National Environment and Planning Agency

State of the Environment Report 2010

Jamaica

STATE OF THE ENVIRONMENT REPORT 2010

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MESSAGE FROM THE MINISTER OF HOUSING, ENVIRONMENT, WATER AND LOCAL GOVERNMENT

The 2010 State of the Environment Report (SOE) presents an opportunity for the nation to assess the state of the country's natural resources, while highlighting some of the more fundamental environmental issues facing Jamaica and the action taken to address them. It is evident that we will have to employ more creative and effective strategies to ensure a better quality of life for all Jamaicans including – safe water, a healthy environment and shelter. Over the last decade, natural occurrences coupled with human activity have had an adverse impact on our environment. Indeed, Jamaica has had 'first hand' experience of the effects of changing global weather patterns. There has been an increase in the frequency and intensity of climate phenomena such as hurricanes, droughts and floods. With this in mind, all Jamaicans must become more aware of and proactive in employing mitigation and adaptation measures to meet our changing reality. In moving forward, we need to forge strong partnerships among key stakeholders, including Government, the private sector, civil society and the general public in addressing the country's environmental concerns.

The 2010 SOE provides a 'wake up' call for all Jamaicans as well as an opportunity to reorder priorities, where necessary and appropriate. In this regard, more emphasis must be placed on the transition towards a Green Economy which will require increased capital investment in cleaner technologies and more environmentally friendly products and services, including renewable energy sources.

Next year, the global community, will review the progress made over the last 20 years in implementing the sustainable development agenda arising out of the 1992 United Nations Conference on Environment and Development as well as address emerging issues, with a focus on strengthened political commitment. In this regard, the SOE will be an important tool in assessing our progress in achieving our sustainable development goals, such as Goal 7 of the Millennium Development Goals – to ensure environmental sustainability.

As we enter the next decade, it will be important for us to renew our commitment to the protection and conservation of our environment. A concerted effort at all levels will be required to develop and implement an ambitious and progressive agenda, based on scientific and other data, which will allow for the realization of a "healthy natural environment 'in keeping with Jamaica's National Development goals.

For me, sustainable development is based on four policy pillars, "education, energy, economy and the environment". So, with strong leadership, creativity and goodwill, we can safe guard our environment for all. We must do our part to use this information to make better decisions in our daily lives – at work and at home towards enabling Jamaica to move to the path of sustainable prosperity whereby this land of wood and water becomes for us all "the place of choice, to live, work, raise families and do business".

Hon. Dr. Horace Chang
Minister of Housing, Environment, Water and Local Government

MESSAGE FROM THE CEO, NATIONAL ENVIRONMENT AND PLANNING AGENCY

On behalf of the National Environment & Planning Agency (NEPA) I am pleased to present Jamaica's State of the Environment Report (SoE), 2010. This is the first in a series of reports that will be presented every three years to the Jamaican public. The SoE Report sets out the programmes, plans and projects that the country has and is implementing and their contribution to the management of our natural environment.

Although Jamaica has made substantial improvements in environmental management, this Report shows that many challenges still remain and need to be addressed. The data presented in this Report show that there exists some worrying trends. There are concerns regarding riverine and coastal water quality, the management of solid, liquid and hazardous wastes, watershed degradation and the net loss of forest cover.

In 2008, Jamaica's position in terms of environmental performance as measured by the Environmental Performance Index (EPI) was 54th out of 149 countries. The country was ranked best in terms of environmental performance in the English-speaking Caribbean. In 2010, the country was 89th out of 163 countries. This apparent fall reflects the need for more focused attention as well as targeted development and implementation of policies and programmes in areas such as biodiversity management and environmental health.

Improving the current state of the Jamaican environment is the responsibility of all Jamaicans and is to be led by the state in active collaboration with civil society, the private sector and the citizenry. The many complexities and unique features of the Jamaican environment require a focus on strategies that can be utilized to ensure that the country's developmental objectives are compatible with the natural environment and in keeping with the tenets of sustainable development. In recognition of the importance of the aforementioned, many sectoral policies of the government over the past ten to twelve years, have reflected the importance of sustainability and seek to take into account social, environmental and economic factors. The SoE 2010 and other similar Reports will be important tools for us to use to continuously monitor and evaluate our performance with respect to how we protect, conserve and manage our natural resources.

Notwithstanding the value inherent in sharing the information in this report we continue to work with stakeholders in the public and private spheres to implement various plans, programmes and projects in the areas of biodiversity management, waste management, forestry management and freshwater resources management to name a few. This will be underpinned by continuing to raise awareness among Jamaicans about the links between the state of the natural environment and our actions. We expect that these programmes, if properly implemented, taking into account the principles of sustainability and continuous improvement, will work to reduce the pressures on our ecosystems. A healthy natural environment will not be achieved without voluntary compliance by all stakeholders, good monitoring and strong enforcement actions.

In moving forward we recognize that as a nation we have a lot to do and that the environment sector will play a fundamental role in helping Jamaica to reach developed nation status by 2030 and to achieve the vision of making this land "the place of choice to live, work, raise families and do business" which is the guiding focus of Vision 2030 Jamaica.

Heartfelt thanks to my colleagues in the Ministries, Department Agencies and each individual who contributed to this Report. I thank my staff and in particular the Policy, Planning, Evaluation & Research Division who led the process in completing this important Report.

Peter Knight, JP
Chief Executive Officer/Government Town Planner

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- National Water Commission
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- Pesticides Control Authority
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- Rural Agricultural Development Agency
- Statistical Institute of Jamaica
- University of the West Indies
- United Nations Development Programme
- Water Resources Authority

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LIST OF ACRONYMS

APCAR	Action Plan for Corals and Reefs in Jamaica
BBFFS	Bluefields Bay Fishermans Friendly Society
BJCMNP	Blue and John Crow Mountains National Park
BOD	Biochemical Oxygen Demand
CAP	Criteria Air Pollutant
CARICOM	Caribbean Community
CASE	College of Agriculture, Science and Education
CBA	Community Based Adaptation
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
C-CAM	Caribbean Coastal Area Management (Foundation)
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDEMA	Caribbean Disaster Emergency Management Agency
CDM	Clean Development Mechanism
CEO	Chief Executive Officer
CFC	Chlorofluorocarbon
CH_4	Methane
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CO	Carbon monoxide
CO_2	Carbon dioxide
CSR	Corporate Social Responsibility
E10	"Ethanol-10" (a fuel mixture of 10% ethanol and 90% gasoline)
EEZ	Exclusive Economic Zone
EFJ	Environmental Foundation of Jamaica
EHU	Environmental Health Unit
EIA	Environmental Impact Assessment
EMD	Environmental Management Division
ERA	Environmental Regulatory Authority
ESSJ	Economic and Social Survey Jamaica
EU	European Union
EVI	Environmental Vulnerability Index
FAO	Food and Agriculture Organization of the United Nations
FCF	Forest Conservation Fund
FRA	Forest Resources Association
FX	Foreign Exchange
FY	Fiscal Year
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GMO	Genetically Modified Organism
GOJ	Government of Jamaica
GPS	Global Positioning System
HC	Hard Coral
HCFC	Hydro-chlorofluorocarbon
HFC	Hydrofluorocarbon
HIA	Health Impact Assessment
ICENS	International Centre for Environment and Nuclear Sciences
ICRI	International Coral Reef Initiative

IJAP	Improving Jamaica's Agricultural Productivity
IMF	International Monetary Fund
IPCC	Inter-governmental Panel on Climate Change
IPM	Integrated Pest Management
ISO	International Organization for Standardisation
IUCN	International Union for Conservation of Nature
JaNEAP	Jamaica National Environment Action Plan
JBI	Jamaica Bauxite Institute
JCDT	Jamaica Conservation and Development Trust
JMD	Jamaican Dollar
JOAM	Jamaica Organic Agriculture Movement
JPAT	Jamaica Protected Areas Trust Limited
JPSCo	Jamaica Public Service Company
JSLC	Jamaica Survey of Living Conditions
KHEMP	Kingston Harbour Environmental Management Programme
KMA	Kingston Metropolitan Area
KSA	Kingston and St. Andrew
LBS	Land-Based Sources (of pollution)
LFMC	Local Forest Management Committee
LNG	Liquefied Natural Gas
LSDP	Local Sustainable Development Plan
MBMPT	Montego Bay Marine Park Trust
MDAs	Ministries, Departments and Agencies
MDG	Millennium Development Goal
MDG7	Millennium Development Goal 7 (Ensure environmental sustainability)
MEM	Ministry of Energy and Mining
MoAF	Ministry of Agriculture and Fisheries
MOU	Memorandum of Understanding
MTW	Ministry of Transport and Works
NBSAP	National Biodiversity Strategy and Action Plan
NCRPS	Negril Coral Reef Preservation Society
NCU	Northern Caribbean University
NEGAR	National Ecological Gap Assessment Report
NEPA	National Environment and Planning Agency
NEPT	Negril Area Environmental Protection Trust
NGO	Non-Governmental Organization
NIA	Nutrient-Indicating Algae
NIC	National Irrigation Commission
NO_2	Nitrogen dioxide
N_2O	Nitrous oxide
NO_x	Nitrogen oxides
NRCA	Natural Resources Conservation Authority
NRV	Natural Resource Valuation
NRW	Non Revenue Water
NSDI	National Spatial Data Infrastructure
NSP	National Spatial Plan
NSS	National Spatial Strategy
NSWMA	National Solid Waste Management Authority
NWC	National Water Commission
O_3	Ozone
ODPEM	Office of Disaster Preparedness and Emergency Management
ODS	Ozone-Depleting Substance
PASMP	Protected Areas System Master Plan
PCB	Polychlorinated Biphenyl

PDC	Parish Development Committee
PFC	Perfluorocarbon
PIOJ	Planning Institute of Jamaica
$PM_{2.5}$	Particulate matter less than 2.5 microns
PM_{10}	Particulate matter less than 10 microns
POP	Persistent Organic Pollutant
PSR	Pressure-State-Response
RADA	Rural Agricultural Development Authority
RiVAMP	Risk and Vulnerability Assessment Methodology Development Project
SAR	Sodium Adsorption Ratio
SGP	Small Grants Programme
SO_2	Sulphur dioxide
SOE	State of the Environment
SPAW	Specially Protected Areas and Wildlife
STATIN	Statistical Institute of Jamaica
STP	Sewage Treatment Plant
TCP	Town and Country Planning
TCPA	Town and Country Planning Authority
TDS	Total Dissolved Solids
TEF	Tourism Enhancement Fund
TNC	The Nature Conservancy
TS	Tropical Storm
TSP	Total Suspended Particulates
VOC	Volatile Organic Compounds
UDC	Urban Development Corporation
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNV	United Nations Volunteers
USD	United States Dollar
UTech	University of Technology, Jamaica
UWI	University of the West Indies
WHO	World Health Organization
WMU	Watershed Management Unit
WRA	Water Resources Authority
WRI	World Resources Institute

UNITS

boe	barrels of oil equivalent
BTU	British Thermal Unit
g, µg, mg, kg, Gg	gramme, microgramme (one millionth of a gramme), milligramme (one thousandth of a gramme), kilogramme (1,000 g), gigagramme (1,000 kg)
ha	hectare (10,000 square metres, i.e. 100 m x 100 m)
kW, MW	kilowatt, megawatt (1,000 kilowatts)
kWh, GWh	kilowatt-hour, gigawatt-hour (1 million kWh)
l, ml	litre, millilitre (one thousandth of a litre)
m, mm, km	metre, millimetre (one thousandth of a metre), kilometre (1,000 m)
MCM	million cubic metres
MPN	Most Probable Number
T, MT	tonne (1,000 kg), megatonne (1 million tonnes)
y	year

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Environmental Resources and Ecosystems

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INTRODUCTION

Jamaica's State of the Environment Report 2010 provides an overview of the current state and quality of the country's natural heritage. The report is a tool to help in the sustainable management of Jamaica's natural and physical environment in support of achieving Goal 3 as set out in **Vision 2030 Jamaica – National Development Plan**, "Jamaica has a Healthy Natural Environment". This will be accomplished by pursuing the national strategies contained primarily in National Outcome No. 13: "Sustainable Management and Use of Environmental and Natural Resources", National Outcome No. 14: "Hazard Risk Reduction and Adaptation to Climate Change", and National Outcome No. 15: "Sustainable Urban and Rural Development".

This State of the Environment Report will help to evaluate Jamaica's progress against **Millennium Development Goal** Number 7 (MDG7), ***Ensure environmental sustainability***. MDG7 has four targets and a number of indicators which are reported against in this document.

Within this report, the main sections regarding the

Millennium Development Goal 7:

Ensure environmental sustainability

Target 7.A: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss

Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation

Target 7.D: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers

components of the environment are structured according to the Pressure-State-Response (PSR) principle. The **Pressure** is concerned with human activities and natural events that can degrade the natural environment, affect health, threaten survival of species; place pressure on resources and cause deterioration in the quality of human settlements. This leads to the **State** or quality of the environment and to the **Response** – the observations made of the effects of stress on the environment and the consequent measures undertaken to improve the state of the environment. This report presents primarily the Government of Jamaica's response but recognizes the important role of business enterprises, NGOs and others in environmental protection and conservation.

This report is structured as follows:

Current State of Jamaica's Environment – A Snapshot – A summary of the important issues and trends with respect to Jamaica's environment, as well as responses and actions to manage the country's environment in a sustainable way

Section 1 – Discussion within the PSR framework of Jamaica's environmental resources and ecosystems, focusing on biodiversity, forests and watersheds, marine and coastal resources (including, but not limited to, coral reefs, beaches and fisheries), freshwater resources, and protected areas

Section 2 – Discussion within the PSR framework of the management of key aspects of Jamaica's environment – air quality and waste – and a general discussion of the three main economic sectors (mining, tourism and agriculture) and the energy sector which underpins the entire economy, highlighting the linkages of these sectors with the natural environment

Section 3 – Discussion on governance issues related to environmental management, focusing on international agreements, national legislation, policies and plans and participation by non-state actors in the sustainable use of natural resources and conservation efforts

Section 4 – Discussion within the PSR framework of natural and man-made hazards, and reported environmental incidents

CURRENT STATE OF JAMAICA'S ENVIRONMENT – A SNAPSHOT

What is the current state of Jamaica's environment? Over the past few years, there has been an increased focus on improving environmental management in Jamaica, through activities such as creating new standards, policies and regulations (and enforcing existing ones); increased environmental monitoring; and greater awareness raising.

In the last three years, between 2008 and 2010, the overall status of Jamaica's ecosystems and natural resources has remained fairly constant. During this time:

- Key elements of biodiversity – species and ecosystems (including watersheds, forests, coral reefs and other marine areas) have remained at the same state in general. The amount of protected land and marine areas has remained the same (although there were new fish sanctuaries declared in 2009 and 2010). There have been changes in management activities, for example, the number of prosecutions under the Wild Life Protection Act increased. In fact, the number of enforcement actions increased in all areas.
- The quality of air, coastal and riverine water quality remained relatively constant except for an apparent increase in the percentage of river sites meeting nutrient standards.
- There were reductions in the amount of solid waste generated and hazardous waste exported. This could be attributed to increased focus on waste reduction efforts.
- The portion of our energy mix that comes from renewable energy almost doubled, demonstrating a stronger focus on reducing our use of imported petroleum and on developing alternate energy.

These trends are shown in Table 1, which presents the status of Jamaica's environment as measured by selected key indicators. This State of the Environment (SOE) Report provides details and context within which these measurements can be interpreted. These indicators also are used in the annual status reports to measure progress in the implementation of Jamaica's National Environmental Action Plan (JaNEAP) and are linked to the monitoring and evaluation framework for Vision 2030 Jamaica. The indicators are important tools which can be used to make comparisons of Jamaica's environmental status from year to year, can also compare Jamaica with other countries in the Caribbean region and other parts of the world. Monitoring efforts will ensure that data for these indicators are collected so that subsequent SOE reports can provide meaningful comparisons and demonstrate trends to inform decision making.

Table 1: Environmental Indicators and Trends 2008 – 2010

Proposed Indicators[a]	2008	2009	2010
BIODIVERSITY			
Number of species threatened/endangered	207	207	206
Number of violations of Wild Life Protection Act prosecuted	3	8	10
FORESTRY AND WATERSHEDS			
Forest area as a percentage of total land area	…	…	29.9%
Annual rate of change in forest cover	0.1%	0.1%	0.1%
Area of land reforested by Forestry Department (ha)	150	281	200
Number of tree seedlings produced by Forestry Department	250,000	250,000	250,000
Number of the 26 Watershed Management Units (WMU) severely degraded	4	4	4
PROTECTED AREAS			
Protected terrestrial areas as a percentage of total land area	18%	18%	18%
Percentage of marine and national parks with management and zoning plans	75%	75%	75%
MARINE AND COASTAL RESOURCES			
Percentage of live coral cover	13.7%	13.2%	13.3%
Annual major fish species production (MT)	15,825.01	18,235.03	16,213.75
Percentage of beach sites monitored affected by chronic beach erosion	30%	33%	30%
Percentage of marine sites meeting faecal coliform standards	65%	70%	70%
Percentage of marine sites meeting BOD standards	76%	82%	79%
Percentage of marine sites meeting nutrient standards	64%	59%	59%
FRESHWATER RESOURCES			
Percentage of fresh water (river) sites meeting BOD standards	76%	82%	79%
Percentage of fresh water (river) sites meeting nutrient standards	55%	59%	72%
AIR QUALITY			
Percentage of monitoring sites in Kingston meeting ambient air quality standards	75%	75%	75%
WASTE MANAGEMENT			
Waste generation per capita per day (kg)	0.74	0.86	…
Solid waste produced from residential sources (tonnes)	845,896	821,903	762,623
Hazardous waste exported (MT)	8,000	5,000	4,000

Proposed Indicators[a]	2008	2009	2010
ENERGY			
Energy from renewable sources as a percentage of total energy consumption	5%	7.5%	9%
MINING			
Area of mined out lands certified as rehabilitated (ha)	513	678	…
TOURISM			
Number of tourism facilities with green certification	…	24	24
ENVIRONMENTAL GOVERNANCE			
Number of EIAs evaluated compared with approved developments (environmental permits issued)	30 EIAs 104 permits	35 EIAs 202 permits	24 EIAs 165 permits
Expenditure on environmental protection and conservation (J$'000)	2007/08 2,026,749	2008/09 3,464,198	2009/10 1,939,107
Number of enforcement actions taken by NEPA	…	2008/09 256	2009/10 352
NATURAL HAZARDS			
Total cost to the country due to hurricane damage (J$B)	0.15	…	20.6
MAN-MADE HAZARDS AND ENVIRONMENTAL INCIDENTS			
Number of fish kills reported and investigated	…	3	5
Number of petro-chemical spills reported and investigated	4	3	6
Number of chemical spills reported and investigated	2	2	4
Number of fires at the Riverton solid waste disposal site	3	5	4

… indicates that no data are available

a. These indicators include core indicators and sub-indicators

Section 1:

Environmental Resources and Ecosystems

BIODIVERSITY

Jamaica has a remarkable diversity of species and ecosystems, and is an important contributor to biodiversity of the Caribbean Basin, which is ranked fifth out of "the eight hottest hotspots" on the Conservation International list of Biodiversity Hotspots. (The Caribbean has the fifth highest concentration of endemic species on earth)[1].

