and intention of the NIDMP is to recover the operation and maintenance costs of new and rehabilitated irrigation schemes.

In terms of improvement of irrigation schemes, the JCS only envisages the improvement of an irrigation system on 3,000 ha at Monymusk, as well as upgrading of irrigation works on private estates. Precise details as to what specific actions will take place are not provided in the JCS; however the estate has indicated a) the re-commissioning of wells by restoring the power transmission system, b) extending cane production in areas closest to good water sources, c) better exploiting good to moderate quality water sources by using more efficient irrigation to cover increased areas, and d) increasing storage of rainwater and good quality surface waters

In the St Catherine area, improvement of the Rio Cobre conveyance system, and possible use of recycled tertiary treated sewage water are the main means of improving water availability.

The JCS should have a firmer stance on ensuring the water efficiency of irrigation systems is improved, as this is a key weakness in the sector from an environmental sustainability point of view. A commitment should be made to assist in the implementation of the NIDMP, especially with regards to the upgrading of the Rio Cobre and Rio Minho basin irrigation schemes.

Use of treated waters for irrigation

As mentioned above, an alternative source of water for irrigation is the use of treated wastewaters; this option has been under consideration for a number of years, and was included in the Water Resources Development Master Plan (1990), but has not materialised. A possible (partial) solution could be found in the use of recycled waste water from the Soapberry plant; this would however involve a significant re-direction of the Rio Cobre distribution System to the West and South, with the eastern area of Bernard lodge being supplied from a new distribution system from Soapberry. Water quality from Soapberry (and other plants in the area) would have to be tested and regularly monitored to ensure qualities adequate for irrigation.

Storage for seasonal high river flows

Another opportunity to reduce the pressure on groundwater in Clarendon and St. Catherine is the construction of reservoirs for seasonal high river flows. For example, a rudimentary water conveyance and capture system on the West of Monymusk using water from the Milk River could be expanded and upgraded.

Minimising negative incentives for water efficiency

There are two main negative incentives for saving water: subsidies on irrigation water and flow-based charges for water (as opposed to volume-based).

Subsidies on irrigation water are considerable, amounting up to 70% of the real cost. Currently farmers pay 0.78J$/$m^3$ for the first 5,508 m^3, thereafter 1.02J$/ m^3 for irrigation water. There is also a service charge of 32J$ per acre per month for areas over 10 acres. The service charge may be waived if the water is not used for two months or more, but a nine-month interruption of use can lead to cancellation of the supply contract. The real cost of water is stated at 3.60J$/ m^3. Although the costs are allegedly already too high for farmers, this does not seem to have motivated farmers to seek water-saving opportunities.

The Jamaica Water Policy and Action Plan already foresees that relevant agencies will re-work the subsidies on irrigation water, so maintenance and operation costs can be recovered, but that farmers will not have to abandon irrigation of their lands. The best way to reduce impact of any reductions in subsidies is to create the conditions for farmers to appreciate water-saving cultivation methods, and facilitate their adoption.

There is an opportunity for the JCS to support the restructuring of the irrigation water charges if possibly not directly, certainly by facilitating the adoption of water saving measures in the field, which would reduce the demand for irrigation water, and thus allow a larger margin to reduce subsidies.

Other opportunities

Other opportunities to improve water efficiency in the sugar industry are by reducing water consumption in the factory operations, primarily in sugar cane washing. Washwater consumption can be achieved primarily by promoting green cane harvesting (dealt with below). Other opportunities are described below in the section on waste water management.

Table 15. Strengths, opportunities, weaknesses and threats to reduce pressure on groundwater resources

Strengths and Opportunities	Weaknesses and Threats
Promotion of water efficient irrigation methods – Drip irrigation	
• Drip irrigation is the most water-efficient method (~95% water use efficiency) • Most of the lands in the irrigated plains are suitable for drip irrigation • The system has already been piloted, and thus there is experience to draw from • Opportunity to implement drip irrigation in areas where replanting is foreseen • It can minimises the application of saline water, thus contributing to mitigation of land degradation • Dunder can be applied through drip-irrigation, further reducing water stress and providing an alternative for management of dunder • Very low maintenance costs • Consistently high yields are maintained over longer ratoon cycles • Expansion of drip irrigation was already part of the original divestment plans, so useful for negotiation of new divestment plans	• Very high installation costs • Installation is gradual depending of the pace of replanting • Farmers require technical assistance on the use of the method • Farmers require funding to implement drip irrigation

Promotion of water efficient irrigation methods - Centre-pivot irrigation	
• Centre-pivot is more water efficient than furrow irrigation, although not as much as drip irrigation • There are over 7,000 ha of sugar cane lands on which centre-pivot irrigation could be used • The system has already been piloted, and thus there is experience to draw from • It can reduce the necessity to use saline water, thus contributing to the mitigation of land degradation • Expansion of more water efficient irrigation methods was already part of the original divestment plans, so useful for negotiation of new divestment plans	• It is expensive to implement and maintain • Very high operational costs • Vulnerable to scrap metal thieves, hurricanes • Movement is energy dependent • Very high labour cost • Farmers require technical assistance on the use of the method • Farmers require funding to implement drip irrigation • May not be suitable for applying dunder as the corrosion potential is too high
Promotion of water efficient irrigation methods - Alternate furrow irrigation	
• Where drip-irrigation or centre-pivot irrigation is currently not feasible, is a water-saving alternative • It is not costly to implement • It has been piloted, and results show its efficiency • It reduces the application of saline water, thus contributing to tackle land degradation	• Farmers need an incentive to change from traditional furrow irrigation
Promotion of water efficient irrigation methods – Reblocking and land forming	
• Properly done it is very cost effective as it is a one-time only process • Drastic improvement in water use efficiency compared with traditional furrow/twig & main systems • Moderately costly to implement • It had been promoted in the past in some areas which were successfully reblocked (Innswood, Handal's farm) • It could be the best system to manage irrigation of heavy saline-vulnerable clays • Is compatible with alternate furrow irrigation	• Needs detailed and skilled survey work • Needs some specialised equipment (laser guided graders)
Promotion of water efficient irrigation methods – GCH/Mulching	
• Increases moisture retention • Reduces the water requirements • Reduces weed growth and thus has an incidence in reducing herbicide application • It can reduce the amount of extraneous material that arrives at the mill, and thus can reduce or eliminate the use of cane wash waters.	• It is disadvantageous in certain very humid areas (e.g. Frome in the latter half of the year)
Improve water efficiency in irrigation schemes –Improve irrigation infrastructure	
• Result in an increase of water efficiency, and thus a reduction of pressure on groundwater resources • The necessary actions have already been studied and are reflected in the NIDMP	• Financial resources need to be allocated
Improve water efficiency in irrigation schemes –Use of treated waters for irrigation	
• Recycling of water	• Quality of waters have to be ascertained to

• Reduces pressure on groundwater • Non-saline waters, contributing to reduce soil salinisation	ensure adequate for agricultural use
Improve water efficiency in irrigation schemes –Storage of seasonal high river flows for irrigation	
• Reduces pressure on groundwater • Non-saline waters, contributing to reduced soil salinisation	• May be expensive as requires retention and conveyance infrastructure
Minimising negative incentives for water efficiency	
• Result in incentives for implementation of water-efficient irrigation measures and practices by cane farmers	• Must be carefully worked out so higher costs of irrigation will not affect farmers' income and lead to abandonment of lands • Must be implemented in parallel with measures to raise awareness of water-saving mechanisms and practices, and assistance to their implementation • Must be negotiated with WUAs and farmers

13. Key issue 2: Land degradation

The main challenge is to bring back into production approximately 9,000 ha of land in the permanently irrigated areas whilst arresting and reversing salinisation. For reasons already stated, sugarcane culture would represent optimal use for most of the available abandoned land. Environmental benefits would be of a highly efficient carbon sink, a source of renewable energy, protection of the land and aesthetic value.

Of the alternative crops, coconuts would also represent an upgrading of the saline tolerant scrub that now occupies the more saline lands (a small coconut farm was established in the salinised area near to Mitchell Town and grew quite successfully; B.Been, CIB, pers. comm.)

Cotton could be grown in special soil niches. Currently cotton culture in Jamaica is not as pesticide-intensive as in most other areas, as pest levels are kept low by long rest periods when no crop remains on the land to act as pest reservoirs. The fallow period is also useful to allow cracking and flushing of salts from the topsoil. Further, because of the higher than average quality premium offered for Sea Island cotton, productivity needs not be as high nor as pesticide intensive as elsewhere. This is also a useful crop for medium to small scale farmers as a good extension and support system exists.

Fish and shrimp farms are already established in the Monymusk area and opportunity could be given for the further development of such enterprises, although with proper previous study of its environmental sustainability through an Environmental Impact Assessment (e.g. damage to wetlands).

For the sugar industry some capacity-building will be necessary in the most appropriate implementation of the newer irrigation technologies and their management in the context of marginally saline water sources, recycled water and lands vulnerable to saline degradation.

Under NRCA regulations no prior approval is necessary for changes in crop types on agricultural lands. However changes from agriculture to urban or other uses requires multi-agency approval. It appears that the only pending major change of land use requested will come from the Ministry of Transport which proposes the use of lands in the Bernard Lodge area, specifically 90 ha on the North East of Caymanas farm, for an industrial park.

The JCS is concerned that any lands going out of cane should be put back into productive use in the shortest possible time. However, the areas likely to go out of sugar cane do not represent

large areas of productive land as stated in the JCS. It appears that mostly small and marginal farmers and some saline lands will be affected. Between SIRI and STU these farmers can be identified and SIRI has been trialling various alternative crops including pepper, vegetables, fruit and cotton as alternatives. For saline lands the alternatives mentioned above (coconuts and fisheries) seem most feasible. Environmental impacts from the small farmers cropping would have to be monitored as erosion and higher levels of pesticide use could result.

Table 16. Strengths, opportunities, weaknesses and threats to reduce land degradation

Strengths and Opportunities	Weaknesses and Threats
• Land put back into productive use • Degradation by invasive species halted • Salinised lands reclaimed • Advance of salinisation arrested • Informal settlements on unoccupied land prevented • Optimisation of resource use – both land and water	• Water resource misuse if not carefully managed • Inappropriate use of badly salinised land • Drainage and reclamation costs high • Cost of surface water capture and conveyance to reclaim abandoned lands • Potential significant environmental impacts of some alternative land uses (e.g. shrimp farms), that require detailed prior study

14. Key issue 3: Water contamination

The contribution of the JCS to water contamination is mainly associated to the planned production of 70 million litres of ethanol annually, as well as the expected growth of rum production. Also a key environmental concern in the sugar sector is ongoing contamination of aquatic systems from factory operations (and to a lesser extent field operations), which is not currently being addressed by the JCS, in spite that one of its objectives being to strengthen environmental sustainability.

Table 17 below presents a synthesis of the main options available, and presents their strengths, opportunities, weaknesses and threats.

Opportunities for mitigation and enhancement

Ensuring adequate management of dunder for the future ethanol plant

The production of 70 million litres of ethanol per year is expected to produce approximately 1.05 Mm^3 of dunder annually. The possibility of more ambitious plans (as originally foreseen by IBE), could increase this amount up to 3.105 Mm^3 per year from ethanol production alone.

As discussed above dunder is a highly contaminant effluent, having a very large organic load. Furthermore actions oriented to address water efficiency in sugar cane field operations, by promoting more water efficient irrigation, may also reduce the options to use dunder for fertigation.

Use of dunder for fertigation may not be as simple as it appears. 3.1 Mm^3 are sufficient to irrigate over 4,000 ha at 750 m^3/ha per wetting. Considering 80% irrigation efficiency, it would be sufficient for the irrigation of some 3,200 ha; this implies considerable modification of the distribution network.

The ethanol plant should ideally be located close enough to the fields where dunder will be applied, so it becomes a cost-effective disposal method (currently irrigated sugar cane fields are in the Clarendon and St. Catherine Plains – Monymusk and Bernard Lodge – and, in the future St. Thomas and Frome as supplementary applications). Appropriate storage facilities must be

built at the receiving end. Dunder will require basic treatment (e.g. settling ponds) before disposal onto land.

Under the original plans of IBE the ethanol plants would be constructed in Monymusk and Frome. This would partly solve the problem of having the ethanol plant close to the irrigated cane lands in the case of Monymusk, but at Frome some other disposal method would have to be found in the wet season (May to November). Were a new dedicated ethanol plant to be constructed, e.g. in St. Catherine, presumably it would be near enough to cane fields to allow vinasse disposal by fertigation, If the fertigation option is not possible other options (below) would have to be considered.

Furthermore, dunder disposal for fertigation is currently taking place under a NEPA permit, which forbids the application of dunder during rains to prevent runoff reaching water bodies; this is already the case for some facilities that have a permit with NEPA (Appleton, Worthy Park, Long Pond, Monymusk and New Yarmouth), where the distilleries have to shut down during rains as they cannot dispose of the dunder being produced. NEPA licenses for fertigation will most likely to be conditioned in a similar fashion. If the ethanol plant operations are not to be disrupted by rain events, alternative treatment options will need to be in place.

Options for treatment of dunder include aerobic treatment using activated sludge, anaerobic bacterial digestion and concentration by evaporation (Cheesman, 2004). Anaerobic digestion (biodigestors) can be harnessed to produce biogas and fertiliser sludge. Concentration of dunder allows recovery of water that can be fed back into the distillery (e.g. for molasses dilution), and yields a concentrated syrup (concentrated molasses solubles/solids, CMS); the CMS can be neutralised by treatment with lime if necessary, and used as a fertiliser, in animal feed or as fuel (in an appropriately designed furnace), and the resultant ash can be used as potash-rich fertiliser. Other anaerobic options are available, e.g. the Biostil process and mixing (and then drying) dunder with bagasse pith to produce fuel material[13].

In the time-frame of this SEA it was not possible to undertake a more in-depth study of the options available for vinasse treatment.

The ethanol plant (or ethanol production facilities within existing installations) will require a detailed Environmental Impact Assessment (EIA) before authorising the project, in order to ensure it will be fully compliant with all applicable environmental standards. The EIA will particularly have to determine the generation of waste waters and ensure the proposed design and operational practices can guarantee safe disposal and treatment of dunder.

Reduction of water pollution resulting from factory operations (sugar and rum)

Non-compliance with trade effluent standards is a major concern, as waste waters are either disposed of directly to aquatic systems, or can reach them indirectly (e.g. inadequate use in irrigation). The main sources of pollution are cane wash waters and dunder (dunder production from the new ethanol plant is addressed above).

One way to reduce water pollution is to reduce the use of water for cane washing, which can be achieved mainly by: reducing the amount of extraneous material arriving to the factory and/or using dry cleaning of cane. The reduction of extraneous material can be achieved by increasing GCH and promoting mulching. GCH is expected to increase and eventually the cessation of intentional cane burning will occur. However the original target date to cease burning by 2010 cannot be met. GCH is discussed under key issue on atmospheric emissions.

[13] Cheesman (2004), pp. 165-167 provides further discussion on alternative methods for dunder (vinasse) disposal and treatment.

Cane wash waters (and other factory effluents which mix with it) should be treated to a sufficient degree so they are compliant with trade effluent standards. The JSC outline compliance plan envisages a series of actions, mainly through the use of settling ponds; however, settling ponds are unlikely to lead to compliance with trade effluent standards (e.g. in Appleton, wash waters pass through a series of eight settling ponds, and final effluent is still non-compliant). Full scale waste water treatment plants may be required.

In some cases wash waters are being used for irrigation (e.g. Monymusk), but this practice will have to be regulated through the trade effluents licence with NEPA, showing that its use results in reductions in application of synthetic fertilisers, something which is unlikely.

Currently the outline Compliance Plan proposed by the SCJ to NEPA is based on the implementation of actions (e.g. constructing and enhancing settling ponds), but it is not certain that such actions will lead to compliance with standards. It is recommended that the compliance plans are linked instead to results through associated targets (i.e. % compliance with standards), leaving to companies to decide the best means to achieve targets.

In the case of use of factory effluents for irrigation, this practice requires a NEPA license, which should establish the maximum allowable concentrations of pollutants. The use of settling ponds may be sufficient to reduce levels of contaminants to sufficiently low levels for release on land (but not dunder) (Cheesman, 2004). However, for effluents discharged into water bodies (e.g. at Appleton, Frome and St. Thomas), aerobic or anaerobic waste water treatment would normally be required.

A pilot anaerobic treatment system was tested at Frome, funded by GTZ and the Jamaica's Scientific Research Council (SRC). The project was discontinued in the mid nineties, but results were recorded and are available from the SRC or SIRI.

As far as dunder is concerned (produced by the rum factories), its use in fertigation should be fully regulated by NEPA through licensing system, for which NEPA (in co-ordination with the Ministry of Agriculture) must have clear reference criteria to define conditions under which fertigation can take place. Such conditions could include aspects related to nearness of water bodies, runoff and leaching potential, and load of contaminants. In the case of fertigation at Appleton Estate, the permit conditions were established based on pilot fertigation trials and monitoring; however the pilot was not adequately set up and there were problems associated to the monitoring of key variables and reporting[14] (see WRA, 2002 and WRA, 2003). The conditions imposed on Appleton's licence, based on the piloting of fertigation at the Estate, were then extended to other permits.

Appleton has continued to apply dunder with some improvements to the procedure, such as greater set backs from the river and application only during dry periods (as foreseen in the permit conditions). This has resulted in some improvement but contamination, whilst much reduced, still occurs. A pilot of 33 ha of drip irrigation through which filtered dunder is applied underground is also being trialled.

Worthy Park also has begun application of stillage to fields with required setbacks from water bodies under a similar NEPA permit. This exercise is however still in early stages of development.

The assessment of applications for fertigation will be done by NEPA and the Ministry of Agriculture based on the submitted Nutrient Management Plans. In cases where it is considered that dunder cannot be applied for fertigation (e.g. because water needs are already met, or

[14] For example, there were problems associated to the absence of information on the application of dunder (rates of application and areas of application); inorganic fertilisers were applied together with the dunder; research plots compromised and no meaningful attempt to re-establish plots to evaluate effect of dunder on growth rate and sugar content of cane; weak project management and monitoring.

because of the sensitivity of the receiving environment), then it will have to be treated (either to comply with standards for release to the aquatic system, or to bring load of contaminants to a sufficient level that would allow disposal onto land). Treatment options are discussed above, in the sub-section on recommendations associated to the new ethanol plant. Treatment will also be the only option available if application of dunder is banned during periods of rain, and where distilleries would not be prepared to stop operations.

Table 17. Strengths, opportunities, weaknesses and threats to reduce surface water contamination

Strengths and Opportunities	Weaknesses and Threats
Ensuring adequate management of dunder at ethanol and rum plants - Use of dunder for fertigation	
• More environmentally sound method of disposal than discharge to aquatic system • May require basic prior treatment only (e.g. settling ponds) • Reduction in application of synthetic fertilisers	• Production of dunder should be close to fields for method to be feasible • Requires NEPA license • Risk of water contamination runoff and leaching, especially during rain events • License may prohibit application of dunder when raining, so alternative disposal methods should still be available if distillery/ethanol plant is to operate year-round • There may not be sufficient demand for all dunder production to be disposed of with this method • NEPA needs to ensure capacities to assess license applications
Ensuring adequate management of dunder at ethanol and rum plants - Aerobic treatment of dunder using activated sludge	
• Can bring down load of contaminants to comply with trade effluent standards • Allows year-round operation of distillery	• Very high energy costs
Ensuring adequate management of dunder at ethanol and rum plants - Anaerobic treatment of dunder (biodigestors)	
• If well designed can bring down load of contaminants to comply with trade effluent standards (normally followed by aerobic treatment of lagooning) • Energy recovery (biogas) • Sludge can be used as fertiliser • Allows year-round operation of distillery • Opportunity to generate carbon credits through the CDM	• Expensive to implement • Even efficient treatment may be insufficient to bring levels to comply with trade effluent standards, so follow-up treatment (aerobic treatment or lagooning) recommended
Ensuring adequate management of dunder at rum ethanol plant - Concentration of dunder by evaporation	
• Allows recovery of water, which may be used in the factory • Yield concentrated syrup (CMS) which, after treatment by lime, be used as fertiliser, animal feed, or fuel • Allows year-round operation of distillery	• Production of CMS involves additional costs to factory
Waste water treatment at sugar factories	
• Needed to ensure compliance with trade effluent standards (settling ponds may not	• Adequate methods need to be studied and selected

suffice)	• Waste water treatment have higher operational and maintenance costs than settling ponds
Results based environmental compliance plans	
• Allows monitoring based on results (% achievement of trade effluent standards) • Avoids problem that defined actions may not be sufficient to meet standards • Allows factories flexibility to find alternative solutions to meet standards	• Places higher burden on factories • More sophisticated monitoring mechanisms (though based on measurements that factories should be systematically reporting)

15. Key issue 4: Atmospheric contamination

The contribution of the JCS to atmospheric pollution will have mainly positive effects, through the upgrading of combustion equipment and the provision of mechanised harvesters, which will facilitate a shift to green cane harvesting. As well, the substitution of MTBE by ethanol will have an indirect positive effect on air quality in Jamaica.

The positive effects of the JCS will be further enhanced by the actions for pollution abatement contained in the SCJ's outline Compliance Plan, as well as the unofficial policy to minimise cane burning.

Negative environmental impacts can also be expected, mainly by increase of emissions due to increases in production, although these have not been identified as significant, especially in the context of pollution abatement equipment and increased boiler efficiency. However the JCS is not explicit in addressing the significant concern of sugar cane burning in the sector, and if an increase of cane land is to take place (to satisfy the expansion of the rum industry and supply the ethanol plant), then atmospheric pollution from cane burning has the potential to increase.

Table 18 below presents a synthesis of the main options available, and presents their strengths, opportunities, weaknesses and threats.

Opportunities for mitigation and enhancement

Minimise sugar cane burning

Cane burning is a major environmental concern in Jamaica, especially for environmental reasons, but it also affects cane quality, soil quality, and has adverse effects on cane processing. Jamaica is already working in trying to reduce cane burning. GCH also allows mulching, which brings additional benefits, such as minimising presence of weeds and maintaining soil humidity (thus also reducing water and herbicide requirements).

Although the JCS states that it will support the phasing out of cane burning, it would do well in spelling out how it will do so, especially amongst small scale farmers. In the cases where GCH cannot be practiced, controlled cool burning should be promoted. Cool burning implies burning in the early morning, when the wind is low and dew is usually present, which reduces emission of particulate matter; for example, in Mauritius it has shown to reduce particulate matter by 60% when compared to conventional afternoon burns (Seeruttun, S *et al*, 2003).