Jamaica has the highest number of endemic birds and plants of any Caribbean island and is ranked number five in terms of its endemic flora and fauna amongst islands worldwide. Jamaica's endemic plant and animal species include 60 endemic orchid species, more than 67 fern species, 33 endemic reptile species, 31 endemic birds, 22 endemic amphibian species and over 500 endemic species of land snails. The Cockpit Country and the Blue and John Crow Mountains National Park (BJCMNP) have some of the highest terrestrial endemism in Jamaica (Jamaican Clearing-House Mechanism 2005). In 1997, the BJCMNP was included in the World Wildlife Fund and IUCN list of globally important sites for conservation of plant biodiversity (The Nature Conservancy 2008). Jamaica's social and economic well-being is dependent on the country's biodiversity. Ecosystems provide many essential services such as the provision of clean water and air, prevention of soil erosion, provision of medicinal plants, nutrient cycling, provision of food and shelter, and the meeting of spiritual, cultural, aesthetic and recreational needs. Large portions of the country's economy are heavily dependent on biodiversity, including tourism, horticulture and agriculture.

Intact ecosystems (i.e. ecosystems which are in a natural or near-natural state) play an important role in providing cost-effective resilience to the impacts of climate change, including buffering human settlements and activities from the impacts of extreme climate events and sea level rise. For example, mangrove forests along the coast act as wave breakers and protect the coastline from storm surges and extensive flooding during storms and hurricanes.

[1] As reported in Norman Myers, Russell A. Mittermeier, Cristina G. Mittermeier, Gustavo A. B. da Fonseca and Jennifer Kent Nature 403, 853-858(24 February 2000)

PRESSURES ON JAMAICA'S BIODIVERSITY

Deforestation, wetland destruction, removal of seagrass and coral reef degradation have resulted in both the reduction and loss of biodiversity. In addition, population growth, coupled with agricultural, industrial and commercial expansion, has resulted in intense competition for land, leading to encroachment and fragmentation of natural habitats. Land degradation, fragmentation of habitats, and alien invasive species are key challenges to biodiversity that need to be addressed. The country's biodiversity also is impacted by natural processes and events such as erosion and hurricanes, the effects of which are often exacerbated by human activities and practices. Furthermore, climate change is likely to further increase the negative impacts of these natural events.

Threats to Jamaica's biodiversity include the following:

- Habitat loss
- Over-exploitation
- The impact of alien invasive species
- Weak law enforcement
- Inadequate awareness of the value of natural resources
- Urban population growth
- Poor spatial planning and land use
- Climate change

The relative importance of some threats on terrestrial, freshwater, estuarine and marine ecosystems in Jamaica is presented in Table 2.

Table 2: Anthropogenic Threats to Jamaica's Ecosystems

Anthropogenic Threats	Terrestrial	Freshwater	Marine
Habitat loss and degradation	↑	↑	↑
Invasive alien species	↗	↗	↗
Over - harvesting/exploitation	↑	↑	↑
Pollution	↑	↑	↑
Climate change	↗	↗	↗
Lack of Law enforcement	↑	↑	↑

Colours indicate severity of the threat with severity increasing from pale yellow to red. Arrows indicate the trend in the driver, with an arrow at a 45 degree angle representing a gradually increasing trend.
Source: Fourth National Report to the Convention on Biological Diversity

There are several factors that apply pressure on Jamaica's plants and animals, resulting in threatened species. For example, animals are hunted and collected for sport, food, research, and trade. Various capturing techniques are used to opportunistically, illegally, or accidentally capture turtles, manatees, crocodiles and birds to supplement food or income (for example, through the pet trade). Plants, especially orchids, are harvested from the forest for local sale or export. Other plant species are collected for scientific research or private use. Table 3 shows species in Jamaica listed on the IUCN Red List of Threatened Species 2010.

Images of *Heppiella corymbosa* (left) and *Turnera zeasperma* (right) - endangered endemic plants from Cane River, St. Andrew

Table 3: Species in Jamaica listed on the IUCN Red List of Threatened Species 2010

Mammals	Birds	Reptiles	Amphibians	Other Invertebrates
Geocapromys brownii (Jamaican Hutia)	Amazona agilis (Black-billed Amazon)	*Cyclura collie* (Jamaican Iguana)	*Eleutherodactylus alticola* (Jamaican Peak Frog)	*Acropora cervicornis* (Staghorn Coral)
Lasiurus degelidus (Jamaican Red Bat)	*Amazona collaria* (Yellow-billed Amazon)	*Epicrates subflavus* (Jamaican Boa)	*Eleutherodactylus cavernicola*	*Acropora palmata* (Elkhorn Coral)
Natalus jamaicensis (Jamaican Greater Funnel-eared Bat)	*Catharus bicknelli* Bicknell's Thrush)	*Eretmochelys imbricata* (Hawksbill Turtle)	*Eleutherodactylus fuscus*	*Agaricia lamarcki* (Lamarck's Sheet Coral)
Physeter macrocephalus (Sperm Whale)	*Dendrocygna arborea* (West Indian Whistling-duck)	*Hypsirhynchus ater* (Black racer)	*Eleutherodactylus junori*	*Dendrogyra cylindrus* (Pillar Coral)
Trichechus manatus (West Indian Manatee)	*Dendroica cerulea* (Cerulean Warbler)	*Crocodylus acutus* (American crocodile)	*Eleutherodactylus luteolus*	*Dichocoenia stokesii* (Elliptical Star Coral)
	Patagioenas caribaea (Ring-tailed Pigeon)		*Eleutherodactylus orcutti* (possible extinct)	*Hypolestes clara* (Jamaican Hypolestes)

Mammals	Birds	Reptiles	Amphibians	Other Invertebrates
	Pterodroma caribbaea (Jamaica Petrel)			*Montastraea annularis* (Boulder Star Coral)
	Siphonorhis americana (Jamaican Pauraque)			*Montastraea faveolata*
	Tachycineta euchrysea (Golden Swallow)			*Montastraea franksi*
	Nesopsar nigerrimus (Jamaican Blackbird)			*Mycetophyllia ferox* (Rough Cactus Coral)
				Oculina varicosa (Large Ivory Coral)

Source: International Union for Conservation of Nature

Invasive Species

The invasive species list for Jamaica includes 40 plants and 46 animals (Institute of Jamaica 2010), some of which threaten the viability of endangered indigenous plant and animal populations as well as ecosystems. For example, the Black River Lower Morass is affected by two invasive plant species (*Alpinia allughas*, and *Melaleuca quinquenervia*) and two fresh-water invasive animal species Australian Red Claw Crayfish (*Cherax quadricarinatus*), and freshwater Suckermouth Catfish (*Pterygoplichthys paradalis*), which have had negative effects on native species, as well as the hydrology and structure of the wetlands. In the marine environment, the Lionfish (*Pterois volitans*) is an invasive species with potentially devastating effects on Jamaica's vulnerable fisheries industry. Data show that the lion fish has become established in waters around Jamaica, including the Pedro Banks.

Photo of *Pterois volitans* commonly called Lion Fish – The Lion Fish is an example of an invasive species in Jamaica which has potentially devastating effects on the country's already vulnerable fisheries industry

Some invasive species that are agricultural pests are the Pink Mealy Bug (*Maconellicoccus hirsutus)*, Asian citrus psyllid (*Diaphorina citri*), which causes Citrus Greening, Lime Swallowtail Butterfly *(Papilio demoleus)*, and Red Palm Mites (*Raoiella indica*). These have caused millions of dollars in damage to the agriculture sector.

CURRENT STATE OF JAMAICA'S BIODIVERSITY

One of the four targets for the Millennium Development Goal (MDG) 7 related to the environment, addresses biodiversity. The inclusion of this target in the MDGs demonstrates the importance of biological diversity to a healthy environment. The target, set in 2000, calls for a significant reduction in the rate of loss of biodiversity by 2010. The state of Jamaica's biodiversity can be determined by examining the condition of its ecosystems as well as the plant and animal species within these ecosystems.

Ecosystem Diversity

Jamaica's many ecosystems are the repositories of biodiversity. Therefore, conservation and sustainable use of these forests, coral reefs, wetlands etc, is a critical component of Jamaica's overall biodiversity conservation strategy. ***The sections in this report on Forests and Watersheds, Coastal and Marine Resources and Protected Areas, provide a more detailed discussion of these ecosystems.***

Diversity of Plant and Animal Species



There are over 3,304 vascular plant species in Jamaica (of which 28% are endemic), 600 species of ferns, 116 species of butterflies, and 256 known species of birds (106 indigenous to Jamaica as well as migratory birds). There are thirty birds endemic to Jamaica, including the yellow-billed and the black-billed parrot and the streamer tail hummingbird – Jamaica's national bird. Table 4 shows terrestrial species diversity in Jamaica. As can be seen from the table, endemism is very high in land snails (98%), grapsid crabs (100%), fireflies (~94%), and amphibians (100%).

With respect to marine biodiversity, there are well over 3,500 different plants and animals (not including bacteria, viruses and fungi) in the shallow, shore or shelf waters of the Jamaican marine environment (Warner and Goodbody, 2005). Few deep-sea studies have been conducted, but it is likely that the greatest proportion of new species may be discovered in this environment. Table 5 below shows the estimates of marine species in Jamaican Shallow, Shelf, or Shore Waters.

Seagrasses can be found throughout the Jamaican coastal areas, but are more abundant on the south coast where the island shelf is broader. The three species found in Jamaican waters are Shoal Grass (*Halodule wrightii),* Turtle Grass *(Thalassia testudinum),* and Manatee Grass *(Syringodium filiforme)*.

Table 4: Terrestrial Species Diversity in Jamaica

Fauna and Flora	Total # of Indigenous Species	Total # of Endemic Species
Rotifer	211	<21
Land Snails	514	505
Grapsid Crabs	9	9
Jumping Spider	26	20
Fireflies	48	45
Butterflies	133	20
Ants	59	6
Amphibians	22	22
Reptiles	43	33
Shore and Sea Birds	39	1
Land Birds	67	30
Bats	21	2
Other Mammals	2	2
Bromeliads	60	22
Orchids	230	60
Ferns	579	67
Cacti	20	10
Palms	10	7
Grasses	˜200	1

Source: Fourth National Report to the Convention on Biological Diversity

Table 5: Estimates of Marine Species in Jamaican Shallow, Shelf, or Shore Waters

Taxon	Number of Species	Taxon	Number of Species
Phytoplankton	374	Mollusca	825
Macroalgae	386	Bryozoa	64
Porifera	194	Chaetognatha	10
Cnidaria	204	Echinodermata	88
Ctenophora	6	Hemichordata	2
Nematoda	81	Chordata	75
Annelida	100	Cephalochordata	1
Crustacea	455	Vertebrata	637

Source: George R. Warner and Ivan Goodbody, “Jamaica” In Caribbean Marine Diversity: The known and the Unknown (Lancaster: DEStech Publications, 2005), 57-70

Important large aquatic and marine related animals include the West Indian Manatee, dolphins and whales, sea turtles and crocodiles.

- The West Indian Manatee (*Trichechus manatus manatus)* is endangered and is now rare in Jamaica. The numbers of manatee seen in the Alligator Pond area (border of Manchester and St. Elizabeth), the area where they were most often seen, is extremely low.
- Dolphin and whale species in Jamaica's waters (Creary 2008; O'Sullivan 2006) include:
    - Bottlenose dolphins *(Turslops truncatus)* – the most numerous species; the international trade in Bottlenose dolphins is regulated and monitored by CITES
    - Atlantic Spotted dolphin *(Stenella frontalis),* the Pantropical Spotted dolphin *(S. attenuata)*, and the Striped dolphin (*S. coerulealba*) – these are commonly seen
    - Killer whales *(Orcinus orca)*, Short-finned Pilot whales *(Globicephalus macrocephalus),* Risso's dolphin (*Grampus griseus)*, Melon-headed whale *(Pepenocephala electra)*, Sperm whale *(Physeter catadon)*, Pygmy Sperm whale *(Kogia breviceps)* and the Humpback whale *(Megaptera novaeanglae)* – small numbers of which exist.

Photo of the West Indian Manatee *(Trichechus manatus manatus)* and its young

- The American Crocodile (*Crocodylus acutus*) is the only species of crocodile found in Jamaica and is listed as vulnerable by the World Conservation Union (IUCN). This means that the species is "facing a high risk of extinction in the wild in the medium-term future". The crocodile is protected by law and is found mainly on the south coast in mangrove swamps, marshes, shallow bays, rivers, and other water bodies as shown in Table 6 below. There are a few isolated populations present on the north coast (Bogue Lagoon in St. James and Salt Marsh in Trelawny). This risk is mainly due to a significant loss of habitat by wetland reclamation for development and also human encroachment. Subsequently there is also an increase in the number of human/crocodile confrontations as the animals seek out new areas (storm drains, micro-dams, and sewage and fish ponds).

Table 6: Crocodile Survey Conducted in 2007

Location	Area (km^2)	Resident Crocodiles	No. of crocodiles /km^2	Criteria Habitat Quality Availability of fresh/brackish water	Human Activity in area	No. of Nesting Areas Identified
The Great Morass, St. Thomas	18.4	22	1.20	Few ponds, Plantain Gardens River	Fishing, charcoal burning mangrove clearing	3
Portmore Community/Hellshire	8.5 3	52	8.53	Sewage ponds and 5 ponds within the mangroves	Fishing, charcoal burning, dumping	2
The Milk and Rio Minho Rivers and associated wetlands	9.40	74	7.8	Milk and Rio Minho and a few ponds along the coast	Fishing, swimming, washing, bathing	3
Amity Hall - Cabarita (St. Catherine)	16.7	19	1.14	Salt Island creek and several small ponds within the mangroves	Fishing	0
West Harbour - Cockpit salt Marsh	45.0	22	0.58*	Salt River and several inlets along the coast	Fishing, washing, swimming, bathing	10
The Black River Lower Morass Including Parottee	90.30	32	0.35*	Middle Quarters, Y. S. River, Black River, Broad Water and the Great Parottee Pond	Fishing, washing, swimming, bathing, boat tours	0
The Black River Upper Morass	26.9	N/A	N/A	Black River, Braes River, Smith River, New River	Fishing, swimming, bathing	N/A
Font Hill	3.90	22	5.64	>20 ponds within the mangroves	Fishing, swimming, mangrove, clearing, dumping	8
Canoe Valley	5.50	2	0.36	Alligator Hole, Swift River and Guts River	Fishing, dumping	0

* The low density (no. of crocodiles/km^2) is reflective of the large area in which the crocodiles are found.

Source: NEPA

The two most populated areas were the Milk and Rio Minho Rivers along with their associated wetlands (74) and the Greater Portmore/The Flashes (52). Sizes ranged from 0.305m (1ft) to 3.962m (13ft) in these areas. Surveys for nesting sites indicated that nesting activity takes place in all the wetlands, however Rolling Bay (Clarendon) and Font Hill (St. Elizabeth) showed the highest density (6 nests/km and 2 nests/km, respectively).

Photo of the Hawskbill sea turtle (Eretmochelys imbricata) hatchlings on their way down the beach to the sea at Palisadoes Port Royal - October 2008.

- There are four species of sea turtles that can be found in Jamaican waters: the Green sea turtle *(Chelonia mydas)*, the Hawskbill sea turtle *(Eretmochelys imbricata)*, the Leatherback turtle *(Dermochelys coriacea)*, and the

Loggerhead sea turtle *(Caretta caretta)*. Of the four, the Leatherback is listed as critically endangered by IUCN, and the others are listed as endangered. All sea turtles are protected by CITES[2] convention and the Jamaican Wildlife Act.

Threatened Species

The proportion of species threatened with extinction has been selected as one of the Millennium Development Goals environmental indicators. The IUCN describes three categories of threatened species, depending on the degree to which they are threatened: vulnerable, endangered and critically endangered. A number of Jamaica's plant and animal species are labeled as "threatened" and are in danger of becoming extinct. Jamaica is ranked sixth on the International Union for Conservation of Nature (IUCN) Red List for mammals of endangered species (i.e. at risk of extinction) because of threats to the country's bats and the Hutia. In 2006, the existence of one species of bat that was thought to be possibly extinct was recorded. However, there are approximately four species which have not been recorded for more than ten years. ***Over the last five years, there has been no noted increase in the number of endangered species.*** Tables 7, 8 and 9 show Jamaica's threatened plant and animals.

Table 7: Threatened Animals and Plants in Jamaica

Species	1996	2006	2010
Mammals	4	5	5
Birds	7	10	10
Reptiles	8	8	5
Amphibians	4	17	6
Fish	-	16	15
Molluscs	5	-	-
Other Invertebrates	..	5	11
Plants	...	209	209
Total	**...**	**270**	**261**

Note: - none; … not known
Source: International Union for Conservation of Nature

Table 8: Number of Animals and Plants in Danger

Status	2006		2010	
	Plants	Animals	Plants	Animals
Extinct	5	2	…	3
Extinct in the Wild	10	…	…	…
Critically Endangered	8	40	…	13
Endangered	17	53	1	8
Vulnerable	16	116	1	27
Near Threatened	5	73	…	20
Data Deficient	209	5	…	30
Least Concern	270	1	36	372
Total	**540**	**290**	**38**	**473**

Note: - none; … not known
Source: International Union for Conservation of Nature

[2] The Convention International Trade in Endangered Species of Wild Fauna and Flora

Table 9: Threatened Species by Type 2010

Species	Critically Endangered	Endangered	Vulnerable	Near Threatened	Total
Amphibians	5	1	…	…	6
Birds	2	1	7		10
Velvet Worm	1	…	…	1	2
Fish	4	2	7	…	13
Mammals	1	…	4	…	5
Insects	…	1	…	…	1
Reptiles	3	1	1	…	5
Total	**16**	**6**	**19**	**1**	**42**

Note: - none; … not known

Source: International Union for Conservation of Nature

JAMAICA'S RESPONSE TO MANAGING ITS BIODIVERSITY

The Government of Jamaica has developed a number of policies, plans and programmes to protect the country's biological resources. These include a permit and licensing system to regulate developments and activities that affect the natural environment, protected area management plans and species management plans. Furthermore, Jamaica is signatory to the major international environmental agreements that govern various aspects of biodiversity. At the same time, appreciation among the general public of the value of biodiversity is increasing, leading to increased action at the community level and heightened demand for action from the country's leaders.

International Agreements and National Legislation

The biodiversity-related international environmental agreements to which Jamaica is a signatory include the following:

- **Convention on Biological Diversity (CBD)** – promotes conservation and sustainable use of biodiversity and the sharing of benefits arising from the use of genetic resources. Under its commitments to the convention, Jamaica has prepared a National Biodiversity Strategy and Action Plan (NBSAP) to indicate how the country will protect its biodiversity. Also, Jamaica submits periodic national reports to the CBD which identifies and presents the measures taken to implement the provisions of the CBD and their effectiveness. Jamaica has produced the draft Fourth National Report (for 2005-2009) which is currently being reviewed.

- **Biosafety Protocol** – a subsidiary agreement to the CBD which allows countries, to regulate the imports of products which contain genetically modified organisms intended for release into the environment. This convention has not yet been ratified by Jamaica.

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** – aimed at ensuring that international trade in specimens of wild animals and plants does not threaten their survival. All import, export, re-export and introduction from the sea of species covered by the Convention have to be authorized through a licensing system depending on the state of vulnerability of the species and therefore the degree of protection they need. This is regulated under the **Endangered Species (Protection, Conservation and Regulation of Trade) Act.** Protection under this Act affords a species the highest degree of legal protection against international trade.

- **Protocol Concerning Specially Protected Areas and Wildlife (SPAW)**[3] – a Caribbean regime which aims to protect, preserve and manage in a sustainable way, areas and ecosystems of special value: threatened or endangered species of flora and fauna and their habitats.

- **UN Convention to Combat Desertification (UNCCD)** – promotes efforts to prevent land degradation, i.e. to protect important habitats and ecosystems. The Convention is implemented through a National Action Plan.

While these international environmental agreements and conventions provide an important framework for action at the national level, they do not have direct legal authority within the signatory countries and must be locally implemented through national legislation.

The first pieces of legislation promulgated to protect biodiversity were the **Morant and Pedro Cays Act** (1907), which protects the sea birds and seas turtles on the cays, and the **Wild Life Protection Act** (1945) and its later regulations which protect designated species of animals and regulate hunting in Jamaica. The provisions of the Act and Regulations relate to: protected species; game sanctuaries and reserves; hunting; river fishing and pollution; use of dynamite; and game wardens.

Management Plans

As mentioned above, habitat protection is critical to biodiversity conservation. Protected areas are generally created in order to conserve species and ecosystems. As required under the CBD's Programme of Work on Protected Areas, Jamaica has commenced the development of a Protected Areas System

[3]SPAW is a protocol to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention) – a comprehensive, umbrella agreement that provides the legal framework for the protection and development of the marine environment. It is the only Caribbean region-wide environmental treaty that protects critical marine and coastal ecosystems.

Master Plan. It is expected to provide a structured framework within which protected areas will be managed. This Plan will address public awareness, legislation, culture and heritage, institutional arrangements, financial sustainability, and biodiversity conservation, including prioritization of areas proposed for inclusion in the protected areas system. The Plan is to provide a framework for the management of protected areas which are the responsibility of NEPA, the Forestry Department, Fisheries Division and the Jamaica National Heritage Trust.

See Section on Protected Areas for further discussion of Jamaica's Protected Areas.

NEPA has been implementing Jamaica's **National Biodiversity Strategy and Action Plan** since the completion of the Plan in 2003 as part of Jamaica's commitment to the CBD. The Plan outlines a plan for the conservation and sustainable use of Jamaica's biodiversity and requires collaboration among the private sector, civil society, the Government, communities and environmental organizations.

Conservation activities are also guided by **policies and management plans for specific species**, developed by NEPA in collaboration with other organizations. These include policies for:

- Dolphins
- Orchids *(Malpighia proctorii)*

And management plans for:

- Sea turtles
- West Indian Manatee
- Jamaican Boa
- Giant Swallowtail Butterfly
- American Crocodile
- Jamaican Hutia (Coney)
- Other species (e.g. bats, game birds)

These plans include conducting inventories, raising public awareness and involving communities in monitoring and protection activities through volunteer programmes. There has been mixed progress on the implementation of these plans due to limits on human and other resources within NEPA and other responsible agencies.

Jamaica is preparing a draft **Invasive Alien Species Strategy and Action Plan** supported by the project, "Mitigating the Threats of Invasive Alien Species in the Insular Caribbean."[4] The project is geared towards increasing national capacity to address potential risks posed by invasive alien species and to prevent the introduction of new invasive species that can impact the country's biodiversity of global significance.

[4] This project, funded by the Global Environment Facility (GEF) is being implemented by NEPA and CABI Caribbean & Latin America

Approaches to Protect Jamaica's Biodiversity

Natural Resource Valuation

The project, "Supporting Country Action on the CBD Programme of Work on Protected Areas" is taking an innovative approach in building capacity to assess the value of protected areas to the Jamaican economy and to incorporate natural resource valuation into policy, and apply the information to relevant decision making. The project aims to increase awareness of the value of protected areas, resulting in increased budgetary allocations and acceptance of a multiplicity of sustainable financial sources for these areas. Appropriate methods, standards, criteria and indicators for evaluating the effectiveness of protected area management and governance will be developed and adopted and related database established to collect data.

Another project, the Piloting Natural Resource Valuation (NRV) Project is developing a set of natural resource valuation tools, and incorporating these into policies and procedures governing the preparation and use of Strategic Environmental Assessments (SEAs) and Environmental Impact Assessments (EIAs). The project is demonstrating the use of these techniques to improve the decision-making process concerning economic development plans and projects that may potentially have impacts on the natural environment. The project also is employing a strategy of targeted capacity development activities, in developing a set of natural resource valuation tools that are applicable to the Jamaican context.

Data Collection and Management

Realizing the importance of a data management regime, Jamaica is implementing a project to create and maintain a web-based protected areas database which will be compatible with the World Database for Protected Areas. The data will be used to inform Parish Development Orders, in order to improve the depth of information used in planning decisions.

Rescue Centres

The Wildlife Protection Act makes provisions for private rescue centres to receive and care for protected species that are caught, confiscated or found injured. Rescue centres are an important part of the system to protect Jamaica's species that are endangered by illegal capture and trade as well as by habitat destruction. The Hope Zoo works in close collaboration with private centres, which are typically under-resourced.

Captive Breeding/Artificial Propagation Programmes

Captive breeding is seen as one means of protecting Jamaica's species from extinction. One successful programme has been the Jamaican Iguana (*Cyclura collie*) programme. Care needs to be taken with such programmes to ensure that re-introduction of captive bred animals do not transfer diseases to the wild population and that the release habitat can accommodate the species.

Photo of the Jamaican Iguana (Cyclura collie) – One successful captive breeding programme has been the Jamaican Iguana programme.

NEPA has, with the assistance of the Forestry Department and the Hope Botanical Garden, conducted artificial propagation of *Malpighia proctorii* one of Jamaica's endemic plant species, in an attempt to determine if this plant could be used for horticulture. This process has not been completed but will be extended to other species to further the study.

A review of facilities which could participate in captive breeding and artificial propagation programmes also will be undertaken within the next year.

Volunteer Programmes

Volunteer programmes have been recognized as a means to supplement the human resources of government agencies involved in biodiversity conservation. For example, in 2011, NEPA commenced the development of a volunteer programme for sea turtle monitoring, and workshops have been held, and will continue to be conducted for community members to participate in a beach watch programme. Additionally, the United Nations Volunteers (UNV) continues to support work in Jamaica through the Small Grants Programme (SGP) implemented Community Based Adaptation (CBA) Programme.

FORESTS AND WATERSHEDS



Jamaica's tropical climate and topography create conditions for moist forests to thrive. The two main mountain ranges, the John Crow Mountains (reaching a maximum height of 1,000 m), and the Blue Mountains (reaching 2,290 m) are largely covered with forest. Currently, only the most remote and inaccessible forests are considered original and undisturbed. Four broad groups of forest exist in Jamaica: limestone forests, predominantly shale forests, lowland dry forests, and alluvial and wetland forests of the coastal plains (Johnson 1988).

Jamaica's topography makes soil protection and restoration services of great importance to the country. More than two-thirds of Jamaica's land mass is above 300 metres high therefore forest cover plays an important role in preventing soil erosion and landslide from rainfall. These forests also help to conserve surface and groundwater resources particularly in watershed areas[5]. The sustainable use of forest resources through appropriate forest management strategies is essential for the protection of watersheds, the conservation of biodiversity, and the maintenance and increase of the economic benefits that forests provide[6]. Notwithstanding, Jamaica's forests continue to experience significant demand to provide several services to meet national economic and social needs. The fundamental challenge with this reality is balancing the supply of ecological and socio-economic services used as resources in the various sectors.

The ecological services directly provided by forests include the production of oxygen, soil restoration, water conservation and filtration, the provision of habitat for animal and plant species, and coastal protection through wetland functions, among many others. As the issue of climate change gains momentum in the international and regional arenas, forests as a sequestration system for greenhouse gas emission have increasingly become a critical ecological service. Forests also provide the base for important resources such as paper, firewood and charcoal, timber production, medicinal plants as pharmaceutical resources, food, recreation and employment. Through its natural beauty and diversity, forests provide eco-tourism services such as hiking, community tours, and nature walks.

[5] Statistical Institute of Jamaica. (2009). Environment Statistics Jamaica 2007-2010. p43
[6] Forestry Department. (n.d.) Strategic Forest Management Plan 2009-2013. p3

Some Forest Ecosystems in Jamaica

Cockpit Country is the largest remaining primary forest in Jamaica, which supports the largest number of globally threatened species of any key biodiversity area in the Caribbean Islands Hotspot[7]. In the Cockpit Country, the low, flat lands are dominated by agriculture, and invasive plant species, but the mountains are covered by forest and the area is also the source of freshwater for 40% of Jamaicans[8].

Dolphin Head is a forest reserve and an important area of biodiversity with unique flora which arose from its isolation, climate, and geology (Limestone Mountain). However, the area is under threat from timber extraction and illegal agriculture[9]. There are nearly 150 animal species present, representing 61 families in 10 classes of 4 phyla. At least 50 of these animal species are endemic to Jamaica and a minimum of four (1 freshwater crab *Sesarma dolphinium*, 2 Lampyridae fireflies, 1 species of Operculate snail) are endemic to Dolphin Head[10]. There also are 328 plant species, 107 of which are endemic to Jamaica, and 20 endemic to Dolphin Head[11].

Other important ecosystems include, the **Portland Bight** area, which supports the largest intact area of mangrove forest in Jamaica according to BirdLife International[12]. The Blue and John Crow Mountains and the Rio Grande valley are important biodiversity areas which support globally threatened and critically endangered species[13].

PRESSURES ON JAMAICA'S FORESTS AND WATERSHEDS

Leading environmental concerns include deforestation, soil erosion, population pressures, mining for limestone and bauxite, large and small-scale cultivation on mountain slopes and lack of public awareness concerning conservation. Deforestation causes massive soil erosion, and water-courses becoming heavily laden with sediment, resulting in floods at lower levels. Until recently, interior forests were quite inaccessible; however, continued road construction into these areas will inevitably lead to selective cutting and increased deforestation.

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[7] NEPA (2010) Convention on Biological Diversity: Fourth National Report for Jamaica p21
[8] Ibid.
[9] Ibid.
[10] NEPA (2010) Convention on Biological Diversity: Fourth National Report for Jamaica p24
[11] Ibid.
[12] Ibid
[13] Ibid

Inadequate Enforcement in Protected Areas

Enforcement issues were amongst the main concerns of stakeholders at national consultations held throughout the period[14]. It has been reported that timber from illegal logging is continually used for yam sticks, lumber, fence posts and charcoal. Mangrove areas and the Cockpit Country in particular are being threatened by deforestation with trees being cut down for yam sticks, particularly since the price of yam has increased[15]. These unsustainable practices continue to place pressures on the fragile forest ecosystems primarily as a result of inadequate enforcement and monitoring of the protected areas.

Poor Farming Practices

Jamaica is divided into 26 Watershed Management Units (WMUs). Steep slopes usually in excess of 20 degrees characterize the land in the upper part of the WMUs, which in addition to thin or erosive soils, makes the soils on non-limestone areas susceptible to landslides and slope failures. Most of the soils in the watersheds are limestone-derived soils and the remaining areas are composed of soils derived from weathered igneous and metamorphic rocks.

Although high intensity rainfall in the upper watershed areas and soil erosion add to the problem of landslides and slope failures, it has been recognized that farming activities on the slopes are the most notable cause of land degradation. Over 170,000 farmers cultivate just fewer than 245,000 hectares of land using unsuitable farming practices and this has contributed to massive soil loss resulting in siltation of drains and rivers and destructive flooding downstream.

It has long been recognized that farming activities on the slopes are the most notable cause of degradation. Over 170,000 farmers cultivating just fewer than 245,000 hectares, and using unsuitable farming practices and this has contributed to massive soil loss through soil erosion, siltation of drains and rivers and destructive flooding downstream.

Poor Land Use Practices

It was reported in 2008 that poor agricultural practices, pollution and squatting pose the biggest threats to the country's 26 watersheds[16]. Rivers such as the Morgan and Negro Rivers in Westmoreland and St. Thomas respectively are also reported to be polluted, either from agricultural chemical run-off, or by persons deliberately using agricultural chemicals to catch fish[17]. These activities over the past 15 years have resulted in the decline of a number of species of fish which are caught in Negro river[18].

Ten of the twenty six watersheds have been deemed to be in critical condition as a result of deforestation and soil erosion from poor land use practices. The watersheds in critical condition are Hope, Swift, Rio Grande, Yallahs, Wag Water, Rio Cobre, Rio Minho, Oracabessa and Morant rivers as reported in the Fourth Report of the Convention on Biological Diversity[19].

[14] NEPA (2010) Convention on Biological Diversity: Fourth National Report for Jamaica p24
[15] Ibid
[16] Ibid
[17] Ibid
[18] Ibid
[19] Ibid

CURRENT STATE OF JAMAICA'S FORESTS AND WATERSHEDS

Forested Areas

Jamaica's land use/forest cover is divided into three national classes, namely; Forest Land Use, Mixed Land Use and Non-Forest Land Use. In 1998, an actual inventory of land use/forest cover was conducted. Since then, data of land use/forest cover have been extrapolated or forecasted using the 1998 figures based on a change assessment done for the period 1989 to 1998. Table 10 shows the figures for land use/forest cover up to 2010.

Table 10: Forest Land Use/Cover in Jamaica

National classes	1989 '000 ha	1998 '000 ha	1990 '000 ha	2000 '000 ha	2005 '000 ha	2010 '000 ha
Forest Land Use						
Bamboo	2.8	3.0	2.8	3.0	3.1	3.3
Mangrove	9.8	9.7	9.8	9.7	9.6	9.6
Closed broadleaf	88.7	88.2	88.9	88.3	88.0	87.7
Disturbed broadleaf	177.2	174.8	177.3	174.7	173.3	172.0
Short open dry	12.1	12.1	12.1	12.1	12.1	12.1
Swamp	2.4	2.2	2.4	2.2	2.0	1.9
Tall open dry	42.1	42.0	42.2	42.1	42.0	42.0
Total	**335.1**	**332.0**	**335.5**	**332.1**	**330.1**	**328.6**
Mixed Land Use						
Bamboo and fields	29.8	29.0	29.8	28.9	28.4	28.0
Bamboo and disturbed broadleaf	12.3	12.7	12.4	12.8	13.0	13.3
Bauxite and disturbed broadleaf	1.6	2.9	1.7	3.2	3.9	4.6
Fields and disturbed broadleaf	118.9	118.0	119.1	118.0	117.5	117.1
Fields/Disturbed broadleaf and pine plantation	8.9	8.2	8.9	8.2	8.2	7.3
Disturbed broadleaf and fields	166.8	166.0	167.1	166.2	165.7	165.3
Total	**338.3**	**336.8**	**339.0**	**337.3**	**336.7**	**335.6**
Non-Forest Land Use						
Non-Forest land use	407.0	411.6	408.5	413.6	416.2	418.7
Water	16.0	16.0	16.0	16.0	16.0	16.0
Total	**423.0**	**427.6**	**424.5**	**429.6**	**432.2**	**434.8**
Grand Total	**1096.4**	**1096.4**	**1099.0**	**1099.0**	**1099.0**	**1099.0**

Source: FRA 2010 - Country Report, Jamaica: Estimation and forecasting - 1.3.3, pp 8
Note: Years 1989 and 1998 are original data years (inventoried) other years 1990, 2000, 2005 and 2010 were extrapolated or forecasted

The proportion of land area covered by forest has been selected as one of the Millennium Development Goals' environmental indicators. For purposes of this indicator, "land area covered by forest" is deemed to mean land classified as Forest Land Use. Based on the data presented in 2010, **Jamaica currently has**

an estimated forested area of 328,600 hectares, or 29.9% of its total land area. This represents a 2.2% decrease in forest cover since 1989 when forests covered 30.6% of the land area.

Rate of Deforestation

An analysis of the 1989 to 1998 figures showed the annual rate of deforestation in Jamaica to be 0.1%.

It may be difficult to compare forestry statistics obtained from different sources as the definition of "forest" varies, which can result in significant variation in the area deemed to be covered by "forests." Jamaica's Forestry Department includes the following categories in its definition of forested areas: closed broadleaf forest (primary forest with broadleaf trees at least 5m tall with minimal human disturbance); disturbed broadleaf forest; (tall open dry forests) open natural woodland; open scrub or brushland; riparian forests; mangroves. Some inventories include Caribbean Pine plantations and other forest plantations and exclude bamboo, while others include bamboo and exclude plantations. The Forestry Department is engaged in addressing these discrepancies.

There has not been an update since 1998 but the Forestry Department is scheduled to conduct an update in 2011 under the European Union Climate Change Adaptation and Disaster Risk Reduction Project.

Reforestation

Photos above show watershed reforestation activities in the Rio Bueno-White River Watershed.