Support farmers with equipment and capacity-building to increase GCH

GCH requires more labour time than BCH, especially if hand-cut. In order to increase GCH farmers would need to increase their access to mechanical harvesters, as well as receive

capacity-building for effective GCH (e.g. preparation of the fields to accommodate harvesters, availability of upright self-trashing cane varieties).

The retention of persons trained and willing to hand-cut green cane should also be given serious attention.

Install atmospheric pollution abatement equipment

Stack emissions from boilers in sugar factories need to comply with the standards in the Air Quality Regulations. There is already a commitment to install wet scrubbers, which is an efficient method, although it increases the generation of waste waters (by producing ash slurry). In spite of this commitment, it is recommended that the JCS emphasises the need to comply with air quality standards.

Other more efficient abatement methods are available, especially electrostatic precipitators (ESP), which also have the benefit of not producing a slurry, but it is a more expensive technology. In any case the technology should be kept in mind for potential use in the future.

Results-based environmental compliance plans

It is possible that completion of the actions foreseen in the outline Compliance Plan does not bring stack emissions in compliance with the applicable standards. As well the Air Quality Regulations (2006) specify that if such is the case, the operator is not to be fined or otherwise penalised for it, but is not clear on how compliance will be ensured. In order to avoid such a possibility, it is suggested that the Compliance Plans establishes partial emission targets, eventually leading to full compliance, placing burden of compliance on the operator.

Table 18. Strengths, opportunities, weaknesses and threats to reduce atmospheric contamination

Strengths and Opportunities	Weaknesses and Threats
Minimise sugar cane burning	
• Plenty of environmental, agronomic, social and health benefits from eradicating cane burning (as outlined in discussion above) • 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)	• Requires extended access to mechanical harvesters • Not possible in areas where topography is unsuitable, or in very humid areas • Requires capacity-building of farmers on mechanised harvesting and field preparation • Requires awareness raising amongst farmers on benefits of GCH
Install atmospheric pollution abatement equipment (wet scrubbers)	
• Reduction of atmospheric contaminants, leading to compliance with the Air Quality Regulations • Reduction in emission of dioxins and furans (in context of Stockholm Convention)	• Use of wet scrubbers creates an ash slurry, which adds to the load of liquid contaminants
Results based environmental compliance plans	
• Allows monitoring based on results (% achievement of trade effluent standards) • Avoids problem that defined actions may not be sufficient to meet standards • Allows factories flexibility to find alternative solutions	• Places higher burden on factories • More sophisticated monitoring mechanisms (though based on measurements that factories should be systematically reporting)

16. Other environmental concerns

Contamination of groundwaters by runoff and leaching of agrochemical products

The JCS should ensure the implementation of the sugar industry's Environmental Code of Practice which should go a long way to reducing contamination by agrochemicals, which it is already committed to support. However it appears there is a need for monitoring residues so any necessary corrective actions can be taken on a timely basis.

Aerial spraying of ripeners

Use of ripeners and growth regulators would likely increase with expansion jn cane production. Application protocols should aim to reduce drift and other non-target contamination.

Personal protection equipment of field workers

Improved standards of worker protection should accompany revitalisation of the sugar industry.

17. Opportunities to enhance environmental benefits

Two main opportunities were identified to further enhance environmental benefits of the sugar sector in Jamaica. One of them is the possibility of producing fair trade sugar, and the other is the use of the Clean Development Mechanism (under the Kyoto protocol) to generate carbon credits.

Fair trade sugar

Fair trade sugar has a market niche in developing countries, especially in the EU. It is also a way to promote social and environmental sustainability, and in the case of Jamaica it may be an alternative for small-scale farmers who may face difficulties under the reform of the sugar sector to make a living from sugar cane farming.

Although fair trade products can be produced either by small-scale farmers which are organised in Small Producers' Organisations, or by hired labour, in the case of Jamaica and in the context of privatisation, it seems that fair trade can be an option especially for small-scale farmers.

Fair trade is regulated under a series of standards which affect producers and traders. There is a fair-trade 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), the stated intent for environmental development is:

"The producers' organization ensures that its members protect the natural environment and makes environmental protection a part of farm management. The organization is expected to facilitate the development, implementation and monitoring of producers' operational plans with the aim of establishing a balance between environmental protection and business results through the use of a combination of measures including crop rotation, cultivation techniques, crop selection, careful use of inputs such as fertilizers and pesticides and, as relevant, shade production. The organization ensures that its members minimize the use of synthetic and other off-farm fertilizers and pesticides, partially and gradually replacing them with non-synthetic and on-farm fertilizers and biological methods of disease control. FLO encourages small producers to work towards organic practices where socially and economically practical. Producers are encouraged to minimize the use of energy, especially energy from nonrenewable sources. The organization is expected to maintain a management system consistent with its size in order to ensure organizational control of those areas for which it is responsible and to monitor production by its members through the use of recognized inspection and verification methodologies."

In the Caribbean fair trade sugar is currently being produced in Belize, who would be a valuable source of information on experience for any interested farmers. FLO has a regional coordination

for the Caribbean and Paraguay, as well as a Liaison Officer for the English-speaking West Indies, who would be the persons to contact to explore and take forward any initiatives[15].

Carbon credits

The Clean Development Mechanism (CDM) is a mechanism under the Kyoto Protocol, which allows emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. These CERs can be traded and sold, and used by industrialised countries to meet part of their emission reduction commitments. CER prices depend on the market, and are currently around 6-8€.

Projects under the CDM must ensure real, measurable and verifiable emission reductions that are additional to what would have occurred without the project. For this projects must quality through a rigorous registration and issuance process, overseen by the CDM Executive Board. Projects must first be approved by the Designated National Authorities (DNA)[16].

In the sugar sector the obvious opportunity to generate CERs is co-generation with bagasse, although at least one project has been registered for anaerobic digestion of vinasse. A quick search in the CDM data base has yielded about 50 registered co-generation projects in the sugar sector, mainly from India and Brazil. The list of projects and links is provided in Annex 5.

As well there is one registered project for anaerobic treatment of vinasse in Nicaragua (Vinasse 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 will be sent to a lagoon prior to use for fertigation. The project is expected to generate about 119,589 tonnes of CO_2 equivalent in emissions reductions annually.

[15] At the moment the contact persons are the following. Regional Coordinator: Ms Monika Berresheim (m.berresheim@fairtrade.net) and the Liaison Officer for the English-speaking West Indies is Ms Julie Francoeur (j.francoeur@fairtrade.net).

[16] The DNA for Jamaica is in the Ministry of Land and Environment, 16A Half-Way-Tree Road, Kingston 5, Jamaica W.I. The contact person is: Mrs. Anastasia Calnick (acalnickmohe@hotmail.com) Director, Pollution Control; Phone: (876) 960-5632/3; Fax: (876) 920-7267

PART IV: ANALYSIS OF INDICATORS

18. Analysis of environmental consistency of JCS indicators

Depending on their wording, indicators (and associated targets) have the potential to bring about undesired environmental impacts. This will happen when, to comply with an indicator, the easiest route involves carrying out environmentally damaging actions which are overlooked when evaluating performance (environmental externalities). It is often the case that such indicators are formulated without the awareness that environmental damage may result. For this reason it is important to check all indicators to ensure they are worded in such a way that potential negative externalities are not overlooked.

The indicators contained in the JCS (Annex 1) are analysed in this section to check the degree to which they contribute to the key environmental aspects identified. This contribution can be neutral (i.e. there is no relation between the indicator and the environmental aspect), positive (i.e. achieving the indicator can lead to improve the environmental aspect in question) or negative (i.e. achieving the indicator can lead to degrade the environmental aspect in question).

A summary of the analysis is presented in Table 19 below.

Table 19. Consistency analysis of JCS indicators with SEA environmental objectives

JCS component / stated Result	Indicator	Objective 1: Reduce pressure on groundwater resources	Objective 2: Reduce land degradation	Objective 3: Reduce levels of surface water contamination	Objective 4: Reduce levels of atmospheric pollution	Other environmental aspects	Comments
Objective 1: Develop a sustainable private sector-led cane industry							
Successful expansion of private sector participation in sugar industry	100% of production capacity under private control						Expected positive impacts if divestment conditions facilitate better environmental management
Rationalisation of sugar industry capacity to optimise cost-efficient production of raw sugar	200,000 tonnes of raw sugar produced annually by 2020						Negative impacts expected if measures not taken to ensure water efficient irrigation and reduce irrigation with salt water.
Increased cane production and sugar production efficiency in field	Average output of 77 tonnes/ha achieved by 2010						Negative impacts if achievement of targets implies increased pressure on groundwater in water-stress areas, and increase use of agrochemicals
	Average of 12.5% JRCS at core sampler achieved by 2010						Better quality can be promoted by increasing GCH
Increased cane processing efficiency	Mill extraction rate of 94% achieved by 2010						
	Boiling house retention rate of 87% achieved by 2010						

Overhead costs reduced	Overhead costs reduced by 40% by 2010, based on 2003/2004 levels						Negative impacts if reductions imply reduced environmental commitments
Molasses requirements for rum manufacturing met by local sugar cane industry	130,000 tonnes of molasses produced annually by 2010 subject to relative prices of high test molasses and raw sugar						Negative impacts if achievement of targets implies increased pressure on groundwater in water-stress areas, and increase use of agrochemicals
Increased sales of Jamaican rum in world market	Total rum sales increased to 32 mnla by 2010 and by 3% per annum from 2011-2015						
Production and market framework for renewable energy resources developed	Policies implemented by 2006					Energy efficien-cy	Positive indirect impacts by substitution of MTBE by ethanol
	70 million litres of ethanol produced annually from locally grown cane						Negative impacts expected: production of dunder + if no measures to ensure water efficient irrigation and reduce irrigation with salt water.
Diversified market opportunities developed for other sugar products and derivatives	5% revenue of sugar industry derived from branded sugar and derivatives by 2015						
Human resources development strengthened	Comprehensive training plan designed for industry						
	Training plan implemented						
	Labour market flexibility negotiated with Unions						
Objective 2: Strengthen the economic diversification, social resilience and environmental sustainability of sugar-dependent areas							
Sustainable alternative uses established for lands released from sugar cane	All released sugar lands fully utilised within 3 years						Positive as land will not be abandoned, but possibly negative depending on new uses
Sustainable alternative economic activities in sugar areas developed	Area Development Plans implemented in target areas						Potential positive effects if new land uses are environmentally sustainable
	Business start-ups increased by 25% per annum by 2014						
Improved rural infrastructure in	Infrastructure component of						New roads will need to integrate environmental

target areas	ADPs implemented						safeguards
Adequate social services are delivered in rural sugar areas	Social indices maintained in target areas						Reduced need to rely on unsustainable use of natural resources for livelihoods
Land use and environmental management strengthened in sugar cane areas	No violations of zoning and environmental regulations on existing and former sugar lands						
Displaced sugar workers are equitably compensated	100% of displaced workers compensated with no unresolved disputes						
Objective 3: Maintain progress towards macro-economic goals							
Macro-economic stability maintained	Macro-economic targets for economic growth rate, inflation rate and ratio of debt to GDP met						
	Targets for current account deficit and employment met						
Research and innovation capability in key sectors enhanced	Targets of National Committee on Science and Technology met						
	Targets of National Integrated Planning Project met						
	Number of patent applications and registrations at JIPO						

Colour code: Green: positive impact; Yellow: negative impact of low significance; Red: negative impact of high significance.