Data for the 2006 to 2010 period showed that a total of 1,058 hectares was set as the target for reforestation and was achieved. Between 2005 and 2009, reforested areas included Blue Mountain Forest Reserve and the Cockpit Country. These two areas reportedly carries native species such as the West Indian Cedar *(Cedrela odorata L.)*, Jamaica Mahogany *(Swietenia mahagoni (L.) Jacq.)*, Blue Mahoe *(Hibiscus elatus Sw.)*, Spanish Elm *(Cordia gerascanthus L.)*, Santa Maria *(Calophyllum calaba L.)*, and Bitter Damson *(Simarouba glauca DC)*.

Methods used for reforestation included block planting, agroforestry, and enrichment strategies. Private forest areas were supplied with over 200,000 seedlings, and using a planting density of 625 plants per hectare, is equivalent to 320 hectares of forest plantation[20]. Table 11 below shows the area of land reforested between 2006 and 2010.

[20] NEPA (2010) Convention on Biological Diversity: Fourth National Report for Jamaica p23

Table 11: Areas Reforested: 2006-2010

Type	2006	2007	2008	2009	2010
Reforestation	174 ha	253 ha	150 ha	281 ha	200 ha

Source: Jamaica Forestry Department's Annual Report 2009-2010

Forest Reserves and Protection Status

Data on the protection status in Jamaica for 2010 reveals that of the 1,099,000 hectares of forest land use/cover in Jamaica, only 13.1% is protected, primarily as forest reserves or under other legislation[21] (see Table 12). The data also shows that 3.5% of this protected forest is still being disturbed by human actions with disturbed broadleaf accounting for the majority of the disturbed areas. The 49% of unprotected forest in Jamaica experiences the majority of its disturbance in broadleaf areas, including forest and non-land use forest. The Forestry Department has reported that enforcement has been a problem during the 2005/2009 period[22].

Table 12: Forest Area by Type and Protection Status (2010)

Classes	Area (%) of Jamaica by Forest Land Class and Protection Status			
	Forest Reserve	Other Protected	Unprotected	Grand Total
Closed broadleaf	5.8	0.1	2.1	8.0
Disturbed broadleaf	1.1	0.2	14.6	15.9
Tall open dry	0.6	1.3	2.0	3.9
Short open dry	0.1	0.4	0.6	1.1
Riparian/Swamp	0.0	0.1	0.1	0.2
Mangrove	0.1	0.5	0.3	0.9
Caribbean pine plantation *	0.3	0.0	0.1	0.4
Other species plantation *	0.3	0.0	0.1	0.4
Forest total	**8.3**	**2.6**	**19.9**	**30.8**
Disturbed broadleaf forest and Non-forest land use **	0.7	0.3	14.1	15.1
Non-forest land use and disturbed broadleaf forest ***	0.8	0.4	13.9	15.1
Mixed total	**1.5**	**0.7**	**28.0**	**30.2**
Grand forest and Mixed Total	**9.8**	**3.3**	**47.9**	**61.0**

Source: FRA 2010 - Country Report, Jamaica: Forest management and ownership rights - 2.2.3, pp 11

* Caribbean pine plantation and other species plantation = Fields/disturbed broadleaf and pine plantation

** Disturbed broadleaf forest and non-forest land use = Disturbed broadleaf forest and fields

*** Non-forest land use and disturbed broadleaf forest = bamboo, bamboo and fields, bamboo and disturbed broadleaf, bauxite and disturbed broadleaf, and fields and disturbed broadleaf

[21] Forestry Department (2010)

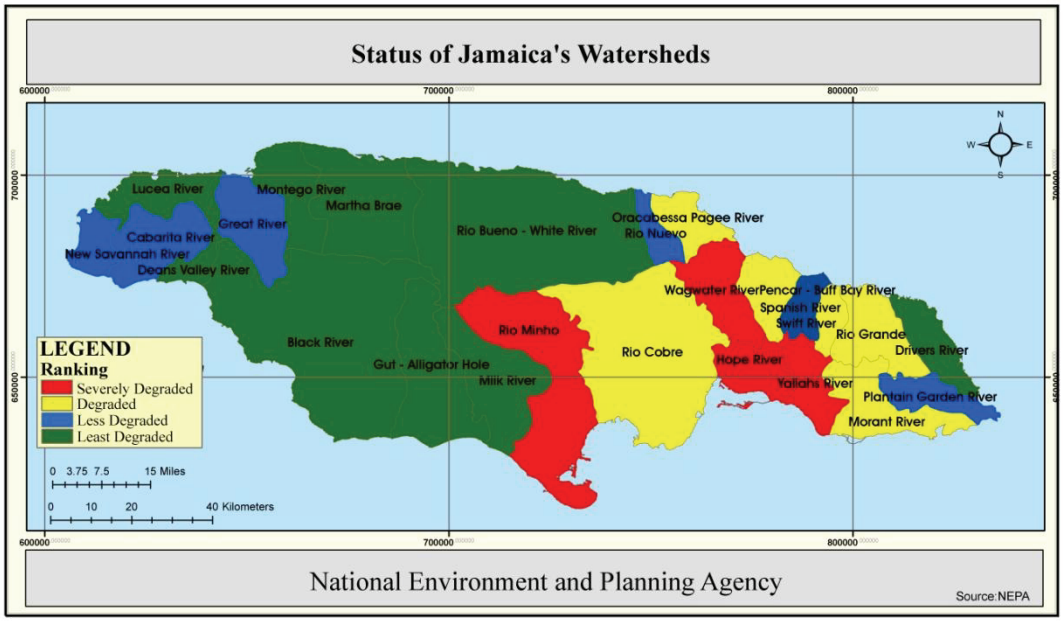
[22] NEPA (2010) Convention on Biological Diversity: Fourth National Report for Jamaica

Watershed Health

Photo shows a section of the Hope River Watershed Area – there are signs of degraded vegetation and evidence of storm damage

Results obtained from routine monitoring of watershed management units by NEPA between 2008 and 2009 (Figure 1), reveal that 10 watersheds are degraded or severely degraded. These watersheds include Rio Minho, Hope River, Yallahs River, Wagwater River, Rio Cobre, Morant River, Rio Grande, Swift River, Pencar-Buff Bay River and Wagwater River. The remaining 16 watersheds monitored are experiencing a relatively lower level of degradation and are either considered less degraded or least degraded. Watershed health may have been attributed to various land use activities continuously driven by socio-economic pressures of communities.

Figure 1: Status of Jamaica's Watersheds



Jamaica is divided into 26 Watershed Management Units (WMUs).

Demand for Forest Products

Lumber or timber is one main product of forests. Besides pulpwood for paper products, timber is used to make furniture and a range of other items in the construction industry such as flooring, roofing, frames and houses. The data shows that the general demand for lumber between 2008 and 2009 fell by 25%, meaning that there was less demand on forest resources to provide lumber for commercial purposes during this period. No data was provided for 2007 and 2010. Table 13 shows the estimated annual demand for lumber.

Table 13: Estimate Annual Demand for Lumber

Lumber	2008	2009
Coniferous Imported (m^3)	83,129	64,331
Coniferous Produced (m^3)	719	198
Total	83,848	64,529
Hardwoods Imported (m^3)	5,926	2,389
Hardwoods Produced (m^3)	370	222
Total	6,296	2,611
Grand Total	90,144	67,140

Source: STATIN, External Trade, FAO Questionnaire, stated years

JAMAICA'S RESPONSE TO MANAGING ITS FORESTS AND WATERSHEDS

Jamaica has various policies, plans and programmes in place to maintain and protect the country's forests and watersheds and Jamaica is signatory to the major international environmental agreements that address forest and watershed issues. The Forestry Department has also been implementing a range of actions geared towards sustainable forestry. These include:

- Ongoing forest inventory to generate information/data
- Four draft Local Forest Management Plans developed, using inventory information
- Improved forest governance structures, through the establishment of 7 Local Forest Management Committees established in several watersheds, using participatory involvement of stakeholders
- Increased vigilance to reduce forest loss and infringements
- Research into restoration of forest cover on mined-out bauxite lands
- Awareness building to protect forest values and benefits.

International Agreements and National Legislation

The international environmental agreements related to forests and watersheds to which Jamaica is a signatory include:

- **Convention on Biological Diversity (CBD)** – promotes conservation and sustainable use of biodiversity and the sharing of benefits arising from use of genetic resources. It is implemented through the National Biodiversity Strategy and Action Plan on Biological Diversity and is of significance to the forestry sector as Jamaica's forests are critical to the country's biodiversity.
- **UN Framework Convention on Climate Change (UNFCCC)** – promotes actions to reduce greenhouse gas emissions; forests are valuable carbon sinks that remove carbon dioxide from the atmosphere
- **UN Convention to Combat Desertification (UNCCD)** – promotes actions to reduce land degradation

Jamaica is an active member of the **United Nations Forum on Forests**, established to promote ***"… the management, conservation and sustainable development of all types of forests and to strengthen long-term political commitment to this end…"***

The **Forestry Act (1996)** provides the legal basis for the organization and functioning of the Forestry Department and addresses declaration, management and enforcement of forest reserves and forest management areas, as well as the establishment of nurseries and the provision of seedlings. The Act is currently being reviewed. A revised Act would reflect new objectives and policies as well as the new changes resulting from the Forestry Department being designated as an Executive Agency in 2008.

National Plans

The **Strategic Forest Management Plan 2009-2013** is the overarching tool guiding the Government of Jamaica's efforts to conserve Jamaica's forests for biodiversity, watershed protection and sustainable exploitation. The Strategic Forest Management Plan articulates the current state of the country's forest environment and sets targets by which the Forestry Department's performance can be measured. The Plan includes targets for reforestation but the Department has had to revise its targets downward, aiming for stabilization and 'no net loss' of forest cover. The Plan builds on the National Forest Management and Conservation Plan, approved in 2001.

The **Protected Areas System Master Plan** serves as the primary national policy document for defining the coverage and strengthening management of protected areas. Priorities for protecting and designating Forest Reserves are aligned with this Plan.

Approaches to Protect Jamaica's Forests and Watersheds

Data Collection and Research

The Forestry Department has an on-going forest inventory to generate information and data. The Department is conducting research into the restoration of forest cover on mined-out bauxite lands.

Tax Incentives and Inclusion of Private Lands in Conservation Efforts

Tax incentives are provided for landowners for maintaining existing forest and for establishing or restoring tree cover. In the period 2005 – 2009, there were three privately owned forest lands which were brought under protection.

Development of Private Forestry Sector

The Strategic Plan for Forestry states that while the first priority of forest management is to safeguard existing forest ecosystems for their watershed and biodiversity values, it is also important to address national demand for products from Jamaica's forests. There is currently focus on increasing the sustainable production of wood from plantations on private lands in an environmentally-friendly manner. The strategy is based on the assumption that this approach will reduce the pressure on natural forests and sensitive areas.

Community-Based Resource Management

Four Local Forest Management Plans have been drafted using data from the forestry inventory. The Forestry Department facilitated improved forest governance structures through the establishment of seven Local Forest Management Committees in several watersheds, using participatory involvement of stakeholders.

A community-based integrated approach to the management of watersheds has been adopted by NEPA. This has been manifested in the development of a Watershed Area Management Model which has been

tested and implemented in the Drivers' River Watershed Management Unit. Working with other public sector partners and community organizations, the institutionalization of this approach and its application to other watersheds will be a priority of the Agency.

Implementation of Watershed Management Projects and Programmes

The **Upper Ocho Rios Watershed Pilot Reforestation Project**[23] was successfully implemented over the 2008-2009 financial year in the Rio Bueno-White River Watershed.

The **Hope River Watershed Slope Stabilization Project**[24] which began in the 2007-2008 financial year was successfully finalized over the 2008-2009 financial year. Under this project, visible demonstrations of proper land management practices on degraded lands were undertaken in the watershed to enable residents to be able to replicate these practices. This project has resulted in reduced soil erosion, protection of water resources and enhancement of biodiversity habitat values. The project was implemented via a Memorandum of Understanding (MOU) between NEPA and the Rural Agricultural Development Authority (RADA). Two farming communities in Woodford namely Windsor Castle and Freetown, St. Andrew were selected.

Northern Caribbean University (NCU) and the College of Agriculture, Science and Education (CASE) with funding from the Environmental Foundation of Jamaica (EFJ), have been working to rejuvenate the Swift River Watershed through work in Fruitfulvale, Portland. This watershed ranks high among the priority watersheds for action, as identified by NEPA.

Sustainable Farming Practices

Various projects have been or are being implemented to demonstrate and encourage farming practices which will prevent soil erosion and the degradation of land used for farming. The impacts from these activities have multiplier effects downstream, such as siltation of streams and a general deterioration of water quality that negatively impacts aquatic ecosystems.

Reforestation

The Forestry Department has taken several initiatives to stem the trend of deforestation which was identified in the 1989-98 assessment. These include the creation of seven Local Forest Management Committees, the institution of a Private Tree Planting Programme and the provision of incentives to private land owners with a view to having them declare their forested lands forest reserves or forest management areas.

Prevention of Soil Erosion - Pursuing Soil Stabilization

Engineering solutions are being used at a number of sites to reduce soil erosion. These solutions include bamboo log barriers to contain sediment, check dams to reduce the velocity of runoff; and retaining walls and culvert improvement to transport excess storm water into existing gullies.

[23] 2008-2009 Upper Ocho Rios Watershed Pilot Reforestation Project Implementation Report
[24] 2008-2009 Hope River Watershed Slope Stabilization Project Report

PROTECTED AREAS

Protected areas are considered to be the cornerstone of biodiversity conservation and they help to secure the well-being of all Jamaicans. These areas can maintain key habitats, provide refuge, allow for species migration and movement, and ensure the maintenance of natural ecological processes. Protected areas range from untouched wilderness to managed resource areas. Well managed protected areas with participatory and equitable governance mechanisms yield significant benefits far beyond their boundaries, which can be translated into cumulative advantages across national economy and contribute to poverty reduction and sustainable development including achievement of the Millennium Development Goals. As the detrimental impact of climate change threatens the planet, better connected, better governed and better financed protected areas are recognized as the key to both mitigation and adaptation responses to climate change. (CBD, 2010)

Jamaica's draft Protected Areas System Master Plan defines a protected area as ***"a clearly defined geographical area of land and/ or water that is dedicated to and managed for the long term conservation and sustainable use of its ecological systems, biodiversity and/or specific natural, cultural or aesthetic resources".***

Established protected areas are managed by the Fisheries Division, Forestry Department, Jamaica National Heritage Trust and the Natural Resources Conservation Authority /National Environment and Planning Agency or through legal co-management agreements by other government entities or non-governmental organizations.

PRESSURES ON JAMAICA'S PROTECTED AREAS

Land Use Practices

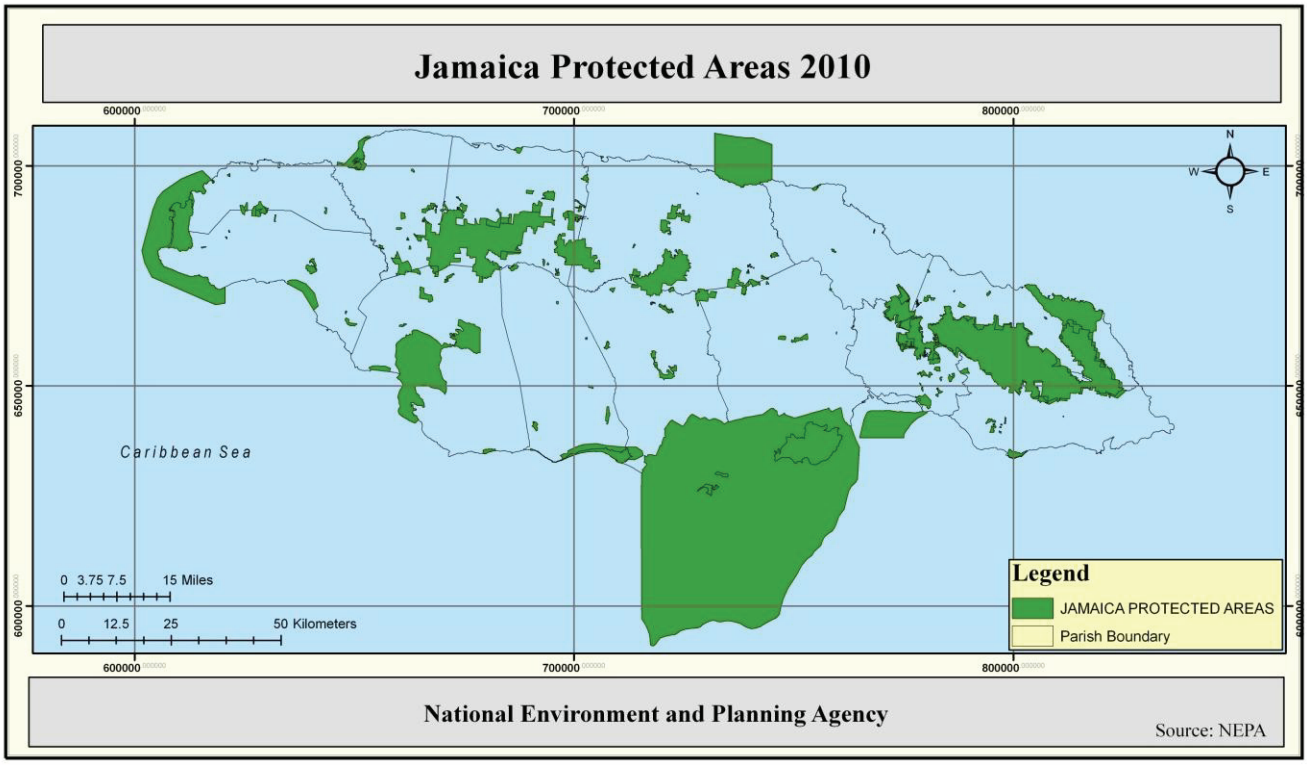
Protected areas are coming under pressure from various land uses. These areas of environmental importance are surrounded or bordered by either housing, mining or agricultural areas which are likely to put pressure on the areas through activities such as 'slash and burn' cultivation, squatting, deforestation for fuelwood, and pollution from agricultural run-off, mining activities, and improper solid waste disposal.

Photo shows clearing of land in St. Ann

CURRENT STATE OF JAMAICA'S PROTECTED AREAS

Jamaica designates different types of protected areas under a number of pieces of legislation, as shown in Table 14 below. The main legally declared protected areas are shown in the map in Figure 2 below.

Figure 2: Map Showing Legally Declared Protected Areas



The MDG indicator 7.6 measures the proportion of land and marine area that is protected. The protected areas as at 2006 and 2010 are shown in Table 14. Between 2006 and 2010, thirteen new protected areas were declared.