In overall terms the proposed indicators largely neglect the key environmental concerns in the sugar sector. If performance of the JCS is measured exclusively with these indicators, not only will the set of indicators not encourage addressing the key environmental concerns in the sector, but may actually promote further environmental degradation.

Performance indicators are a delicate issue, as measurement of performance is often linked to disbursement of funds (but also recognition of personal and institutional performance). Thus any actions (e.g. in this case actions aimed at addressing the key environmental concerns of the sugar sector) that are not conducive to meet indicators not only become unnecessary, but also become an additional cost, as any benefits that they may bring about will not be valued. Environmental benefits will fail to be reflected in performance measurement, and any resource requirements for such measures will be better put to use to meet indicators.

The following indicators are particularly conducive to aggravate the already pressing environmental problems in the sugar sector:

- *"200,000 tonnes of raw sugar produced annually by 2020"*
- *"70 million litres of ethanol produced annually from locally grown cane"*
- *"All released sugar lands fully utilised within 3 years"*

The only environment-specific indicator, *"no violations of zoning and environmental regulations on existing and former sugar lands"* is likely to be insufficient to act as a safeguard to possible negative effects. In terms of zoning, as discussed above there are currently no land use zoning plans in place for sugar areas, and the degree of environmental integration (use of environmental criteria in determining acceptable land uses) of any new zoning plans will have to be ascertained.

It is also not clear if the component on *"no violation of environmental regulations on existing and former sugar lands"* covers operations at sugar, rum and ethanol factories, or only field operations. It definitely does not, however, address issues of water use efficiency and minimising cane burning.

It is recommended that the above indicator be reformulated to ensure it covers factory operations. One possible wording is:

- No violations of zoning and environmental regulations on existing and former sugar lands, including of operations of sugar, rum and ethanol factories

It is recommended that new indicators be added which specifically address the key environmental concerns of the sector. Such indicators may be in the following lines:

- % area of irrigated cane fields under centre-pivot, drip and upgraded surface irrigation
- % area of cane fields under green cane harvesting

However it is important to ensure that the indicators on production of sugar and ethanol are not singled out for performance assessment without including the indicators that address environmental performance.

PART V: RECOMMENDATIONS

This report provides recommendations for the Government of Jamaica and for the European Commission; these are differentiated. Recommendations for the GoJ are oriented to improve the environmental performance of JCS implementation, under the understanding that the JCS is a completed document, but that the GoJ has the willingness and commitment to improve its implementation so as to ensure its environmental sustainability. Recommendations are of a strategic nature, although specific interventions may be indicated where these are deemed relevant.

On the other hand, recommendations to the EC are elaborated with the objective of informing the EC on ways they may shape their assistance strategies, so that they promote the environmental sustainability of the JCS. Such recommendations take into account the aid delivery mechanisms used (mainly budget support).

Although the JCS has as one of its objective to promote environmental sustainability of the sugar sector, it fails to address the key environmental concerns the sector is facing: (1) pressure on groundwater resources, especially in Clarendon and St. Catherine; (2) land degradation; (3) contamination of aquatic systems by trade effluents; and (4) atmospheric emissions from point and non-point sources.

Implementation of the JCS is also expected to have some adverse effects on the environment, especially from the expansion of sugar cane cultivation (impacts on groundwater resources, land degradation and non-point source atmospheric emissions); increased cane processing for sugar and rum production (generation of trade effluents and atmospheric emissions); and ethanol production (generation of vinasse).

The following general recommendations are addressed both to the GoJ and the EC:

- It is highly recommended that a follow-up of this SEA is carried out, in order to assess its effectiveness and learn lessons for future SEAs. This is relevant to the EC for future SEAs in the context of sectoral and budget support to environmentally sensitive sectors, and to the GoJ in the context of the further development and implementation of their SEA Policy. Useful references to assess SEA effectiveness are the OECD/DAC Guidelines for Strategic Environmental Assessment (OECD, 2006) and the EC's Environment Integration Helpdesk (www.environment-integration.eu), who has prepared a draft internal assessment framework for SEA effectiveness. Key issues that should be studied include, *inter alia*:
    - The degree to which the SEA recommendations were useful to enhance environmental performance of the JCS and EC support;
    - The degree of "ownership" of the SEA process by key stakeholders (especially environmental and sectoral authorities, and the EC itself);
    - The degree to which the SEA recommendations actually made a change in improving environmental performance of the JCS and EC support.

- It is recommended that this SEA Study report received wide circulation amongst all key stakeholders, and is made publicly available through relevant web sites (e.g. those of the EC, NEPA, SIA, STU).

19. Recommendations to the GoJ to enhance environmental performance of JCS implementation

- The GoJ should recognise that for the JCS to be environmentally sustainable it must address the key environmental concerns that the sugar industry faces, mainly: (1) pressure on groundwater resources, especially in Clarendon and St. Catherine; (2) land degradation; (3)

contamination of aquatic systems by trade effluents; and (4) atmospheric emissions from point (stack emissions) and non-point (cane burning) sources.

- The Sugar Adaptation Development Programme does not limit the environmental sustainability component of the JCS as simply ensuring environmentally sound uses of lands released from cane. Environmental sustainability of the JCS is much broader, and must at least recognise and address the key issues above.

- The privatisation process is a major opportunity for the GoJ to promote the environmental sustainability of the sugar sector. Plans originally made by IBE allegedly addressed many of the concerns identified in this SEA; however, these are not binding commitments and the privatisation process is still open.

- The GoJ should ensure that divestment plans require the new company to:

    - Comply with all environmental regulations and standards, including the trade effluent standards and the air quality standards. This will imply making licence applications within a reasonable period of time and regularise permits with the WRA.

    - Maximise water efficient irrigation, by installing drip irrigation systems where possible, and using centre-pivot irrigation as a second option. That wherever furrow irrigation is to remain, actions are carried out to upgrade irrigation schemes and all possibilities explored and used to maximise water efficiency (e.g. alternate furrow irrigation, reblocking).

    - Eradicate cane burning in their lands, and actively promote green cane harvesting by farmers that sell their cane to their mills (e.g. by providing awareness-raising on the benefits of GCH and capacity building). That where GCH cannot feasibly be practiced (e.g. topographical constraints for harvesters or super-humid areas), cool burning practices are adopted.

    - Minimise water consumption in the sugar mills, by minimising wash waters and maximising recycling.

    - Environmentally sound management of dunder generated, either through fertigation according to a NEPA licence and a Nutrient Management Plan, and/or through treatment of dunder (e.g. anaerobic digestion and lagooning).

    - The new company is encouraged to implement an Environmental Management System (e.g. ISO 14001:2004).

- As most government-owned facilities are considered to be “existing facilities” under the environmental regulations, NEPA may allow gradual compliance with trade effluent and air quality standards (maximum 7 years) according to Compliance Plans, which have to be agreed with the JSC before privatisation, and which are urgent. This means that the new company will be bound to these Compliance Plans, unless new ones are proposed and agreed with NEPA.

    - Compliance Plans with JSC should be based on interim standards (yearly) and not only on implementation of activities. Burden of compliance should remain on the polluter.

    - NEPA licences for JSC must be secured for disposal of dunder through fertigation, based on a Nutrient Management Plan, soil properties and environmental sensitivity of the receiving environment.

- It is recommended that treatment of dunder is explored (e.g. anaerobic treatment, ideally coupled as a CDM project), as a means to allow uninterrupted distillery operations (i.e. not having to shut down during rain events), minimise run-off and leaching on the fields, and recover energy.

- NEPA, the MoA and WRA must be involved in studying any applications for land use changes (from agricultural land to other uses), and environmental criteria should be taken into account, especially guaranteeing that the new land use will have a sustainable water supply, and requiring an EIA if necessary. For example, land uses that imply the modification of the natural environment (e.g. modification of mangrove and other coastal environment features for shrimp farming) should require a full EIA as part of the project's permitting process.

- An Environmental Impact Assessment (EIA) is carried out as part of the application for the new ethanol plant. Such an EIA should especially address: management of dunder produced, transport of dunder, and energy efficiency (fuel mix).

- Eradication of cane burning (unless where it cannot be practiced, in which case cool burning should be used) should be established as an official policy and objective, and a plan elaborated to achieve it (coordinated with all key stakeholders, e.g. NEPA, SIA, SIRI, cane farmers' associations).

- Regulation of cane burning should be done based on a policy commitment and an associated action plan (point above), and *not* through the Air Quality Regulations as a fugitive source of emissions. Regulation through the Air Quality Regulations is bound to be complex and time consuming, when the issue can be addressed up-front through a firm policy commitment and action plan.

- Modifications to the Air Quality Regulations are recommended so small-scale farmers do not fall under the "major facility" category, putting them under a time consuming and onerous obligation to secure a NEPA licence and produce regular monitoring reports. In line with the point above, minimisation of cane burning should be addressed in an up-front manner.

- Even if NEPA decides to regulate cane burning through a policy commitment and action plan (and not as a fugitive emission of facilities), the Air Quality Regulations would require amendment to ensure consistency between the letter of the regulations and the actual regulatory approach.

- The action plan for the minimisation of cane burning should address, *inter alia*, capacity-building and awareness raising of farmers on the benefits and techniques of GCH, and support for the acquisition of necessary machinery and equipment.

- The schedule of charges for irrigation water should be revised, in line with the Water Policy and Action Plan, in order to introduce incentives for water conservation (e.g. volume-base charging, reducing subsidies) whilst ensuring irrigation remains feasible. Any such changes should be accompanied by support to farmers to implement and operate water efficient irrigation technologies and practices.

- The GoJ could consider promoting fair trade sugar production as a means to promote alternatives to small scale farmers in a way that would provide them access to new markets and promote social and environmental sustainability.

- It is recommended the GoJ (Ministry of Environment) encourages the use of the Clean Development Mechanism to enhance environmental performance of the sector and generate

carbon credits. This can especially be pursued for co-generation and energy recovery from vinasse treatment.

- The JCS indicator matrix should be revised so it promotes environmental sustainability. More specifically it could add indicators on: area of cane fields under centre-pivot and drip irrigation; area of irrigated cane fields under green cane harvesting.

- It is recommended that the current indicator on compliance with environmental regulations be reformulated to ensure it explicitly covers factory operations, e.g. “no violations of zoning and environmental regulations on existing and former sugar lands, including of operations of sugar, rum and ethanol factories”

20. Recommendations to the EC to enhance the environmental dimension of its support strategy to the JCS

Recommendations are made to the EC on: policy dialogue and specific conditions that could be integrated in its Financial Agreements under the budget support aid delivery modality (SBS or GBS), including performance indicators (also under budget support); and specific projects that could be supported.

- The environmental performance of the JCS, supported by the findings of this SEA, as well as any other relevant issues that may arise, should be part of the policy dialogue with the GoJ. Environmental sustainability should always be seen as an integral component of the JCS.

- Key environmental indicators should be included for performance assessment (however they may be used, e.g. linked to disbursement of budget support variable tranches). Possible indicators in key areas include:

    - Green cane harvesting
        - Area under green cane harvesting (with associated targets showing increase in GCH)
        - Approval of formal policy commitment and action plan to minimise cane burning (in line with recommendations of SEA, e.g. use of cool burning where GCH is not practicable)
    - Water use efficiency
        - Area of irrigated cane fields under centre-pivot and drip irrigation (with associated targets showing increase of area)
        - Average water use efficiency for the pool of sugar areas (with associated targets showing increase). However this indicator would require clear measurement procedures and criteria to ensure consistency and trustworthiness.
    - Atmospheric emissions from point sources
        - % compliance of stack emissions from sugar and rum factories with air quality standards/targets (as applicable) (specific indicator should be elaborated)
        - % compliance of sugar and rum factories with trade effluent standards (specific indicator should be elaborated)
        - Number of sugar and rum facilities in possession of NEPA air quality licences
    - Management of trade effluents

        - Number of sugar and rum facilities in possession of NEPA trade effluent licences
        - % compliance of trade effluents with trade effluent standards (specific indicator to be elaborated)

- The following specific projects and actions could be supported (under project modality):

    - Awareness-raising and capacity-building of small farmers on green cane harvesting and water efficient irrigation

    - Research and development of a system for the treatment of vinasse, coupled with an application for to register as CDM in order to generate CER

    - Support in upgrading of NIC irrigation schemes (Rio Cobre and Clarendon), to maximise water efficiency

    - Support to the GoJ in updating the charging scheme for irrigation water in order to introduce incentives for water savings. Such activity must be accompanied by support to farmers on implementation and management of water efficient irrigation technologies and techniques

    - Development of capacities within the Ministry of Environment and the sugar sector on access to the Clean Development Mechanism

    - Technical assistance for the management of saline water in irrigation of cane fields

ANNEXES

Annex 1. List of stakeholders engaged or consulted (scoping and SEA study phases)

Date	Organisation	Persons interviewed	Tel.	email
SCOPING PHASE				
15/01	Sugar Industry Authority (SIA)	Ambassador Derick Heaven - Executive Chairman	926.5930.3	d.heaven@cwjamaica.com
		Keith E. Scott - Manager, Planning & Information	926.5930.3	kscott@cwjamaica.com
	Sugar Industry Research Institute	Earle V. Roberts – Director of Research	962.2241	earle.roberts@jamaicasugar.org
16/01	Water Resources Agency (WRA)	Mr Basil P Fernandez – Managing Director		
16/01	Jamaica Meteorological Office	Mr Clifford Mahlung – Applied Meteorologist	809.929.3706	cliffmah2000@yahoo.com
19/01	Planning Institute of Jamaica	Ms Dianne Davis – Manager, European Union Unit	935.5071	ddavis@pioj.gov.jm
		Ms Claire Bernard – Director, Sustainable Development and Regional Planning	935.5054	cbernard@pioj.gov.jm
		Ms Allison Richards – Urban & Regional Planner, Sustainable Development and Regional Planning Unit	935.5057	arichards@pioj.gov.jm
		Mr Richard Kelly – Science & Technology Planner, Sustainable Development and Regional Planning Unit	906.4463.4	rkelly@pioj.gov.jm
		Ms Le-Anne Roper – Sustainable Development Officer, Sustainable Development and Regional Planning Unit		lroper@pioj.gov.jm
19/01	All-Island Jamaica Cane Farmers Association (AIJCFA)	Mr Alan Rickards – Chairman		
		NB: the meeting took place within a larger AIJCFA meeting with people from SIA, SIRI and area representatives of the AIJCFA		
19/01	Spirits Pool	Mr Lloyd Forbes – General Manager		
20/01	Appleton Estate	Mr Altamont McKenzie – Environmental Officer		
20/01	University and Allied Workers Union (UAWU)	Mr Humphrey Boland – UAWU sugar industry officer		
21/01	National Irrigation Commission	Mr Maurice Harrison – Operations consultant		
21/01	National Environmental and Planning Authority (NEPA)	Ms Paulette Kolbusch		
	Ministry of Energy	A meeting had been organised with Mr Conroy		

		Watson, but due to a misunderstanding could not take place as planned. Mr Burgess met with Mrs Y. Edwards and Mr Watson on 27/01.		
	Jamaica Environment Trust (JET)	Ms D McCaulay; Ms D Andrade		
SEA STUDY PHASE				
17/02	Sugar Transformation Unit (STU)	Mr George Callaghan		
23/02	Monymusk Sugar Estate	Mr Nicholas Duke		
26/02	Infinity Bio-Energy	Mr João Carlos dos Reis	876.929.4000	jreis@infinitybio.com.br
27/02	Bernard Lodge Estate			
02/03	Environment Management Division (Office of the Prime Minister) NEPA	Ms Leonie Barnaby Ms Gillian Guthrie Ms Paulette Kolbusch		emdmle@yahoo.com

Annex 2. Workshop agenda

Strategic Environmental Assessment Workshop

on

Jamaica's Country Strategy (JCS) for the Sugar Cane Industry

Tropics View Hotel - Hatfield, Mandeville.
Thursday, February 19, 2009

AGENDA

9:30 a.m. - 9:50 am	**Registration**	
9:50 a.m. - 10:00 am	Opening Remarks – Chairman	**Dr E Roberts - SIRI** **Mr C Lamberti – EC Del**
10:00 am - 10:20 am	Workshop Context & Objectives	**Dr J Palerm - Consultant**
10:20 am - 10:50 am	Water Resources - Use & Misuse	**Mr. M Harrison - NIC** **Mrs M Watts - WRA**
10:50 am - 11:20 am	Brief presentation of expected impacts of the JCS and Discussion	
11:20 am - 11:30 am	**COFFEE BREAK**	
11:30 am - 11:50 am	Land Degradation from Poor Water Management	**Mr R Burgess - Consultant** **Mr M Shaw - Consultant**
11:50 am - 12:05 pm	Brief presentation of expected impacts of the JCS and Discussion	
12:05 pm - 12:20 pm	Factory Operations *(focus on waste-water production and disposal and stack emissions)*	**Mrs E Manning - SIRI**
12:20 pm - 12:40 pm	Brief Presentation of expected impacts of the JCS and Discussion	
12:40 pm - 12:55 pm	Distillery Operations *(focus on vinasse management)*	**Mrs. P. Kolbusch - NEPA** **Ms S Williams- NEPA**
12:55 pm - 1:20 pm	Brief Presentation of expected impacts of the JCS and Discussion	
1:20 pm - 2:00 pm	**LUNCH**	
2:00 pm - 2:20 pm	Presentation on Cane Burning	**Mr T Falloon - SIRI**
2:20 pm - 2:45 pm	*Brief Presentation of expected impacts of the JCS and Discussion*	
2:45 pm - 3:00 pm	General Findings and Closure	

Annex 3. Register of workshop participants

Strategic Environmental Assessment Workshop
Tropics View Hotel
February 19, 2009.

NAME	COMPANY	POSITION
Nicholas Duke	SCJ Monymusk	Agri. Manager
Keith Scott	SIA	Planning Manager
Ludlow Brown	SIA	Chemist
Joe Blair	Hampden Distillery	Production Manager
Trevor Falloon	SIRI	Agri. Services Manager
George Callaghan	Ministry of Agriculture	Head STU
Alfred Williams	All Cane	Extension Officer
Richard Bryan	Appleton	Production Manager
Altimont McKenzie	Appleton	Environmental Manager
Micheal Martin	SPF	Manager
Lennox Morgan	Ministry of Agriculture	Actg Deputy Parish Manager
Tracey Ann Steele	SCJ St Thomas	Quality Control Manger
Micheal Sewell	SCJ St Thomas	Farm Manager
Dereck Brown	SPF	Executive Chairman
Hugh Martin	Raising Cane	
Sharleana Williams	NEPA	Manager
Kerrine Senior	NEPA	Manager
Paulette Kolbusch	NEPA	Snr Manager
Vivian Wisdom	New Yarmouth Distillery	Asst. Manager
Richard Jones	FM Jones Estate	Executive Chairman
Maureen Wilson	SIRI	Lab Manager
Gary Simpson	New Yarmouth Estate	Division Manager
Lloyd Forbes	Spirits Pool	
Clarence Fearon	SIRI	Nutrition Agronomist
Malcolm Bennett-Easy	SIRI	Variety Agronomist
Niconor Reece	SIRI	Sugar Technologist
Lancelot White	SIRI	Engineer
David Shady	SIRI	IT
Maurice Harrison	NIC	Consultant
Reginald Burgess		Consultant
Juan Palerm		Consultant
Derek Little	SIRI	Head Extension
Michele Watts	WRA	Snr Environmetal Officer
Humphrey Boreland	UAWU	Trustee
Wycliffe Mathews	BITU	island Supervisor
Cosimo Lamberti Fosati	E U Delegation	
L B Rhoden	Lenworth	Magining Director

Paul Rhoden	Lenworth	Manager
Micheal Shaw		Consultant
Charmaine Mendez	J Wray & Nephew - Appleton	Asst. Agronomist
Paulette A E Wright	SIRI	Snr. Agronomist
Micheal McKenzie	Hood Daniel Weels	Sales Rep
Dr. Earle Roberts	SIRI	Director
Coby McConnell	Worthy Park Estate	Farm Manager
Heera Singh	Worthy Park Estate	Asst. FM & Chief Chemist
Kenneth Newman	Cambria Farms	Managing Director
Thomas Ronlstan	J Wray & Nephew - Appleton	Distellin Manager
Rohan Robinson	SCJ Frome	Production Manager
Elaine Manning	SIRI	Research Technologist

Annex 4. Summary of wastewater quality at JSC sugar factories (based on environmental audit results, 2000-2008 data)

Factory	DO (mg/l)	BOD (mg/l)	COD (mg/l)	SO_4^{2-} (mg/l)	NO_3^- (mg/l)	PO_4^{2-} (mg/l)	Oil/ grease (mg/l)	Alkalinity (mg/l)	TSS (mg/l)	TDS (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Cond. (µmhos /cm)	pH	Temp (ºC)	F. Coli (MPN/100 ml)	T. Coli (MPN/100 ml)
Appleton (data from response to questionnaire, 2006-2007)																	
Min		5	615	14	0.88	1.85			119	53	20	4.4		6.07			
Max		298	874	14	4	15.45			516	757	20	7.3		6.62			
Avg		109	735	14	2.07	7.56			308	606	20	6.3		6.40			
Frome																	
Min	0	38	5,5	15	0	0,80	0	30	10				634	6.15	27.6	<3	240
Max	3.6	332	895	75	10.56	83.0	2	240	722				8540	8.90	34.8	>1100	>1100
Avg	1.73	197	411	38.6	3.38	15.75	0.25	126	205				1786	6.66	31.33	>1100	>1100
Monymusk 1 (drain that takes the filter mud slurry)																	
Min	0.7	18	15	51	0	2.00	0	26	196				1907	6.90	26	<3	<3
Max	4.9	5960	14760	320	1628	1540	8	1496	18724				89600	13.16	39.8	>1100	>1100
Avg	3.28	2106	7755	146	158	276	2	396	6553				10308	8.60	30.58	>1100	>1100
Monymusk 2 (drain that leads from boiler area and joins main drain)																	
Min	0	25	36	28	0	2.10	0	0	14.3				1431	6.30	29.9	29	29
Max	3.5	1360	2680	120	14.52	17	3	188	960				4880	8.84	64.7	>1100	>1100
Avg	2.29	572	1188	69	6.05	8.21	1	110	267				2498	7.41	41.11	>1100	>1100
Bernard Lodge 1 (drain taking overflow from spray pond)																	
Min	0	0	0	0	0	0	0	38	0				809	6.81	28.3	<3	<3
Max	6.96	880	3040	62	18.48	835.0	1	370	1050				3210	8.25	45.0	>1100	4600
Avg	2.91	221.5	652	43	7.24	54.2	0.17	218	156				1536	7.29	35.66	>1100	>1100
Bernard Lodge 2 (drain taking cane wash water and washing from mud filters)																	
Min	0.1	96	113	26	0	0	0	38	16				520	6.52	30.2	<3	>1100
Max	4.55	>4180	11063	150	23.76	865.0	3	480	1855				3200	10.1	38.0	>1100	4600
Avg	2.30	1178	2480	60	7.77	132.0	1.14	200	682				1525	8.15	34.70	>1100	>1100
Long Pond																	
Min	0	220	676	0	0	6.60	2	20	57				148.9	5.20	32.0	29	29
Max	2.6	34200	45250	430	247.0	456.0	>94	774	578				2160	7.80	65	>1100	>1100
Avg	0.85	5698	7830	85.1	33.63	176	36.3	163.5	193				807	6.49	41.9	?	?
St. Thomas (Tropicana 1; 2000-2003 samples)																	
Min	0.4	700	18	19	0	2.10	0	14	7				490	6.70	28.8	23	23
Max	0.9	2700	4700	74	14.8	27.30	1	232	260				3380	7.64	47.4	>1100	>1100
Avg	2	1372	1496	38.6	3.34	10.7	0.20	136	85				1123	7.18	36.1	?	?