Terrestrial protected areas represent approximately 200,000 ha or approximately 18% of Jamaica's total land area and marine protected areas account for 180,000 ha or approximately 15% of the country's archipelagic waters (and 1.1% of Jamaica's total marine area) (NEGAR 2009). There are overlapping areas which may fall within more than one protected area category.

As a party to the Convention on Biological Diversity (CBD), Jamaica is committed to developing an ecologically-representative network of protected areas designed to conserve at least 10% of the nation's remaining naturally-occurring terrestrial, aquatic and marine flora and fauna. The consensus is that this target is inadequate to protect Jamaica's biodiversity because of the high levels of endemism. Table 14 shows lists the protected areas by type.

The Forestry Department declared one Forest Management Area (private – Tulloch Estate, St. Catherine) and the Forest Reserves (Craydon in St. James). As of 2010, there were approximately 99,732 ha in forest reserves. In 2009 and 2010, the Ministry of Agriculture and Fisheries declared ten additional sanctuaries. The first two fish sanctuaries were declared in 1979 and 1986 at Bogue Island Lagoon, Montego Bay, and Bowen Inner Harbour, St Thomas respectively.

Table 14: Protected Areas in Jamaica

Type	Enabling Legislation	Number	
		2006	2010
National Parks	NRCA Act	1	1
Marine Parks	NRCA Act	3	3
Protected Areas	NRCA Act	4	4
Protected Areas	Beach Control Act	2	2
Fish Sanctuaries	Fishing Industry Act	2	12
Forest Reserves	Forest Act	96	102
Game Reserves*	Wild Life Protection Act	13	13
Forest Management Area		…	2
Game Sanctuaries	Wild Life Protection Act	5	5
National Monuments	Jamaica National Heritage Trust Act	92	92
Protected National Heritage Sites	Jamaica National Heritage Trust Act	7	7
Environmental Protection Areas	NRCA Act	1	1
TOTAL		**226**	**244**

Source: NEPA, Forestry Department
*Note that all 99 forest reserves also are game reserves
Note that in addition, 13,223 ha have been declared as Ramsar sites.

As, Table 14 shows, areas declared under the NRCA Act form a significant part of protected land and almost all of the marine area that is protected. Table 15 shows the terrestrial and marine protected areas that have been declared under this Act. The last protected area declared was Mason River, in 2002.

Table 15: NRCA Protected Areas by Type and Date Established

Protected Areas	Designated	Area (ha) Land	Marine
National Parks			
Blue and John Crow Mountains	1993	78,200	
Marine Parks			
Montego Bay	1992	-	1,400
Negril	1998	-	18,500
Ocho Rios	1999	-	13,300
Environmental Protection Areas			
Negril	1997	25,900	16,000
Protected Areas – NRCA Act			
Palisadoes-Port Royal	1998	800	6,000
Coral Spring-Mountain Spring	1998	163	-
Portland Bight	1999	55,000	142,300
Mason River	2002	49	-
Total area (ha)		**160,112**	**197,500**

Source: NEPA

Table 16: Newly Declared Fish Sanctuaries in Jamaica

Name of Declared Fish Sanctuaries	Parish/ Region	Year Declared	Managed by	Approximate size (ha)
Three Bays Fish Sanctuary	Helshire, St. Catherine	July 28, 2009	C-CAM Foundation	1,211.002
Galleon Harbour Fish Sanctuary	Old Harbour, St Catherine	July 28, 2009	C-CAM Foundation	1,668.965
Salt Harbour Fish Sanctuary	Salt River, Clarendon	July 28, 2009	C-CAM Foundation	1,031.983
Galleon Fish Sanctuary	Crawford, St Elizabeth	July 28, 2009	The Breds Foundation	253.236
Bluefields Bay Fish Sanctuary	Belmont, Westmoreland	July 28, 2009	Bluefields Bay Fisherman's Friendly Society (BBFFS)	1,359.409
Orange Bay Fish Sanctuary	Orange Bay, Hanover	July 28, 2009	Negril Area Environmental Protection Trust (NEPT)	535.514
Montego Bay Marine Park Fish Sanctuary	Airport Point, Montego Bay, St James	July 31, 2009	Montego Bay Marine Park Trust (MBMPT)	302.796
Discovery Bay Fish Sanctuary	Discovery Bay, St Ann	July 28, 2009	Alloa Fisherman's Cooperative	168.385

Name of Declared Fish Sanctuaries	Parish/ Region	Year Declared	Managed by	Approximate size (ha)
Sandals Boscobel Fish Sanctuary	Boscobel, St Mary	Feb.23, 2010	Sandals Foundation	99.115
Oracabessa Bay Fish Sanctuary	Oracabessa Bay, St Mary	Feb.23, 2010	Oracabessa Bay Foundation/Oracabessa Bay Fisherman's Group	

Source: Ministry of Agriculture and Fisheries

As noted from Table 16 above, the fish sanctuaries are being managed through collaborative arrangements between the GOJ, non-governmental organizations (NGOs) and local community based organizations (CBOs). The GOJ through the Fisheries Division has signed MOUs with various local community based organizations or NGOs, for the management of these fish sanctuaries.

Ramsar Sites

Jamaica is a party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). To date, three sites in Jamaica have been designated Ramsar sites. These are shown in Table 17 below.

Table 17: Ramsar Sites

Site	Date Established	Area (ha)
Black River Lower Morass	1997	5,700
Palisadoes-Port Royal	2005	7,523
Portland Bight Wetlands and Cays	2006	24,542

Source: NEPA

The Ramsar Convention defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. Wetlands are one of the most productive ecosystems in the world, and as is the case in Jamaica, they are regions with high levels of biodiversity.

JAMAICA'S RESPONSE TO MANAGING ITS PROTECTED AREAS

Protected Areas System Master Plan

Jamaica completed a Protected Areas System Master Plan (PASMP) as part of its commitments to the Convention on Biological Diversity (CBD). The Master Plan, developed by a multi-sectoral Protected Areas Committee, includes an ecological gap analysis to assess where the nation's current protected areas systems fall short of protecting all biodiversity; assess the management effectiveness of existing protected areas; create a plan to build the capacity of Protected Area Managers at local and system level; and, assess the financial gap and planning for long-term financial sustainability.

A project administered by the UNDP and supported by the Global Environment Facility entitled "Strengthening the operational and financial sustainability of the National Protected Area System" has been approved and will support the implementation of the PASMP in the amount of approximately US$7.8M.

International Agreements and National Legislation

The relevant international environmental agreements to which Jamaica is a signatory include the following:

- **Convention on Biological Diversity (CBD)** – promotes conservation and sustainable use of biodiversity and the sharing of benefits arising from use of genetic resources.
- **Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)** – promotes conservation of wetlands. To date, there are no national

regulations which confer protected status on sites designated as wetlands of international importance under this Convention.

The primary national laws which primarily govern protected areas include the following:

- The **Wild Life Protection Act (1945)** and its later regulations which protect designated species of animals and regulate hunting in Jamaica.
- The **NRCA Act (1991)**, and associated regulations for marine parks and national parks
- The **Forestry Act (1996)**, which makes provisions for the declaration of forest reserves

Regulations for Protected Areas

No additional regulations were gazetted during the period (2007 - 2010). Assessments have been conducted in a number of areas including the Palisadoes-Port Royal Protected Area. Work has commenced on the preparation of recommendations/ for generic regulations for Managed Resource Protected Areas and Protected Landscapes/Seascapes as well as specific recommendations for the Palisadoes-Port Royal Protected Area.

Approaches to Manage Jamaica's Protected Areas

Co-Management Agreements

Co-management agreements provide for cooperation between parties in the conservation and management of protected areas, primarily through public education, law enforcement and research. NEPA has agreements with NGOs and one government agency for the management of protected areas as shown in Table 18.

Table 18: Parks/Protected Areas with Co-Management Agreements (as declared by the NRCA Act)

Protected Area	Existing/Previous Protected Area Managers
Montego Bay Marine Park St. James	Montego Bay Marine Park Trust (MBMPT)
Blue and John Crow Mountains National Park St. Mary, St. Andrew, Portland and St. Thomas	Jamaica Conservation and Development Trust (JCDT)
Negril Marine Park Westmoreland and Hanover	Negril Coral Reef Preservation Society (NCRPS) Negril Area Environmental Protection Trust (NEPT)
Portland Bight Protected Area Clarendon and St. Catherine	Caribbean Coastal Area Management Foundation (C-CAM)
	Urban Development Corporation (UDC) (area owned by UDC)

Source: NEPA

The Blue and John Crow Mountain National Park (BJCMNP) An Example of Co-Management

The Jamaica Conservation and Development Trust (JCDT) was given responsibility for the management of the BJCMNP under a delegation agreement with the Natural Resources Conservation Authority (NRCA) executed through a Co-management Agreement with NRCA and the Forestry Department. A committee comprised of representatives from JCDT, NEPA and the Forestry Department oversees management of the Park. This is done through the implementation of six programmes:

- Conservation
- Monitoring and Evaluation
- Enforcement and Compliance
- Education and Public Awareness
- Recreation and Training
- Governance

The number of rangers in the park has increased from 3 in 2004 to 7 in 2010, and there has been an increase in the number of patrols. Enforcement techniques used are the adoption of conciliatory measures, verbal warnings as well as through education and awareness.

Some activities of the JCDT within the park include reforestation of degraded land with native tree species, control of invasive species, sustainable livelihood projects with buffer zone communities, and operation of recreational areas using ecotourism principles. The BJCMNP was nominated as a UNESCO World Heritage Site in 2009.

Zoning of Protected Areas

Zoning is a management tool which provides a framework for the rationalization and regulation of the use of the resources of a protected area. The main purpose of zoning is therefore to promote the conservation of the resources in the area. Zoning must be consistent with the aims and vision for each protected area. The protected areas not only provide ecosystem services but also support vital social and economic activities, including but not restricted to residential, commercial, industrial, shipping, fishing, recreation and research.

Since 2008, draft zoning plans have been prepared for three protected areas namely, the Palisadoes-Port Royal Protected Area; the Coral Spring-Mountain Spring Protected Area, and the Montego Bay Marine Park. These draft zoning plans are presently being revised and it is expected that the process will be completed by the end of fiscal year2011/12.

Broad Objectives of the Zoning Plan

The broad objectives of the zoning plan are to:

- **Promote conservation of biodiversity;**
- **Allow for sustainable use for the enjoyment and benefit of present and future generations;**
- **Minimize potentially conflicting activities; and**
- **Effectively manage the resources of the area.**

It is expected that once the Zoning Plan is implemented, the status of the biodiversity of the area would be improved due to the following outcomes:

- **Reduction in the levels of damage to important habitats;**
- **Protection of spawning areas and nursery grounds;**
- **Provision of refuge for protected species, such as sea turtles;**
- **Boost in species numbers,**
- **Increase in the abundance of fish; and**
- **Increased resilience of the reefs against threats such as bleaching and water pollution.**

Economic Valuation of Ecosystems and Biodiversity

The Economics of Ecosystem and Biodiversity is an over-arching framework approach to valuation of the world's natural capital. Through funding from the United Nations Environment Programme (UNEP) in 2009, Jamaica through NEPA undertook an Economic

Valuation of Protected Areas project which looked at valuing the ecosystem services and biodiversity of three protected areas. The project examined the economic, social and communal values of the Montego Bay Marine Park, the Black River Morass (a proposed protected area) and Dolphin Head Forest Reserve. The Montego Bay Marine Park was valued at US$14.81 million; the Black River Morass at US$66.9 million; and, the Dolphin Head Forest Reserve at US$27.62 million. Over the last 12 years, seven economic valuation studies have been carried out on selected ecosystems in Jamaica. These are presented in the Table 19 below.

Table 19: Summary of Economic Valuation Studies and their Policy Relevance for Jamaica Undertaken over the last 12 Years (World Resources Institute)

Case Study	Study Site	Ecosystem Services	Policy Relevance	Reference
Socioeconomic assessments of fishing and tourism associated with Montego Bay Marine Park	Montego Bay	tourism and fisheries	Assess the level of social and economic dependence upon Montego Bay Marine Park (e.g. volume of reef tourism, hotel use; fisheries revenues). Results can inform policies and justify investment in management of the park.	Bruce and Gustavson (1998)
Financial analysis of reef- associated fisheries and tourism; avoided damages from shoreline protection.	Montego Bay	tourism, fisheries, shoreline protection	The high value of services associated with the park (NPV US$381M, 10% discount rate) can be used to justify greater investment in management. Many jobs and businesses in Montego Bay rely on the health of the park.	Gustavson (1998))
Value of many ecosystem services provided by Portland Bight; includes scenarios of future tourism.	Portland Bight	fisheries, forestry, tourism, carbon fixation, coastal protection, biodiversity	Study estimates US$40 to $53M/yr value from services associated with Portland Bight Protected Area. Results could justify greater investment in the reserve.	Cesar et al. (2000)
Financial analysis of reef -associated fisheries and tourism; avoided damages from shoreline protection.	Ocho Rios	fisheries, tourism, , shoreline protection, biodiversity	Estimated value of ecosystem services provided by the Ocho Rios Marine Park is US$245M/yr. The study also estimates losses to the tourism sector if ecosystem quality degrades further. Management interventions are needed to avoid financial losses in the future.	Environmental Management Unit (2001)
Current value of Jamaica's reef fishery and estimated losses from lack of management over 25 years.	Discovery Bay	fisheries	Estimates US$1.3 B in lost revenues from reef fisheries due to poor management over 25 years. Argues for implementing and enforcing strong fisheries regulations.	Sary et al. (2003)

Source: World Resources Institute 2011

Expansion of Jamaica's Protected Areas System

Jamaica's National Ecological Gap Assessment Report articulates a revised protected area network that is representative of the country's natural heritage. This network is intended to meet Jamaica's conservation goals as well as commitments to the CBD to conserve at least 10% of the nation's remaining terrestrial, aquatic and marine plants and animals that represent the richness of its natural resources and diversity.

The assessment was undertaken to fulfil two basic objectives:

1) Identify where the existing protected areas fall short in adequately protecting a representative sample of all marine, terrestrial and freshwater biodiversity in the country, that is, identifying the ecological gaps
2) Provide recommendations for bridging the identified gaps in representative protected areas and implementing conservation of these areas

The National Ecological Gap Assessment Report included recommendations that the Government of Jamaica develop an implementation plan to create the proposed protected area portfolio to fill critical ecological gaps, as well as meet CBD goals in a phased manner, starting with the highest priority areas where feasibility is high and the probability of success is equally high. To enable this, the current Protected Areas Policy, and related legislation, is expected to be revised based on clear agreements regarding ministerial and government departmental roles, responsibilities and authorities with regard to the coordination, management, monitoring and enforcement of Jamaica's Protected Areas System. Also, the additional capacity development of professionals responsible for monitoring and managing protected areas is vital.

The maps below (Figures 3, 4 and 5, sourced from the National Ecological Gap Assessment Report, 2009) illustrate the recommended conservation portfolio of protected areas, including the marine conservation portfolio and the terrestrial areas portfolio for Jamaica that meets biological conservation goals as well as the country's commitment to protect at least ten per cent of its biodiversity.