St. Thomas (Tropicana 2; 2000-2003 samples)																
Min	0.3	380	206	12	0	4.20	0	20	11				448	6.76	30.4	>1100	>1100
Max	0.3	386	2160	40	14.08	206.0	1	270	128				1990	7.93	40.5	>1100	>1100
Avg	1.75	383	967	23.75	6.87	58.37	0.33	183	60.25				883	7.16	35.15	>1100	>1100
St. Thomas (St. Thomas 1; 2003-2008 samples)																
Min	4.6	28	42	6	0	2.00	0	78	20				372	6.97	28.7	>1100	>1100
Max	4.6	954	1186	24	12.32	20.80	0	190	520				615	8.7	38.7	>1100	>1100
Avg	4.6	352	547	15.5	3.89	8.08	0	127	281.5				554	7.86	33.45	>1100	>1100
St. Thomas (St. Thomas 2; 2003-2008 samples)																
Min	6.8	69	126	7	0	1	0	32	17				393	7.54	30.6	240	240
Max	6.8	940	2165	39	9.68	48.80	0	226	3472				1512	9.0	40.0	>1100	>1100
Avg	6.8	405	855	17	4.65	14.98	0	123	730				701	8.48	33.75	?	?
Standard	**>4.0**	**<30**	**<100**	**250**	**10**	**5**	**10**	**No std**	**<150**	**<1000**	**<300**	**<100**	**No std**	**6.5-8.5**	**Ambient + 2ºC**	**<100**	**<500**

Colour code: Green: within limits of the standard; Red: Outside limits of the standard; Yellow: Unlikely compliance (no reference value provided)

Annex 5. CDM registered co-generation projects in the sugar sector

Project title	Country
Grid connected bagasse based cogeneration project of Ugar Sugar Works Limited (USWL)	India
Ajbapur Sugar Complex Cogeneration Project	India
Bagasse based Co-generation Project at Titawi Sugar Complex	India
Installation of co-generation project at sugar manufacturing unit of Mawana Sugars Limited	India
Bagasse based Co-generation Project at Nanglamal Sugar Complex.	India
Bagasse based Co-generation Project at Mawana Sugar Works	India
The Godavari Sugar Mills Ltd (TGSML)'s 24 MW Bagasse Based Co-generation Power Project at Sameerwadi	India
DSCL Sugar Ajbapur Cogeneration Project Phase II	India
Khon Kaen Sugar Power Plant	Thailand
"35 MW Bagasse Based Cogeneration Project" by Mumias Sugar Company Limited (MSCL)	Kenya
SRS Bagasse Cogeneration Project	India
RSCL cogeneration expansion project	India
Alta Mogiana Bagasse Cogeneration Project (AMBCP)	Brazil
Nova América Bagasse Cogeneration Project (NABCP)	Brazil
Santa Elisa Bagasse Cogeneration Project (SEBCP)	Brazil
Santa Cândida Bagasse Cogeneration Project (SCBCP)	Brazil
Vale do Rosário Bagasse Cogeneration (VRBC)	Brazil
Jalles Machado Bagasse Cogeneration Project (JMBCP)	Brazil
Coinbra-Cresciumal Bagasse Cogeneration Project (CCBCP)	Brazil
Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP)	Brazil
Cerradinho Bagasse Cogeneration Project (CBCP)	Brazil
Coruripe Bagasse Cogeneration Project (CBCP)	Brazil
Lucélia Bagasse Cogeneration Project (LBCP)	Brazil
Serra Bagasse Cogeneration Project (SBCP)	Brazil

Colombo Bagasse Cogeneration Project (CBCP)	Brazil
Campo Florido Bagasse Cogeneration Project (CFBCP)	Brazil
Alto Alegre Bagasse Cogeneration Project (AABCP)	Brazil
Iturama Bagasse Cogeneration Project (IBCP)	Brazil
San Carlos Bagasse Cogeneration Project (SCBCP)	Brazil
Cruz Alta Bagasse Cogeneration Project (CABCP)	Brazil
Zillo Lorenzetti Bagasse Cogeneration Project (ZLBC)	Brazil
Moema Bagasse Cogeneration Project (MBCP)	Brazil
Equipav Bagasse Cogeneration Project (EBCP)	Brazil
Monte Rosa Bagasse Cogeneration Project (MRBCP)	Nicaragua
Bagasse Based cogeneration power project of Rana Sugars Limited, Amritsar District, Punjab;	India
Cucaú Bagasse Cogeneration Project (CBCP)	Brazil
Bagasse based Cogeneration Plant at Seohara, Uttar Pradesh.	India
Biomass based Cogeneration Power Project in Uttar Pradesh	India
26 MW Biomass (Cogeneration) based Power generation Project activity	India
Santa Terezinha – Tapejara Cogeneration Project. (Usina de Açúcar Santa Terezinha Ltda.)	Brazil
Tres Valles Cogeneration Project	Honduras
El Angel Cogeneration Project	El Salvador
Bagasse based Cogeneration Project at Pudukkottai Tamil Nadu, India	India
Dan Chang Bio-Energy Cogeneration project (DCBC)	Thailand
Phu Khieo Bio-Energy Cogeneration project (PKBC)	Thailand
Inversiones Hondurenas Cogeneration Project	Honduras
Guyana Skeldon Bagasse Cogeneration Project	Guyana
"6 MW bagasse based cogeneration plant for electricity generation for grid supply at Mawana Sugars Limited (MSL) at Mawana in Uttar Pradesh".	India
First Farmers Holding Corporation (FFHC) Bagasse Cogeneration Plant	Philippines

Annex 6. List of documents consulted

Armstrong, Delroy A. (SCJ – Berndard Lodge) (undated) The Jamaican sugar industry realizing additional income streams through carbon credit sales.

Cançado, J; Saldiva, P; Pereira, L; Lara, L; Artaxo, P; Martinelli, L; Arbex, M; Zanobetti, A; and Braga, A (2006) The impacts of sugar-cane burning emissions on the respiratory system of children and the elderly, *Environmental Health Perspectives*, 114(5): 725-729.

CDM Executive Board (2006) Clean Development Mechanism Project Design Document Form (CDM-PDD), Vinasse Anaerobic Treatment Project – Compañía Licorera de Nicaragua, S.A. (CLNSA).

Cheesman, Oliver D. (2004) *Environmental Impacts of Sugar Production*, CABI Publishing.

Echavarria, M. (1996) To burn or not to burn: environmental, technological and economic considerations, *Proceedings of the XXII Congress of the International Society of Sugarcane Technologists*, Cartagena, Colombia, 11-15 September 1995, pp. 38-42.

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.

EnviroPlanners Limited (2008) *Final report of an environmental audit conducted on the five government owned sugar factories - Bernard Lodge; Frome; Monymusk; St Thomas Sugar and Trelawny Sugar*, prepared for the Sugar Industry Authority (SIA) (September, 2008).

European Commission, *Multi-Annual EC Assistance Strategy*.

European Commission (2004) *Jamaica Environmental Profile*.

European Commission (2008) *Design Mission for Area Development Programmes in Jamaica, Final Report*, prepared by SHER Ingénieurs-Conseils s.a.

Falloon, T. (2009) Burnt cane harvesting, an environmental perspective, Powerpoint presentation made at the SEA Study workshop, Mandeville, Jamaica, 19 February.

Falloon, T.; Bennett-Easy, M.; Little, D.; White, L; Green, U.; and Woolery, C. *Project of the Common Fund for Commodities to enhance viability and competitiveness of Caribbean Sugar Industries*, Sugar Industry Research Institute.

Fearon, Clarence G. (2006) *Comparisons of chemical and physical properties of soils in the irrigated Clarendon plains in 1941 and 2006: implications for soil productivity decline*, Presentation, SIRI.

FLO – Fairtrade Labelling Organizations International (2009a) *Fairtrade Standards for Cane Sugar for Small Producers' Organizations*, version 16 February, 2009.

FLO – Fairtrade Labelling Organizations International (2009b) *Generic Fairtrade Standards for Small Producers' Organizations*, version 01 January, 2009.

Government of Jamaica (2000), *Initial National Communication of Jamaica to the United Nations Framework Convention on Climate Change*.

Jamaica Country Strategy for the Adaptation of the Sugar Industry 2006-2015, Planning Institute of Jamaica, January 2006.

John, Kimberley – Department of Life Sciences, University of the West Indies (2001) *A study of the impact of the Appleton dunder re-use project on the physico-chemistry and biology of surface water, December 1999 to January 2001, Final Report*, prepared for the Water Resources Authority.

Karanjac, J.; Lalor, G.; and Fernandez, B. (undated), *Groundwater information system uploaded to the Internet, Case Study: Rio Minho Basin, Jamaica*.

Lewis, Fayona and Dunkley, Delroy (Appleton estates) (undated), *Steps taken to improve environmental practices at the Appleton sugar factory*

Ministry of Agriculture, Rural Physical Planning Division (1985) *Jamaica Soil Survey Project, Miscellaneous Paper No. 7, Soil Salinity Survey of the South Clarendon Plains.*

Ministry of Agriculture, Sugar Transformation Unit (2008) *Progress Report: Implementation of the Jamaica Country Strategy for the Adaptation of the Sugar Industry: 2006-2015*.

Ministry of Agriculture, Sugar Transformation Unit (2008) *Sugar Adaptation Development Programme (SADP)*.

Ministry of Energy (2008) *Policy options for the use of locally produced ethanol*.

Ministry of Environment and National Development Unit, Republic of Mauritius (2005) *National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants*.

Ministry of Water and Housing (2004) *Jamaica Water Sector Policy, Strategies and Action Plans*.

National Environment and Planning Agency, *Annual Report 2006/07*.

National Environment and Planning Agency (2003), *Regulatory Impact Analysis Statement (RIAS) of the Natural Resources Conservation Authority (Air Quality Regulations, 2003)*.

National Environment and Planning Agency (2005) *National Implementation Plan for Management of POPS*, report prepared by Claude Davis & Associates.

National Environment and Planning Agency, *JaNEAP Jamaica's National Environmental Action Plan 2006-2009, Planning Sustainable Development – the environmental action agenda*.

National Irrigation Commission Limited, *Annual Report 2006/07*.

OECD DAC (2006) *Applying Strategic Environmental Assessment Good Practice Guidance for Development Cooperation*, OECD DAC: Paris.

Organisation of American States; Commonwealth Science Council; Caribbean Council for Science & Technology; Water Resources Authority/Ministry of Water & Housing (2002) *Co-operative strengthening of national institutions to enhance integrated water resources management, Water situation & assessment of water profile*, prepared by Hydrology Consultants Limited, May 2002.

Paragon Environmental Consultants Ltd. (2000) *Monitoring Fertilizer and Pesticide Residues in Soils and Groundwater in Jamaican Agricultural Ecosystems.*

Platford, G. and Bond, R.S. (1996) Environmental management plan for the South African sugar industry, *Proceedings of the XXII Congress of the International Society of Sugarcane Technologists*, Cartagena, Colombia, 11-15 September 1995, pp. 44-48.

Purchase, B.S. (1996) Disposal of liquid effluents from cane sugar factories , *Proceedings of the XXII Congress of the International Society of Sugarcane Technologists*, Cartagena, Colombia, 11-15 September 1995, pp. 49-54.

Rao, Subba M. (1981) A report on the quality of water at Monymusk, *The J.A.S.T. Journal*, (Jamaica Association of Sugar Technologists), Proceedings for the Association for the year eded 1981, Vol. XXXXII, pp. 23-32.

Richard Jr., EP; E Ng Kee Kwong; GH Korndörfer; JH Meyer; G Kingston and JM Shine Jr. (2003) *Opportunities in sugarcane agronomy to confront the new realities emerging in the 21st Century: a Review of the 2003 Agronomy Workshop*, MSIRI Réduit, Mauritius, 21-25 July 2003.

Paula Júnior, D. and Nogueira do Amaral Gurgel, M (nd) *Potentialities of the biodigestion of the vinasse*, http://www.cori.unicamp.br/centenario2008/2007/completos/A09%20-%20POTENTIALITIES%20OF%20THE%20BIODIGESTION%20OF%20THE%20VINASSE.pdf

Seeruttun, S; Zuel, N and Rughoo, M (2003) *Cool burning reduces particulate matter emission in Mauritius*, presented in the 2003 Agronomy Workshop, MSIRI Réduit, Mauritius, 21-25 July 2003.

Statistical Institute of Jamaica; National Environment and Planning Agency (2001) *Jamaica's Environment 2001, Environment Statistics and State of the Environment Report*.

Statistical Institute of Jamaica (2006) *Environment Statistics 2005 and Water*.

Sugar Cane Industry of Jamaica Environmental Code of Practice, October 2004.

Sugar Company of Jamaica (2008) *Sugar Company of Jamaica's Action Plan for Environmental Compliance*.

Sugar Company of Jamaica (undated) Approach to improved irrigation methods.

Sugar Industry Research Institute, *Annual Report 2005*.

Sugar Industry Research Institute, *Annual Report 2006*.

Sugar Industry Research Institute, *Annual Report 2007*.

Sugar Research Department, *Annual Report 1969*

Underground Water Authority (1990) *Water Resources Development Master Plan, final report, main volume.*

UNEP (2003) *GEO Latin America and the Caribbean.*

UNEP (2008) *Integrated Assessment of the Trade-Related Policies in the Agriculture Sector and Biological Diversity, Country Presentation: Jamaica*, UNEP, powerpoint presentation, Geneva 1-3 July, 2008.

US Army Corps of Engineers (2001) *Water Resources Assessment of Jamaica*.

Water Resources Authority, *Annual Report 2003-2004*.

Water Resources Authority, *Annual Report 2004-2005*.

Water Resources Authority (2002) *The impact of dunder fertilization of canefields on surface and groundwater quality, St. Elizabeth, Jamaica*, January 2002.

Water Resources Authority (2003) *The impact of dunder fertilization of canefields on surface and groundwater quality, St. Elizabeth, Jamaica*, February 2003.

White, Lancelot H (2009) *Water quality in the Clarendon plains and its implication for cane growing*, Sugar Industry Research Institute, presentation made at the SEA Study workshop, Mandeville, Jamaica, 19 February 2009.

WWF (nd) *Sugar and the Environment, Encouraging Better Management Practices in sugar production.*

Annex 7. Terms of Reference

EUROPEAID/ 119860/C/SV/multi

LOT N° 6: Environment
REQUEST N° 2008/148849/1

Strategic Environmental Assessment (SEA) of the implementation of the Multi-annual adaptation strategy 2006-2015 to Jamaica

1. BACKGROUND

The Government of Jamaica and the European Commission require that a ***Strategic Environmental Assessment*** (SEA) be carried out for the implementation of the " THE JAMAICA COUNTRY STRATEGY FOR THE ADAPTATION OF THE SUGAR INDUSTRY 2006 - 2015" (JCS)[17] and the EC support to this "JCS". The major policy documents to consider in the framework of this assignment are listed in Annex I to these Terms of Reference.

Given the potential impact on the Environment from the sugar sector reform process, it is essential from the onset, for stakeholders and decision-makers to have an environmental baseline as well as relevant recommendations to be used to mitigate the possible adverse impact of the implementation of the JCS. Although the main contours of the environmental baseline are already integrated in the JCS, specific environmental impact assessment studies may be needed to ensure that the environment, on a national level is not adversely affected.

1.1 *Context*

The overall objective of the Jamaica Country Strategy for the Adaptation of the Sugar Industry (JCS) is to *"achieve an effective transition to a sustainable sugar cane industry over the period 2006-2015"*. The three areas of intervention of the Strategy are:

1) *To develop a sustainable private sector-led sugar cane industry*;
2) *To strengthen the economic diversification, social resilience and environmental sustainability of sugar-dependent areas;*
3) *To maintain progress toward macro-economic goals.*

Combined with increasing the role of the private sector, the first area of intervention aims to improve the efficiency of production and diversify the sources of revenue (potentially from cane juice, molasses, rum, ethanol, branded sugar and electricity generated from bagasse). This will almost certainly lead to a greater emphasis on green cane harvesting and , if sugar production increases significantly through the production of ethanol to replace MTBE in vehicle fuel, then issues of vinasse disposal, the availability of land for additional cane cultivation will come to the fore. In addition the availability and utilisation of scarce water resources for increasing productivity will need to be addressed, as will problems of salt water intrusion into aquifers where ground water resources have been depleted.

In contrast the second area of intervention focuses on community level interventions to mitigate the potential dislocation of rural labour force, as production is rationalised and the work force needed for a modern sugar cane industry is reoriented. This will involve measures to create new employment opportunities in sugar growing areas, which in themselves may have environmental impacts. The sustainable alternative uses for land released from sugar cane and alternative economic activities will have to be carefully considered, as well as activities which ensure adequate social services continue to be provided in sugar dependent areas.

[17] Copy of the JCS is presented in Annex I

The third area of intervention focuses on measures to achieve macro-economic stability and includes actions to promote the growth of sectors such as tourism, agribusiness and other priority sectors, and "financial support to ministries and agencies that may be called to participate in the adaptation process".

In this context, the European Commission will be providing funding of more than 80 million euros in the form of general budget and sector support for the implementation of the JCS between 2006 and 2010. This assistance will be directed towards (a) assisting where possible in the privatization process, (particularly if assistance is required in developing the regulatory framework for ethanol production); (b) assisting with the design of area development programmes which will cushion the adverse effects of privatization in disaffected rural areas and (c) supporting the Government's drive towards macro-economic stability, largely by reduction in the national debt burden which is currently running at 133% of GDP.

1.2 *Stakeholders*

Coordination of implementation of the JCS is being undertaken by the Sugar Transformation Unit (STU) based in the Ministry of Agriculture. This unit in turn is being guided in the implementation process by a Programme Steering Committee consisting of major stakeholders which are as follows:-

The Sugar Company of Jamaica (SCJ); Sugar Industry Research Institute (SIRI); Jamaica Cane Product Sales (JCPS); Sugar Manufacturing Corporation of Jamaica Ltd. (SMCJ); the Sugar Producers Federation (SPF); the Sugar Industry Authority (SIA); the Ministry of Agriculture (MoA), Ministry of Energy, Mining & Telecommunications (MoE); Ministry of Finance and the Public Service (MoF); Ministry of Foreign Affairs and Foreign Trade (MFAFT), Planning Institute of Jamaica (PIOJ); All Island Jamaica Cane Farmers Association (AIJCFA);University and Allied Workers Union (UAWU); the Bustamante Industrial Trade Union (BITU); National Workers Union (NWU); the National Irrigation Commission (NIC); and the Rural Agricultural Development Authority (RADA).

Policy guidance is provided by the Ministry of Agriculture through the Permanent Secretary.

2. DESCRIPTION OF THE ASSIGNMENT

2.1 *Global objective*

The overall objective of undertaking the SEA is to identify, assess and describe the likely significant environmental challenges, considerations and effects of implementing the JCS with regard to the environmental impact of the sugar restructuring outlined in the JCS.

2.2 *Specific objective*

The specific objective of this SEA is to confirm and complete the findings and recommendations of the JCS pertaining to environmental issues.

In addition, the SEA will provide decision-makers in Government, the EC and other donors with relevant information to be integrated into the implementation processes associated with the JCS.

2.3 *Requested services, including suggested methodology*

The SEA is composed of two parts; - an initial ***Scoping exercise*** followed by a more detailed ***SEA Study***. The Scoping Study will define the critical issues that need to be addressed in the SEA Study, considering the specific context in which the JCS has been developed. The activities and detailed calendar for the SEA Study will be determined on the basis of the conclusions of the initial Scoping Study.

2.3.1 Scoping Study

2.3.1.1 Overview of the JCS and its institutional and legislative framework

A description must be made of the JCS's institutional and legislative framework, including the institutions responsible for the implementation of the JCS, for the management of its environmental impacts and for the SEA process, as well as the relevant environmental policy and legislation. The specific decisions and process that should be influenced by the SEA must be identified. Issues to be analysed should include: the link between institutions and the regulatory framework; health and safety regulations for sugarcane workforce in light of accelerated restructuring, the regulatory framework for industrial emissions and the environmental code of practice which currently guides the industry.

An overview must also be given of the wider policy framework related to the JCS in order to identify other planning or policy documents which will need to be explored in the SEA Study.

2.3.1.2 Description of key stakeholders and their concerns

The involvement and active participation of key stakeholders in the SEA process is a key success factor. At an early stage in the assignment, the consultant should identify key stakeholders (key groups and institutions, environmental agencies, NGOs, representatives of the public and others, including those groups potentially affected by the likely environmental impacts of implementing the JCS).

The Consultant must review records of any national public consultation processes that may have taken place as part of the JCS preparation process. Based on this review and on additional consultations, they should identify key stakeholders' environmental concerns with respect to the JCS. The stakeholder engagement strategy however, must be agreed with the Commission and the Government of Jamaica before being implemented. This will avoid unnecessary conflicts or raising expectations. The strategy should provide stakeholders an opportunity to influence decision making. It may also be important to include an education component in the stakeholder engagement process.