Figure 3: Map Showing the Proposed Protected Areas Portfolio

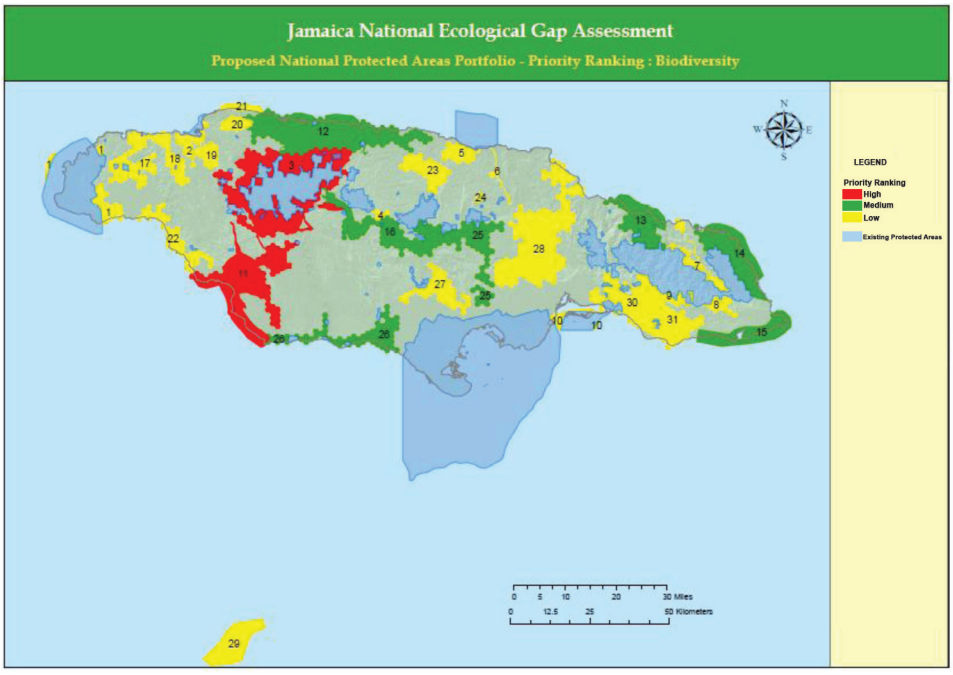


Figure 4: Map Showing the Recommended Marine Conservation Portfolio

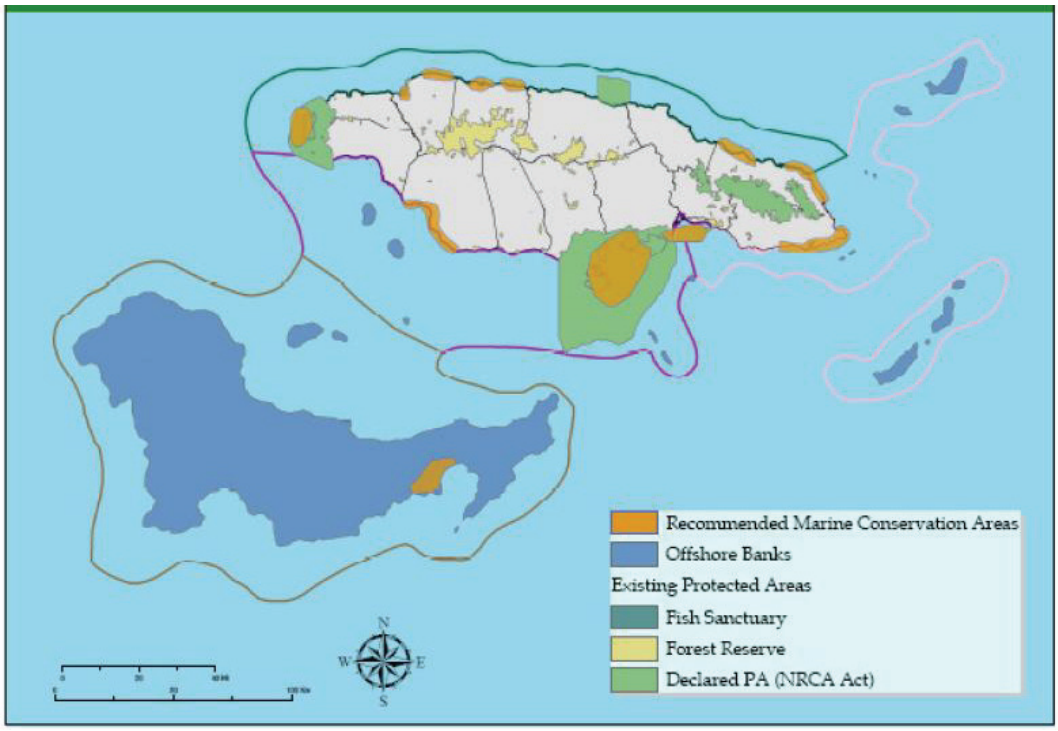
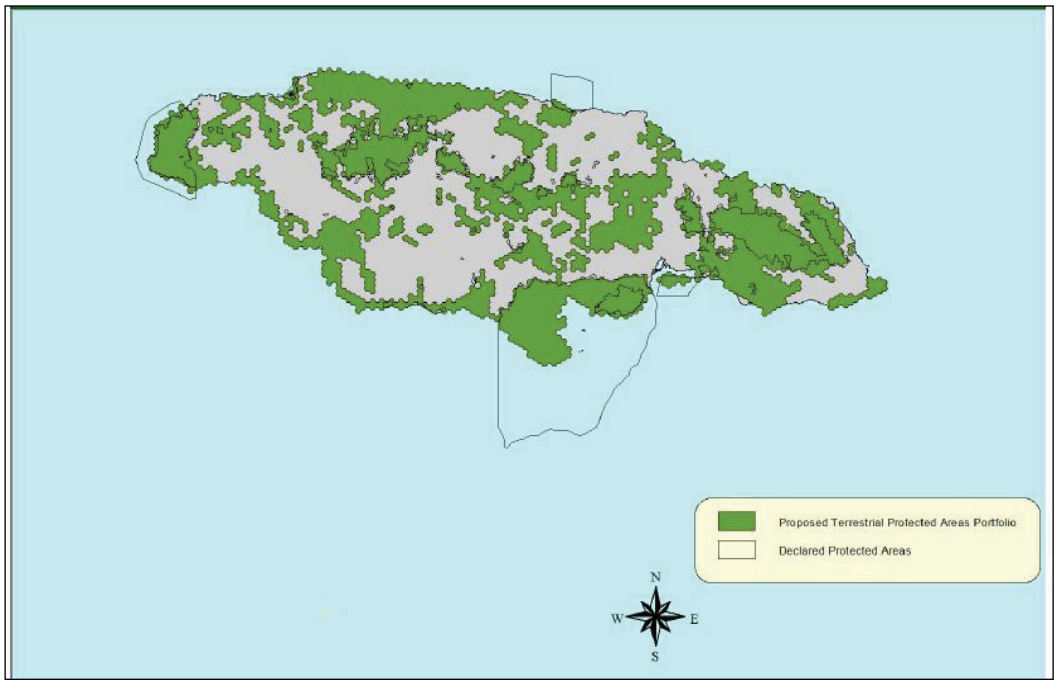


Figure 5: Map Showing the Recommended Terrestrial Areas Portfolio



Research

As recommended in the National Gap Assessment Report, the main areas under which urgent research is needed are:

- Marine, terrestrial and freshwater ecosystem connectivity in protected areas
- Status of critical resource stocks in protected areas
- The economic and monetary value of ecological services of ecosystems

Debt-for-Nature Swaps

The Environmental Foundation of Jamaica (EFJ) has been in existence since 1993, when it was formed under the Enterprise for the Americas Initiative Debt Reduction Agreement between the Governments of Jamaica and the United States of America. The EFJ funds NGOs and CBOs to implement activities designed to conserve and manage Jamaica's natural resources and environment.

The Forest Conservation Fund (FCF) was established to provide financial support for local tropical forest conservation activities as well as the protection and management of the island's forest reserves and national parks. The Fund was formed as a result of an Agreement between the Government of Jamaica, the Government of the United States and The Nature Conservancy.

The Jamaica Protected Areas Trust Limited (JPAT), a public-private initiative established in 2004, is the administrator of the Forest Conservation Fund. An Oversight Committee comprising of seven members is responsible for the management of all the income under the Debt Swap Agreement. The Trust supports the effective management of the country's protected areas by facilitating partnerships among NGOs, the Government of Jamaica, private sector entities, and other stakeholders and by monitoring the administration and distribution of conservation funds.

MARINE AND COASTAL RESOURCES

Jamaica's varied and irregular coastline is 1,022 km long and is characterized by a variety of ecosystems which include harbours, bays, beaches, rocky shores, estuaries, mangrove swamps, cays, and coral reefs. The cays and islands around mainland Jamaica are mainly off the south coast. All these ecosystems form an important part of the country's biodiversity. The benefits of these ecosystems are such that some 90% of the island's GDP is generated in coastal areas. Also, about 60% of the population resides within 2 km of the coast. An archipelago, Jamaica has stewardship over a marine space 24 times its land area of 10,981 km^2, with an exclusive economic zone (EEZ) of approximately 235,000 km^2 [25].

Jamaica's coastal and marine areas are at risk of degradation because of pressures including over-fishing, unplanned coastal development, pollution, tourism, species invasion, and climate change.

Coral Reefs

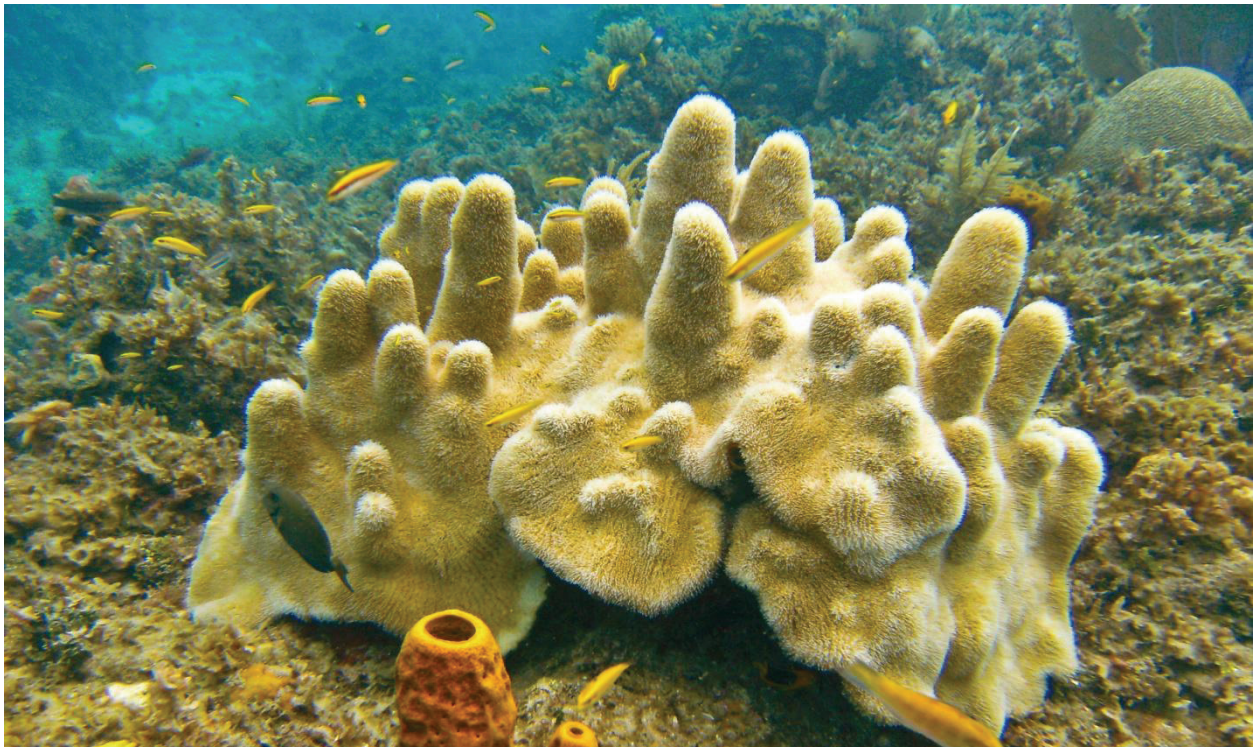
Jamaica's reefs are some of the most diverse in the Atlantic and also among the best studied in the world, with data available since the 1950s. The island has 1240 km^2 of coral reef area, with about 64 hard coral species, 43 soft coral species and 8 black coral species. Fringing, patch and barrier reefs surround just over 50% of Jamaica's shoreline within 50 m from shore. Its fringing reefs are broadly distributed along a narrow 1–2 km shelf on the northern coastline and also, although to a lesser degree, on the broader 20 km wide southern shelf. Additionally, reefs and corals can be found on its two largest offshore banks, Pedro Cays, 80 km to the south, and the Morant Cays, 50 km to the southwest. Coral reefs are critical ecosystems, which provide coastal protection and shelter, and food for many different species of fish and other organisms.

Tourism, fisheries, and shoreline protection are just three of the many culturally and economically important services provided by reef ecosystems in Jamaica. Reef related fisheries for example continue to provide valuable jobs and revenue for the country. From 2001 to 2005, gross revenue from the sale of reef-related fish averaged US$33.1 million per year, including an estimated US$24.2 million per year

[25] NEPA 2003. Jamaica's National Programme of Action (NPA) For the Protection of the Coastal and Marine Environment From Land Based Sources and Land Based Activities

from domestic sales and an estimated US$8.9 million per year from exports. The value of the subsistence catch (consumed domestically and not sold on the market) is estimated at US$1.2 million per year. Combined, Jamaica's reef-related fisheries were worth an estimated US$34.3 million per year from 2001 to 2005, a value equivalent to 0.3% of Jamaica's annual GDP.

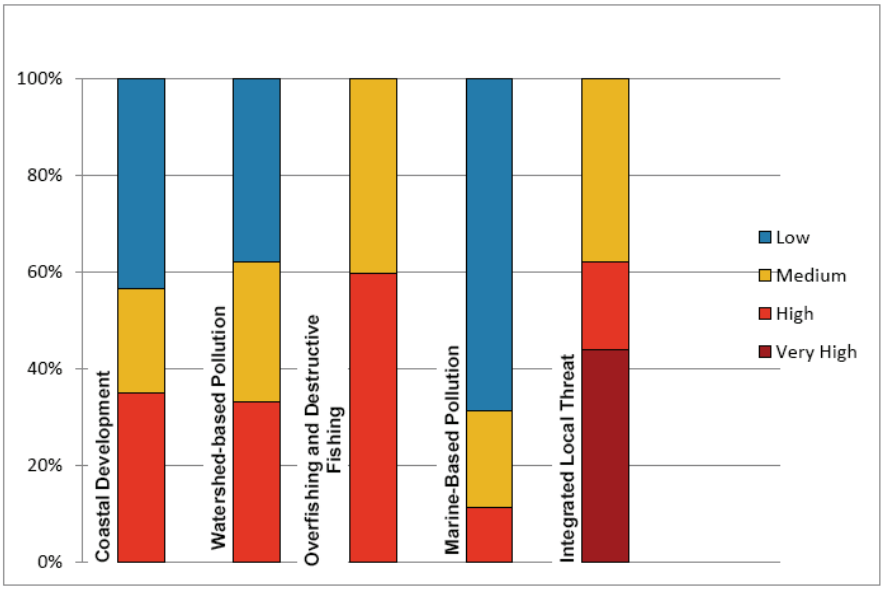
PRESSURES ON JAMAICA'S CORAL REEFS



Pressures on Jamaica's coral reef ecosystems come from human-based activities as well as natural disturbances. According to "Reefs at Risk Revisited" (Burke et al 2011)[26], a report released by World Resources Institute (WRI) in 2010, all of Jamaica's coral reefs are currently under threat, with more than 60% in the high to very high categories. Jamaica's coral reefs continue to suffer from a combination of human-induced and natural stresses including over fishing, dredging, sewage discharge, increased runoff from agricultural activities, and coastal development. Jamaica's expanding population and its activities impact coral reef health in a number of ways. A 2010 Reefs at Risk assessment done by the WRI and The Nature Conservancy (TNC) Coastal Capital project[27] showed that pressure from over-fishing affects approximately two-thirds of reefs, and watershed-based sources threaten over 60%. It also showed that coastal development threatens over half of Jamaica's reefs, while marine-based sources threaten over 30%. Pressures on Jamaica's coral reefs are discussed in more detail below.

[26] Burke, L., K.Reytar, M. Spalding and A.Perry, 2011. Reefs At Risk Revisited. World Resources Institute, Washington. 130 p.
[27] Waite, R., E. Cooper, N. Zenny, and L. Burke. 2011. Coastal Capital: Jamaica. The Economic Value of Jamaica's Coral Reef-Related Fisheries. Working Paper. Washington, DC: World Resources Institute and The Nature Conservancy.

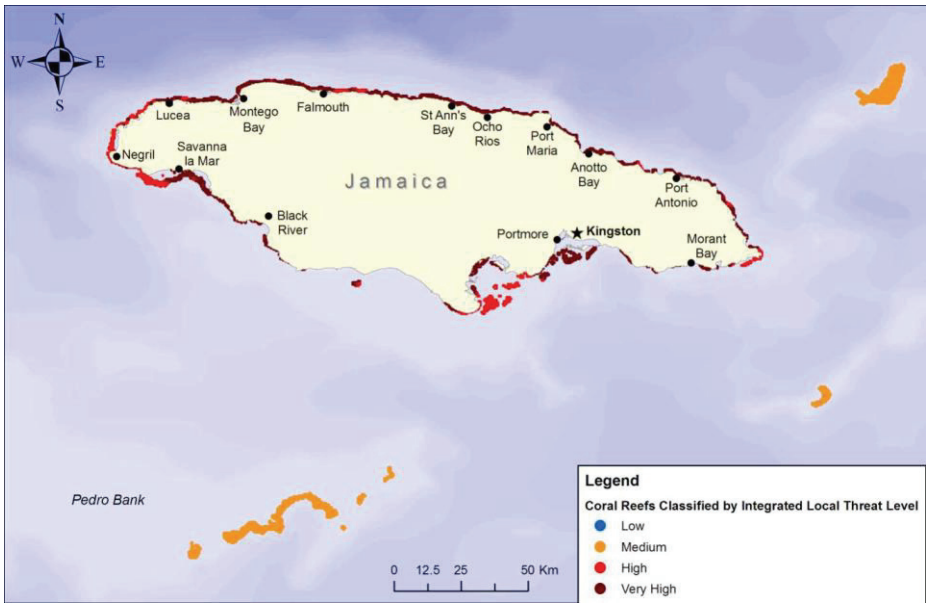
Figure 6: Local Threats to Coral Reefs in Jamaica



Source: World Resources Institute (Coastal Capital project)

Figure 6 above summarizes current threats to Jamaica's reefs. Individual local threats are categorized as low, medium, high, and very high. These threats are integrated to reflect cumulative stress on reefs. The fifth column, integrated local threats, reflects the four local threats (bars 1-4) combined. The location of these integrated threats can be illustrated in the map below (Figure 7).

Figure 7: Map Showing Location of Coral Reefs Classified by Integrated Local Threat Level



Source: Burke, L., K. Reytar, M. Spalding, and A. Perry. 2011. Reefs at Risk Revisited. WRI.

Over-fishing

Over-fishing of Jamaica's reefs has resulted in the capture not only of large predators, but also most of the herbivorous, algal-grazing fish. This situation has made the reef ecosystem highly dependent largely on a single species, the long-spined sea urchin (*Diadema antillarum*), to keep algal levels down. Consequently, there has been a shift to algal-dominant reefs.

Land-based Pollution

Poor water quality from land-based sources of pollution leads to the degradation of coral reefs. Sediment from land-clearing and high levels of nutrients from agricultural areas and sewage outflows is often carried in the runoff. Increased nutrients lead to poor water quality and as well as eutrophication, which enhances algal growth on reefs. Sedimentation can also lead to smothering of corals and also interfere with their ability to feed and reproduce. Pesticides, which are known to affect coral reproduction and growth, as well as petroleum products, are also often transported and they pollute the marine environment, threatening coral reef health.

Marine-based Activities

The coastal and marine environments are threatened by dumping of garbage and human waste from ships and the discharge of wastewater from tankers, yachts and cruise ships as well as oil spills. Ships' bilge and ballast water are a mix of oil, nutrients, alien species and other pollutants. Waste generated from ships has therefore increased as the volume of cruise and cargo ships in the Caribbean has increased. Although, under Marpol[28], large ships are prohibited from discharging untreated sewage within 7 km of land, other vessels are less likely to comply. Human activities that take place in the marine environment, such as diving and snorkelling and ship groundings are also a danger to reefs.

Hurricanes/Storms

Hurricanes and tropical storms have immediate and significant impacts on coral reefs and are perhaps the most obvious and frequent natural disturbances affecting reef communities. Both the structure and function of reef ecosystems are affected by the large and powerful waves that often accompany hurricanes and tropical storms. In Jamaica, a series of hurricanes, from Hurricane Allen in 1980 to Hurricane Dean in 2007, have devastated coral reefs. Though a single storm will not usually kill an entire colony, recovery is slow and slow-growing corals may be overgrown by algae, especially where there are increased nutrients.

Diseases of Marine Organisms

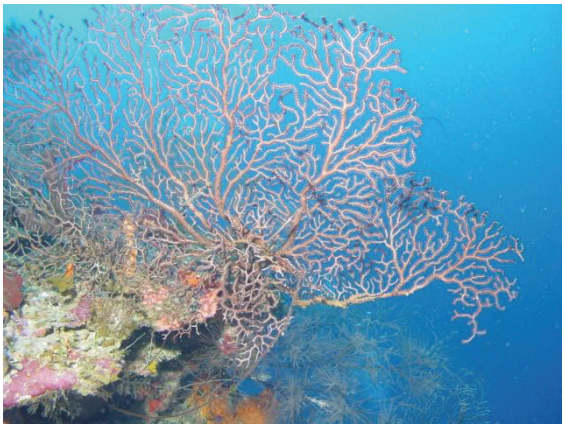
Other natural disturbances include disease of corals and other critical organisms. An important event which impacted Jamaica's reefs was a massive die-out of sea urchins (*Diadema antillarum*), the main grazers which prevent algae overgrowth of reefs. In 1983 more than 97% of the urchins died, thus allowing the uncontrolled growth of algae on the reefs.