Due to the large geographical areas that may be covered by the JCS, stakeholder engagement may focus on key stakeholders, especially targeting directly affected and vulnerable groups as well as key stakeholders that may not have been adequately represented in the JCS formulation. Records must be kept of all consultations and comments received.

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

On the basis of the policy, institutional and legislative framework analysis during the scoping stage, as well as the participation of stakeholders, the consultants must identify the key environmental aspects that should be addressed in the SEA Study, i.e. identify the key JCS environmental interactions that need to be given special consideration and emphasis.

Areas to be appraised will include, but not be limited to: water management; soil and water conservation, including soil fertility and salinity issues,; clean production technologies (power plant bagasse-coal and ethanol plant); alternative land uses; carbon sequestration, ground and air pollution; biodiversity (marine and inland); institutional capacities and the implications of developing additional lands for sugar cane production. Also the beneficial impacts of using ethanol to replace MTBE should be included in this initial scoping exercise.

2.3.1.4 Description of the scope of the environmental baseline to be prepared in the SEA Study

On the basis of the information obtained above, the consultants shall provide the information needed to compile an environmental baseline for the SEA Study. The consultants should give particular attention to the following areas related to the sugarcane cultivation and sugar production, i.e. the seven sugar cane factories and surrounding estates, the practices of small farmers which supply approximately 40 % of the cane consumed by the factories, the existing bagasse fuelled power-plant and in some cases the adjacent rural areas.

2.3.1.5 Recommendations on specific impact identification and evaluation methodologies to be used in the SEA Study

Consultants should provide an indication of the impact identification and evaluation methodologies that they will use 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 adequate.

2.3.2 SEA Study

The scope of the SEA Study will be agreed with the Government of Jamaica and the European Commission on the basis of the results of the initial Scoping Study. It will include an environmental baseline study, an identification of environmental opportunities and constraints, an identification and assessment of the potential environmental impacts, an analysis of performance indicators, and an assessment of the institutional capacities to address the environmental challenges likely to be faced. A section on conclusions and recommendations for future implementation of the JCS will also be important.

2.3.2.1 Environmental baseline study

A description and appraisal must be made of the current state of the environment, focusing on those key environmental components identified by the scoping study. The trends for the various environmental components must be identified and a projection must be made of the state of the environment on the short-, medium- and long-term in the assumption of no implementation of the JCS. External factors must be taken into account, including the influence of other sectoral policies[18].

2.3.2.2 Identification and evaluation of environmental opportunities and constraints

The environmental factors and resources that can affect (positively or negatively) the effectiveness, efficiency and sustainability of the JCS should be clearly identified, described and assessed for each potential project/programme or other initiative identified in the JCS. These factors may include expected impacts from other sectors or policies. The study should make a clear assessment as to whether the JCS provides an adequate response to these opportunities and constraints.

2.3.2.3. Identification and evaluation of impacts

The potential environmental impacts and risks from implementing the JCS must be identified and described for each project/programme initiative being studied, 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. Those impacts which are significant should be assessed in detail taking into account:

- the views and concerns of stakeholders,
- the consistency with international commitments,
- the socio-economic consequences
- compliance with environmental regulations and standards,
- consistency with environmental objectives and policies, and
- their implications for sustainable development.

2.3.2.4 Analysis of performance indicators

[18] It should be noted that Jamaica is relatively advanced with respect to Strategic Environmental Assessments, having developed a draft policy as long ago as 2003.

- Performance indicators and measures proposed by the JCS (and already envisaged under the EC support to the JCS) should be assessed and revised from an environmental perspective, i.e. their usefulness to identify the environmental effects (positive and negative) of JCS implementation should also be considered.

2.3.2.5 Assessment of the capacities to address environmental challenges

The capacity of regulatory institutions to address the environmental issues, especially the impacts identified, should be evaluated. In addition, national budget availability and commitment to environmental issues in the JCS should be analysed.

2.3.2.6 Stakeholder engagement

Stakeholders should be engaged throughout the SEA study according to the stakeholder engagement strategy agreed in the scoping stage.

2.3.2.7 Conclusions and recommendations

This chapter of the SEA study will summarise the key environmental issues for the sectors involved, including policy and institutional constraints, challenges and main recommendations. Recommendations 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. The SEA study recommendations must identify the projects where EIA's should be regularly carried out.

The recommendations for JCS enhancement should be addressed to the EC for incorporation in its policy dialogue with the Partner Government. The SEA study recommendations should also include proposals for indicators.

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 thereof should be given.

2.4 *Required outputs*

The ***SEA Scoping Study*** will deliver the following results:

- A description of environmental aspects of the JCS and the likely projects/programmes and other initiatives identified therein ;
- A brief description of the institutional and legislative framework of the sector;
- A brief presentation of the relevant environmental policy and objectives in the country (taking into account the information provided in the JCS);
- An identification of the key stakeholders and their concerns;
- An identification of the key JCS-environment interactions;
- A description of the scope of the environmental baseline to be prepared;
- An identification of the impact identification and evaluation methodologies to be used in the SEA Study;

The ***SEA Study*** will deliver the following results:

- An environmental assessment of the JCS, taking into account the potential environmental impacts of its implementation and its consistency with the Government of Jamaica's and the EC’s environmental policies and objectives;

- Recommendations for further actions/possible solutions to mitigate adverse impacts of the implementation of the JCS, including the privatisation process. Elements which should be addressed in particular are:
    - industrial waste management,
    - long-term planning of water resources use (including irrigation efficiency issues)
    - soil conservation , fertility management, pollution and salinity aspects,
    - alternative land use (including land use planning)
    - empowerment and redeployment of factory workers
    - carbon emission trading scheme

- Recommendations for EC support implementation (including performance indicators and use of technical assistance) and for JCS enhancement.

3. EXPERTS PROFILE

3.1 Number of requested experts per category and number of man-days per expert

For this assignment a team of two experts will be required as follows:

	Indicative Schedule (mandays)	
	Expert I	Expert II
Desk research (in consultant's head office)	1	1
Scoping study (including field phase)	12	12
SEA Study (including field phase)	20	15
Finalising of the report (in consultant's head office)	4	2
Total days	**37**	**30**

3.2 Profile required (education, experience, references and category as appropriate)

Environmental Expert – Category II

Qualifications

- Minimum an MSc in environmental management or an equivalent field

General Experience

- At least 10 years practical experience in environmental issues, including institutional aspects, socio-economic aspects, international environmental policies and management, and environmental assessment techniques or other related issues.

Specific Experience

- At least 3 years experience in the implementation and follow-up of Strategic Environmental Assessments (SEA)
- At least 6 months experience in the implementation of Environmental Impact Assessments (EIA) as well as related issues (Environmental Management Plans, etc.)

Additional advantages

- Familiarity with co-products/carbon emission credit computation
- Familiarity with EC guidance on programming, country strategies, PCM, policy mix and integration of environmental issues into other policy areas;
- An understanding of the EU environment and development policies;
- Previous working experience in the region
- An understanding of the EU Sugar Market Regime;

Sugar Sector Expert – Category III

For this expert, the consultants must privilege the use of local expertise and specify how they intend to use local skills.

Qualifications

- Minimum a BSc in environmental sciences or a related field

General Experience

- At least 3 years practical experience in environmental impact assessment

Specific Experience

- At least 1 year practical experience in land use project management including reforestation, diversification, etc.
- A sound understanding of Jamaica environment and development policies;
- Knowledge of Jamaica environmental legislation
- Familiarity with the Jamaica Sugar Industry would be a distinct advantage

Additional advantages

- Familiarity with the EIA methodology and implementation.
- Water management and environmental-related issues

3.3 Working language(s)

The working language shall be English

4. LOCATION AND DURATION

4.1 Starting period

The assignment shall indicatively commence on the 12th of January 2009

4.2 Foreseen finishing period or duration

The assignment is expected to end on the 11th of March 2009

4.3 Planning

The planning of the assignment is as follows:

Planned Assignment	Remarks
Commencement of the assignment Induction meeting	Consultants' headquarters With the Representatives of the GoJ and EC Delegation
Submission of the stakeholders' work plan	The EC Delegation and the representatives of the GoJ will provide their feedback on the plan prior to the commencement of the scoping study
Submission of Draft Scoping Study Report	
Presentation of Final Scoping Study Report	The presentation will be organised by the consultants in collaboration with the STU of the Ministry of Agriculture
End of first phase of assignment	
Submission of Draft SEA Study Report	A meeting will be held with the Programme Steering Committee, including the EC Delegation wherein the consultants will present their findings/recommendations
END OF ASSIGNMENT IN JAMAICA	
Submission of GOJ comments on the draft SEA Study report via the	Comments submitted by GOJ and key stakeholders will be compiled and coordinated by the Sugar

EC Delegation	Transformation Unit.
Submission of Final SEA report to EC Delegation	

4.4 Location of assignment

The assignment shall be undertaken in Jamaica as per the planning indicated in § 4.3 with missions to the sugar dependent areas.

5. REPORTING

5.1 Content

The presentation of the reports is explained in Annex III.

5.2 Language

The report shall be written in English.

5.3 Number of copies for reports

The detailed stakeholder engagement plan to be presented 1 week after kick-off shall be submitted to the European Commission and the Government of Jamaica for comments in 5 copies (2 for the EC, 3 for GoJ) together with one CD-Rom.

The draft Scoping Study Report shall be submitted to the European Commission and the Government of Jamaica in 5 copies and one CD-Rom. The draft SEA Study Report shall be submitted to the European Commission and Government of Jamaica in 5 copies and one CD-Rom. The final report shall be submitted to the European Commission in 5 copies and one CD-Rom.

6. ADMINISTRATIVE INFORMATION

Other authorized items to foresee under 'Reimbursable'

The authorized items to foresee under 'Reimbursable' are listed below:

- Per Diem;
- International Travel (including visa);
- Local Travel

Annex I Relevant Documents

1. Ten Year Economic Reform Program 2006-2015 (see Budget Speech 2006/2007 9 June 2006)
2. EC Regulation n^0 266 /2006
3. Jamaica 10th EDF Country Strategy Paper
4. EC Multiannual Indicative Programme
5. Jamaica Country Strategy for the Adaptation of the Sugar Industry: 2006-2015 (JCS)
6. “Policy on Strategic Environmental Assessment”, November 2003 Environmental Action Programme (ENACT) Office of the Cabinet, Ministry of Lands and Environment.
7. Heads of Agreement between Government of Jamaica and Infinity Bio-Energy

Annex II- List of Key Stakeholders

Ministries:

Agriculture; Health; Social Security; Finance and the Public Service; Energy; Mining & Telecommunications

Parastatal organizations:

Sugar Industry Authority (SIA); Jamaica Cane Products Sales Ltd. (JCPS); Sugar Industry Research Institute

Private Sector

All-Island Jamaica Cane Farmers Association; Sugar Manufacturing Corporation of Jamaica Ltd; Sugar Producers Federation, JB Ethanol Ltd, Infinity bio-energy.

Trade Unions

Bustamante Industrial Trade Union (BITU); National Workers Union (NWU); University and Allied Workers Union (UAWU)

Annex III – Standard format for reports

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 Government of Jamaica and the European Commission. It does not necessarily reflect the opinion of the Government of Jamaica 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

SEA report

Maximum length of the main report (without appendices): 100 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 Government of Jamaica and the European Commission. It does not necessarily reflect the opinion of the Government of Jamaica or the European Commission

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 EC support of the MAAS
    - 10.3. Recommendations for MAAS 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. Administrative 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