[28] MARPOL Convention - International Convention for the Prevention of Pollution from Ships

Climate Change

As global warming trends impact on shallow tropical and subtropical seas, we may expect an increase in the frequency, severity and scale of coral reef bleaching. Corals have certain ranges of tolerance to water temperature and extended periods of increased sea surface temperature can result in coral bleaching. Mass coral bleaching took place in Jamaica during 1987, 1989, 1990 and 1998 and again in 2005 due to elevated sea surface temperatures around Jamaica, with considerable mortality. In 2010, it was predicted that higher than normal sea temperatures would cause mass bleaching of coral reefs with the peak of bleaching occurring between July and August.

CURRENT STATE OF JAMAICA'S CORAL REEFS



In the past three decades, there has been significant loss of the island's coral reefs. Between the 1970s and 1990s, mean coral cover at a 10-metre depth fell from 52% to 3%, while fleshy algae cover increased from 4% to 92%. Deeper reefs are in a better condition.

In 2010, mean percentage cover for hard corals ranged from a low of 1.4% in the Oracabessa Bay Fish Sanctuary, to a high of 30.6% within the Palisadoes/Port Royal Protected Area (NEPA - Reef Status and Trends 2010). In contrast, fleshy algae composition ranged from 0.6% to 81.6% with the Oracabessa Bay Fish Sanctuary site recording both the lowest coral coverage and the lowest algal coverage. Of 22 sites assessed, only Drapers and Drunkenman's Cay recorded coral cover over 20%, while eight sites had less than 10% (see Table 20).

Table 20: Mean Substrate Percentages – Hard Coral (HC) Percentage and Nutrient Indicating Algae (NIA) percentage – at select sites, 2010

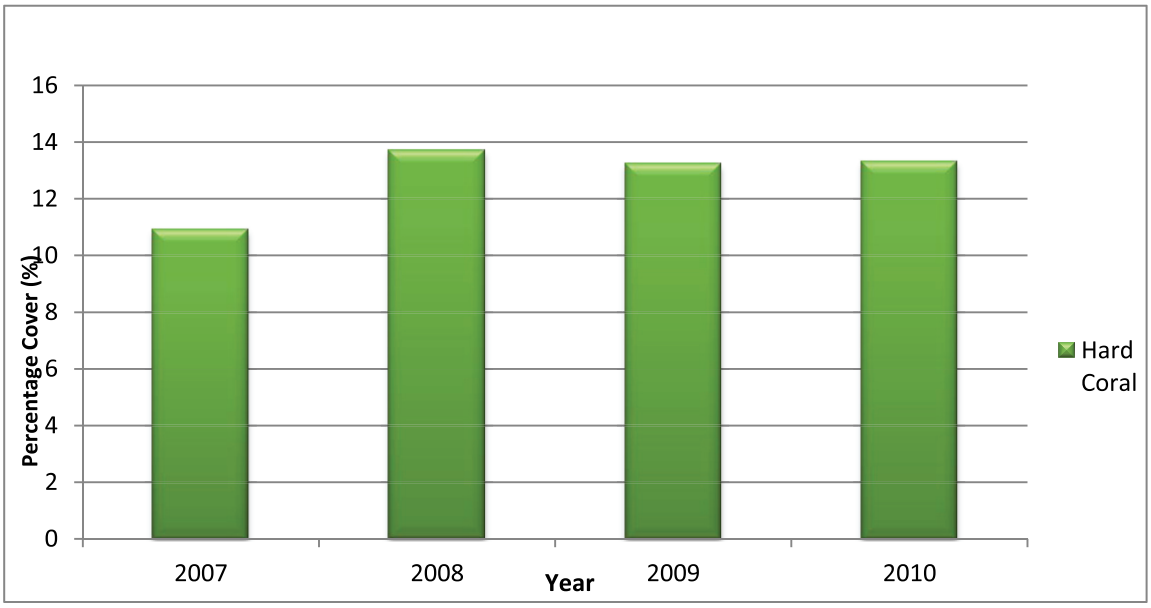
Location	Site Name	HC (%)	NIA (%)
Montego Bay Marine Park	Classroom Reef	14.64	0.57
	Runway Reef	19.02	0.58
	Sergeant Major	10.55	0.95
	Sunset Beach Mooring	17.50	42.50
Discovery Bay Fish Sanctuary	Dancing Lady	8.13	48.75
	Mooring 1	9.38	53.75
Negril Marine Park	Bloody Bay	18.44	22.81
	El Punto Negrilo	17.50	10.63

Location	Site Name	HC (%)	NIA (%)
	Ireland Pen	13.75	29.38
	Little Bay	16.88	13.13
	Arches	6.26	31.82
Oracabessa Bay Fish Sanctuary	UB40	1.37	76.39
	Rock Edge	7.36	65.69
	Goldeneye Beach Bar	7.03	81.62
Ocho Rios Marine Park	Carib Trenches	12.73	43.37
	Double Reef	2.81	52.94
	Grande Reef	12.08	45.68
Palisados Port Royal Protected Area	Drunkenman's Cay	30.63	8.13
	Lime Cay	9.06	48.75
Portland	Drapers	28.27	16.60
St. Thomas	Bowden	18.34	60.40
	Rocky Point	11.74	57.12
photo-transect monitored site			

Source: National Environment and Planning Agency - Reef Status and Trends 2010

Since 2007, the coral reef system appears stable, with no drastic change in annual average coral cover. Hard coral coverage in 2010 was 13.3% compared to 13.2% in 2009 and 13.7% the previous year (see Figure 8).

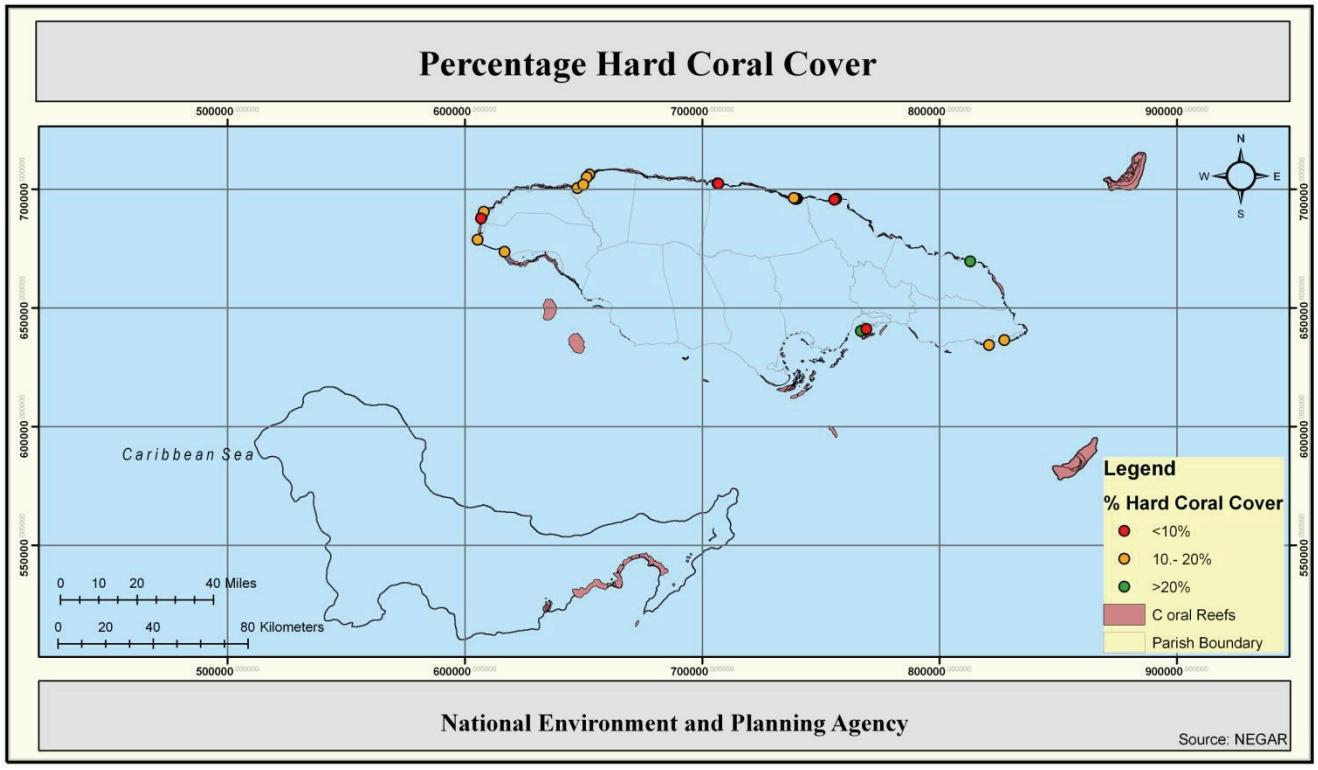
Figure 8: Variation in Average Annual Percentage Coral Cover 2007- 2010



Source: National Environment and Planning Agency - Reef Status and Trends 2010

The map below shows the percentage of hard coral cover at selected sites across the country (Figure 9).

Figure 9: Percentage of Hard Coral Cover across selected sites in Jamaica



Beaches

The beaches in Jamaica are considered to be one of the most dynamic coastal environments. About 30-49% of the coastline of Jamaica is characterized as sandy beach. Less than 1% of this is designated as public and fishing beach areas. The rest of the developed beaches are confined to hotels and other tourist attractions. In Jamaica there are:

- 87 public bathing beaches (18 of which are commercial/recreational beaches)
- 121 fishing beaches
- 61 hotel/resort beaches
- 275 beaches associated with guest houses and villas

Sandy beaches are important to society because of their economic and social values. In spite of this, the special ecological features and unique biodiversity that are characteristic of sandy beaches are often undervalued.

PRESSURES ON JAMAICA'S BEACHES

Jamaican beaches are one of the most dynamic and fast changing parts of the island's landscape. In addition to sea level rise and the impact of storms, anthropogenic activities such as coastal development and direct human uses, mainly associated with recreation, are putting the country's beaches under increasing pressure.

In recent decades, beach erosion has become a major problem and concern to Jamaica. The several

- extraordinary weather systems with intense wave activity and surge – since the turn of the century, Jamaica has faced direct threats of hurricane activity every year without exception
- Building too close to the high water mark (e.g. ignoring the set back limits of 46 m from the High Water Mark in Negril)
- Removal of seagrass beds to provide for "suitable" bathing areas at hotels. Seagrass beds generate significant quantities of sediment for beaches, and act as a buffer to waves
- Removal of naturally occurring coastal vegetation. Coastal vegetation is specially adapted to anchor itself in unconsolidated sediment and therefore binds the sand and helps to reduce erosion

- Placement of massive structures on the beach (e.g. buildings, sea walls, concrete gazebos) which are so heavy that it is possible for "liquefaction" of sand to occur, leading to increased erosion of the beach face
- Creation of impervious surfaces in coastal developments resulting in sheet flow of rain water across the beach and consequent erosion
- Decline in coral reef health, leading to a reduction in the generation of sediment supplied for building sandy beaches, and a reduction in the natural break water function the reef provides
- Climate change leading to more intense and frequent tropical storms
- Sea level rise (also caused by climate change) increasing the landward intrusion of storm waves

Tropical systems have significantly affected the island's coastline over the past decade. Other issues affecting non-commercial public bathing beaches are: inadequate waste disposal and squatting on beach lands.

CURRENT STATE OF JAMAICA'S BEACHES

NEPA carries out a routine programme of beach profile measurements at a number of benchmarks at 7 sites across the island. These sites are: Burwood Beach in Trelwany, Negril in Westmoreland and Hanover, Bluefields and Font Hill in St. Elizabeth, Jackson Bay in Clarendon, Port Royal and Palisadoes in Kingston and Long Bay in Portland.

Of the 36 bench marks monitored, 5 show evidence of chronic erosion (> 25% loss), 11 sites show evidence of mild erosion (1 – 25% loss) and 15 sites show a gain in mean beach width.

Among these locations, Negril was determined to have a significant erosion problem while Palisadoes, Bluefields, Jackson Bay and Burwood beach all show a pattern of accretion. Long Bay, Portland showed both erosion and accretion. It is postulated that this beach is dynamic and that the sediment transport process at this location was the prominent driver of the trends observed (See Figure 10).

Figure 10: Erosion Trends – Sandy Beaches Showing Erosion and Accreation

Mangroves and Seagrass Beds

Wetlands, commonly called morass, represent less than 2% of Jamaica's total surface area, and occur for the most part in the coastal zone. Mangrove forests occur along most of the south coast of Jamaica and along parts of the north coast. The most common species are the red mangrove and the black mangrove. The most extensive areas of mangrove are found in the Portland Bight area, which is now a protected area. Mangroves are found along 290 km – or 29% of the coastline.

Wetlands perform invaluable ecological functions in their natural state. These areas are among the most biologically productive ecosystems, and play a great part in ensuring coastal stability. Coastal wetlands protect the shoreline from erosion by acting as a buffer against wave action as in the case of coastal mangroves. They also reduce the effect of floods on coastal areas by acting as a sponge and slowing down floodwaters, as in the case of coastal marshlands. In the absence of wetlands, the full force of floodwaters would cause erosion of river banks, and affect coral reefs.

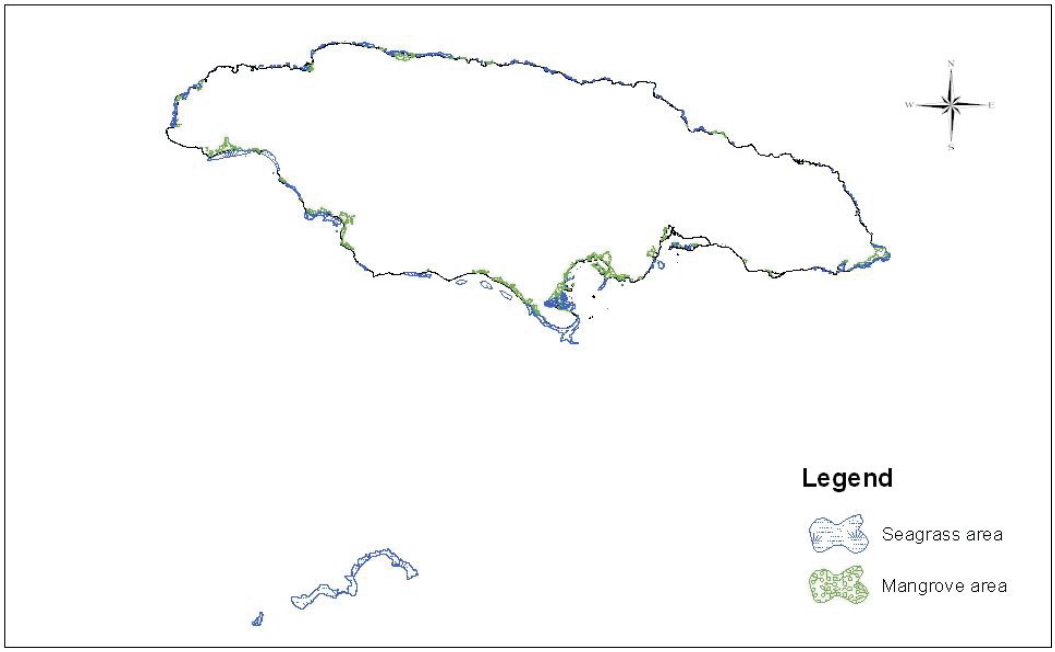
Wetlands support various species of birds, crabs, fish, shrimps, and the American crocodile. Commercially important species using the wetland as a breeding and nursery area include snapper, snook, tarpon, jack, and several species of fresh and brackish water shrimps.

Three of Jamaica's wetlands have been designated Wetlands of International Importance under the Ramsar Convention: the Black River Lower Morass, the Palisadoes–Port Royal Wetlands, and Portland Bight Wetlands and Cays. The Black River Lower Morass is the largest wetland area in Jamaica. Ninety-two (92) species of flowering plants have been found in the wetland, 23 of which are considered rare and eight of which are endemic to Jamaica. ***See Section on Protected Areas for more details.***

Seagrass beds are of direct importance in maintaining the integrity of the Jamaican coastal marine environment. Moreover, by contributing to the preservation of the coastal zone, and by helping to improve the clarity of coastal waters by acting as baffles and promoting the settling of sediment particles, seagrass meadows support a wide variety of animals which are directly or indirectly important to the traditional coastal fishery.

The map below (Figure 11) shows the distribution of seagrass and mangroves in Jamaica.

Figure 11: Distribution of Mangrove and Seagrass in Jamaica



Source: NEPA

PRESSURES ON JAMAICA'S MANGROVES AND SEAGRASS BEDS

Much of the problems affecting corals are the same ones which threaten other coastal resources such as seagrass and mangroves.

Local Human Activities

In general, mangrove areas are under severe human pressures. Awareness of the role played by wetlands in contributing to coastal resource productivity is relatively new, and formerly these areas were regarded as a source of disease, particularly malaria, and therefore a menace to public health.

Over the years, wetland destruction has been hastened by draining for crop cultivation including sugar cane. More recently, the filling of wetlands, particularly coastal wetlands, has resulted from expanding tourism development, as well as from urban growth extending outward from congested central areas.

Marine terminals and warehouses, and sites for industry, and residential subdivisions have replaced coastal wetlands, particularly in estuarine locations. The greatest destruction has occurred in the larger estuaries now used for harbour facilities such as along Hunt's Bay and the Kingston waterfront. Though land reclamation through filling is the most serious and direct threat to mangroves, other issues affecting wetlands in Jamaica include pollution from garbage, sewage, industrial waste and oil spills, timber cutting and fires. Land reclamation of adjacent areas may also affect mangroves indirectly by

altering the hydrology and changing salinity levels. Mangrove plants are also harvested for charcoal production and construction.

The functions and uses of seagrass are generally taken for granted or not well understood by the public. As a result, most recreation seekers consider these plants as a nuisance, impeding swimming, and harbouring sea urchins. Direct impacts to seagrass result from physical development in the coastal zone. The development of bathing beaches may involve the removal of seagrass and corals in order to have an expansive sandy area. Doing this however increases the vulnerability of the sea floor to erosion by wave action.

Seagrass like coral reefs are also negatively impacted by the indirect effects of land based human activities. Among the specific problems affecting seagrass and corals are increased suspended matter in coastal waters, dredge and fill, beach development, effluent and gully discharge, and oil pollution.

Disposal of sewage into the sea increases the nutrient content of the medium. Moderated input of sewage will stimulate growth of seagrass as well as epiphytes. However excessive nutrient input would lead to excessive growth of epiphytes as well as phytoplankton which would reduce the amount of light available to seagrass for photosynthesis.

Climate Change

Because most of Jamaica's coastal wetlands are less than one metre above sea level, a large portion could be threatened by sea level rise, as the outer boundary of wetlands erodes with the rise in sea level. A one-metre rise in sea level could cause a complete collapse of the Port Royal mangrove wetland, which has shown little capacity to migrate in the last 300 years. The Inter-governmental Panel on Climate Change (IPCC) suggests[29] that by 2080, sea level rise could convert as much as 33% of the world's coastal wetlands to open water.

CURRENT STATE OF JAMAICA'S MANGROVES AND SEAGRASS BEDS

Unfortunately, there has been no authoritative catalogue of Jamaica's mangrove and coastal wetlands. However, in 1997, the aerial extent of Jamaica's coastal wetlands was estimated to be 17,700 ha. Since 2007, 40.68 ha of mangroves have been removed or relocated for approved development. This accounts for 0.23% of Jamaica's total estimated coastal wetlands.

NEPA is currently undertaking a two-year exercise to map the wetlands of Jamaica and to formulate a ranked designation for conservation. In the first year (2010), wetlands (mangroves) in six (6) parishes along the northern coast were assessed - St. James, Hanover, St. Ann, St. Mary, Portland and Trelawny. The assessment revealed that in four (4) of the six (6) parishes on the north coast there was a decline in wetland cover. Table 21 below shows the change in area of wetlands in the six parishes assessed.

Table 21: Change in Area of Wetlands in Six Parishes on Jamaica's North Coast

Parish	TNC (2005) (ha)	Digital globe (2010) (ha)	Change (ha)
St. James	207.947	240.367	**32.42**

[29] Fourth Assessment Report of the Intergovernmental Panel on Climate Change. 2007. Pachauri, R.K. and Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. pp 104

Parish	TNC (2005) (ha)	Digital globe (2010) (ha)	Change (ha)
St. Ann	139.53	85.98	**53.55**
Portland	81.848	71.845	**10.003**
Trelawny	1098.29	937.975	**160.315**
Hanover	397.673	749.40	**351.727**
St. Mary	73.511	11.581	**61.93**
Note: Red indicates a reduction in wetland cover			

Source: NEPA Reef Status and Trends 2010

Though small scale assessments have been done, there is presently no complete record of Jamaica's seagrass in terms of abundance, distribution and health. Of note, however, during the period 2007 to 2010, 121,326.34 m^2 of seagrass were removed or relocated for approved coastal development.

Coastal Water Quality

Over the past 10-20 years, marine pollution has become of great importance especially in the Caribbean. Coastal and marine water quality is of great importance to tourism-dependent countries such as Jamaica. Deterioration in coastal water quality has not only made beaches unsuitable for swimming, but has also damaged ecological systems such as coral reefs, mangroves and seagrass communities. Water quality is defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. It is a measure of the condition of the water body relative to the requirements of the plants and animals that live there as well as to any human purpose.

PRESSURES ON COASTAL WATER QUALITY

Jamaica's coastal waters receive pollution from a number of sources, including wastewater treatment facilities, industrial facilities, power plants, construction works (urban expansion, harbour works), habitat modification (dredging, filling and clearing of mangroves), urban run-off, agricultural run-off, construction run-off, landfills and hazardous waste sites. Poorly or untreated sewage is by far the most serious source of pollution affecting many areas on the coast including Kingston Harbour. Note that much of the pollution that reaches the coast and marine environment is conveyed via rivers and streams which are oftentimes polluted by elements such as untreated sewage, fertilizers and sediment.

Much of the pollution that reaches the coast and marine environment is conveyed via rivers and streams which are oftentimes polluted by elements such as untreated sewage, fertilizers and sediment.

CURRENT STATE OF JAMAICA'S COASTAL WATERS

The number of sites monitored by NEPA has increased significantly over the last 2 years (2009-2010). Over 200 coastal water quality stations have been established and are presently monitored by NEPA. The readings at these sites are compared with national standards to determine the quality of the water in that area.

Water quality is best assessed by grouping a number of physical and chemical properties with biological indicators. The main water quality indicators used to assess coastal water quality in Jamaica are:

- Phosphorus – an essential nutrient - excess phosphorus in water results in eutrophication or the excess growth of algae
- Nitrates – excess nitrates generally result in excess growth of plant material
- Dissolved Oxygen/Biochemical Oxygen Demand (BOD) – defined as the amount of oxygen required by aerobic micro-organisms to decompose organic matter in a body of water and is therefore proportional to the amount of organic matter in the water
- Faecal Coliform – largely harmless bacteria; however, when present in water, they indicate the presence of faecal matter and possible pathogens in the water
- Total Dissolved Solids – indicate the amount of sedimentation coming from land- and shore-based activities

While there are a larger number of parameters that give valuable information regarding the health of Jamaica's surface water, the following parameters were chosen because they indicate bacteriological and biochemical as well as chemical characteristics needed to make accurate determination of quality. Ambient standards for all other parameters have been established by NRCA's Inter-agency Standards Committee.

An assessment of marine water quality indicators across the island indicates that most of the coastal area is under threat and are not fully meeting all the established standards for various parameters (see Table 22). Values are highest in areas near coastal townships and within the plume of water ways, gullies and rivers. Notwithstanding, Table 22 shows that over the period 2007-2010 there has been some improvement over the 2003 to 2006 period with respect to coastal water quality. For example, of the 52 sites sampled for Nitrates, there was an improvement[30] in nitrate levels by 72% of those sites over the 2003 – 2006 period. On the other hand, only 42% of the 54 sites sampled for faecal coliform showed improvements in the 2007 – 2010 period when compared to the 2003 – 2006 period.

Table 22: Number of Sites (Marine Sites) Showing Deteriorating Water Quality for 2007 – 2010 Compared with 2003-2006 and the Number of Sites Meeting the Standards in 2010

Parameter	No. of sites	No. of Sites meeting standards (2010)	Standard	No. of sites showing deterioration	%. of sites showing deterioration
Nitrate	52	31	0.0443 - 0.359 mg/l	33	63%

[30] Improvement is defined in this context to mean either that the quality of water at the sites tested remained the same or improved.

Parameter	No. of sites	No. of Sites meeting standards (2010)	Standard	No. of sites showing deterioration	%. of sites showing deterioration
Phosphate	49	28	0.001 - 0.055 mg/l	24	46%
Biochemical Oxygen Demand (BOD)	54	43	0.57-1.16 mg/l	21	38%
Faecal Coliform	50	35	<2-13 MPN/100mL	22	44%

Source: NEPA

Phosphates

An assessment of the profile for phosphates in marine waters across the island indicates that most of the coastal area is under threat. When the average values are compared to the marine standards for this parameter a clear pattern emerged for data collected since 1990. With few exceptions, phosphate values are highest in areas near coastal townships and within the plume of water ways, gullies and rivers.

In Negril, there are two main rivers (North and South Negril River) emptying into the coastal area. The South Negril River receives effluent from the National Water Commission's (NWC) sewage treatment ponds, and often shows high levels of phosphates.

A similar scenario is evident around the Dutch Canal (Westmoreland) which receives cane wash effluent from the Frome Sugar Factory and agricultural runoff from nearby sugarcane lands. Most of the phosphate pollution to the Lucea Harbour is from domestic sources and a small amount can be attributed to small farming in the hinterland.

The data also shows that the Great and Montego Rivers in St. James as well as the Martha Brae in Trelawny are delivering large quantities of phosphate into the marine environment.

Additionally, the level of phosphate pollution around the town of Falmouth in Trelawny is a cause for concern. The absence of sewage treatment solutions and the fact that effluent from the activities at the municipal market flows directly into the sea area has contributed to the high nutrient levels depicted in this area.

The Ocho Rios (St. Ann) area is seeing increased levels of phosphates due in part to the inflow of fresh water in the coastal environment, and also from poor domestic sanitation practices. The low flushing of the Bay area has exacerbated the problem. The trend is constant across the northern coastal area, which has seen extensive development over the last decade.

Nitrates

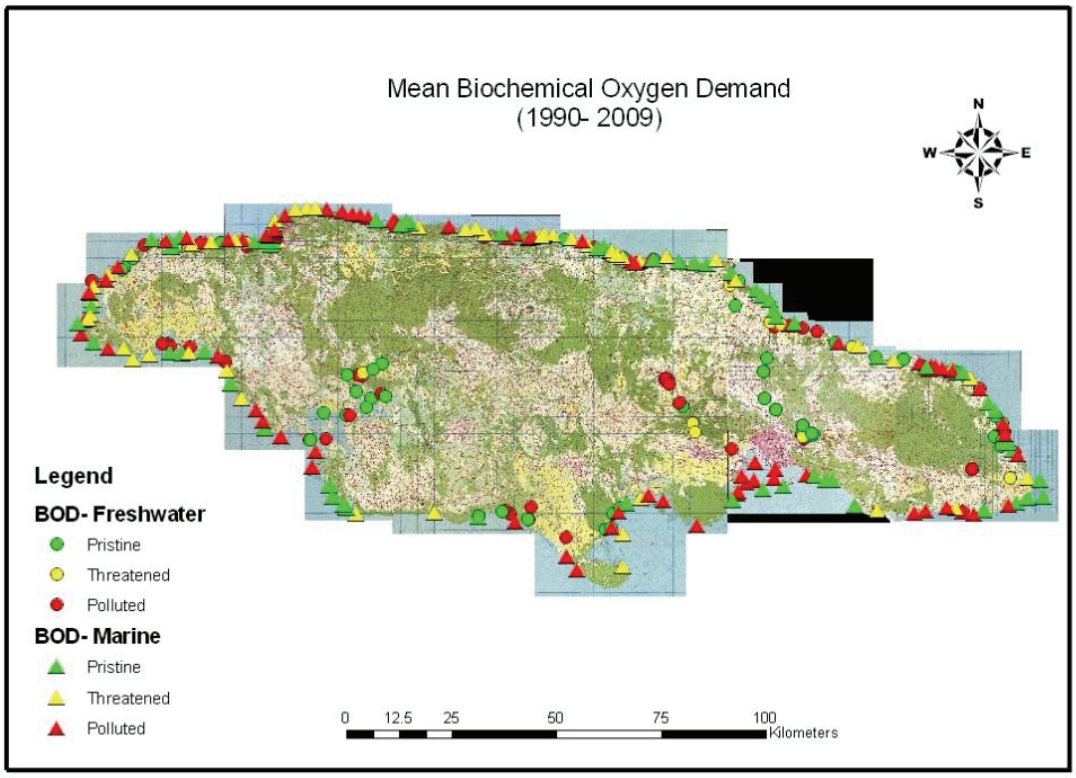
Similar to phosphates, the introduction of nitrates from anthropogenic sources in the marine environment disturbs the nutrient balance in aquatic systems resulting in the over production of plant material. The data shows that a significant portion of Jamaica's coastal area is threatened by nitrogen pollution, and is showing signs of stress. In Ocho Rios Bay and Kingston Harbour, all the marine sites return results that trend toward the general conclusion that the coastal environment is under threat

form nitrogen pollution. Negril area, Montego Bay (and Bogue Lagoon) and the Lucea Harbour all exhibit similar results.

Dissolved Oxygen/Biochemical Oxygen Demand

Dissolved oxygen is a measure of the gaseous oxygen present in solution. Dissolved oxygen is essential for promoting aquatic life, and adequate amounts are necessary for good quality water. In most cases, a minimum level of oxygen is required to sustain life; below this level, generally taken to be 4 mg/L, organisms will experience difficulty breathing and will eventually die if the level persists or decreases. Biochemical Oxygen Demand (BOD) is a standard measure of the amount of organic matter in a system. Hence high BOD is indicative of pollution inflow from various sources, including processing facilities, sewage treatment plants, animal husbandry and abattoirs. The absence of waste treatment facilities in many residential and commercial areas compounds the problem of coastal pollution. Figure 12 below shows spatially the distribution of mean BOD across the island in both freshwater and coastal water.

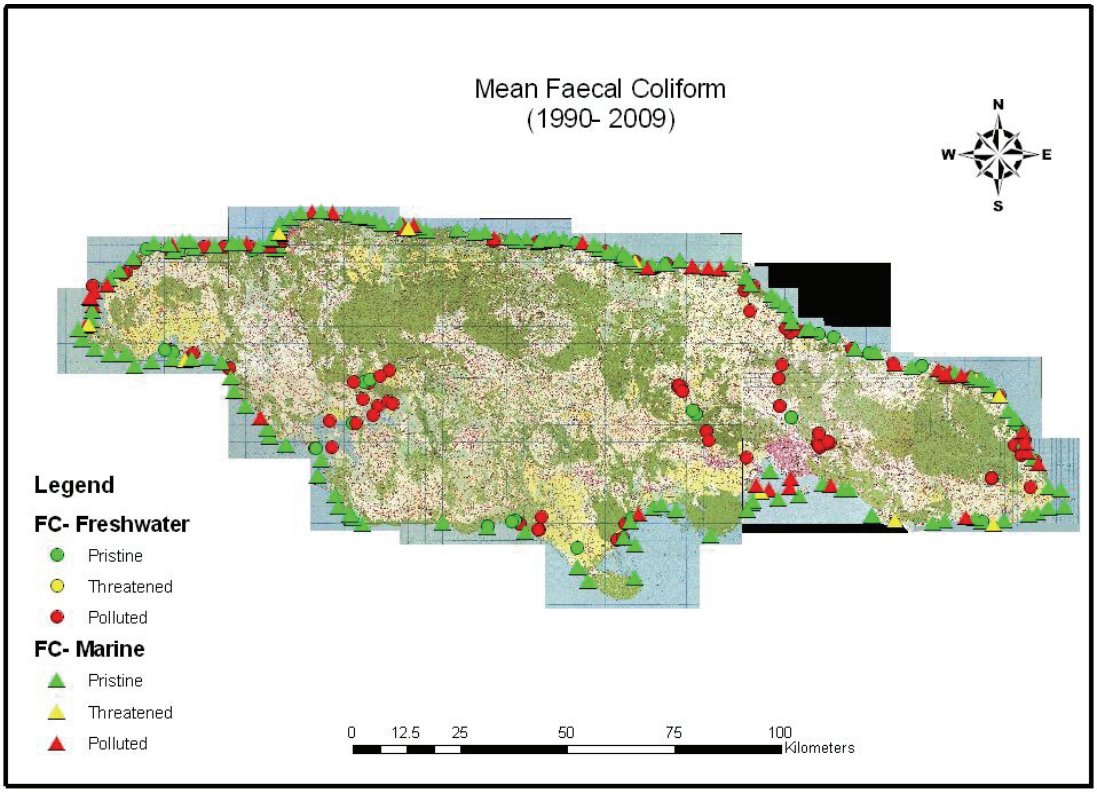
Figure 12: Map of Jamaica showing Mean BOD (1991-2009) in Freshwater and in Coastal/Marine Water



Source: NEPA

Faecal Coliform

Figure 13: Map of Jamaica showing Mean Faecal Coliform (1991-2009) in Freshwater and in Coastal/Marine Water



Source: NEPA

The potential for faecal matter to enter coastal areas is very high. The absence of centralized or formal sewage treatment systems especially in rural areas is a major contributor of this problem.

Coastal areas which receive large and consistent inflow of faecal matter include Hunts Bay and Kinston Harbour, the Black River in St. Elizabeth and the Cabarita and South Negril Rivers in Westmoreland. In support of this, the map above (Figure 13) shows that almost all the marine sites where the standard was exceeded is at or near the outflow of waterways.

Kingston Harbour
Coastal Water Quality Case Example

Kingston Harbour is a major industrial centre and commercial port. Kingston Harbour receives pollution from different sources, including waste-water treatment facilities, industrial facilities, power plants, construction works (urban expansion, harbour works), habitat modification (dredging, filling and clearing of mangroves), urban run-off, agricultural and horticultural run-off, construction run-off, and landfills. Pollution entering the Harbour is mainly in the form of liquid waste coming from gullies, ships, rivers, sewage treatment plants, industrial outfalls and solid waste from poorly managed or illegal waste

dumps, as well as gullies. Poorly or untreated sewage is by far the most serious source of pollution affecting the Harbour.

Before 2007, the two largest sewage treatment plants which had effluent leading to the Harbour were the Western Sewage Treatment Plant (with an estimated volume of 5.3mgd) and the Greenwich Sewage Treatment Plant with an estimated volume of 10.5mgd. Sewage that reached the Western Sewage Plant received only limited primary treatment before being discharged into the Harbour while the amount of sewage reaching the Greenwich Sewage Plant far exceeds the plant design capacity, and the plant is frequently inoperative. The pollutant concentrations at the outfall of the Greenwich and Western Sewage Treatment Plants render these two areas as the most significant point sources of pollution to the Harbour. In a study conducted in 1993 by SENTAR Consultants Ltd. (1998), sewage contributed to approximately 37% of Biochemical Oxygen Demand, 65% Nitrogen and 75% Phosphorus.

Today, it can be reported that some progress has been made in the area of sewage diversion from Kingston Harbour, with the implementation of the new sewage treatment facility, Soapberry that was commissioned in 2007. Currently, sewage from the Greenwich and Western Treatment Plants are redirected to the Soapberry Plant. At Soapberry, sewage is treated in a lagoon treatment system. The implementation of the plant led to the many communities that were previously served by sewage soak away pits to become connected to a sewer system that now channels waste water from the City to this new treatment facility. Treatment of sewage by the Soapberry waste water treatment plant is expected to considerably improve the water quality of Kingston Harbour over time, by reducing the high bacterial, nutrient and organic loading.

The Impact of Activities in Selected Watersheds on Coastal Water Quality

Black River Watershed

The coastal area is under threat from nutrient pollution including runoff from farming, large and small scale agriculture, aquaculture, sugar and rum processing. However, there is notable difference between the less populated region to the south west and the more populated townships of Black River.

Cabarita, Deans Valley, South Negril and New Savannah Watersheds

These four Watershed Management Units are relatively small and are located in close proximity to each other on the south western end of the island. The coastal water quality in these watersheds shows moderate effects from phosphates and faecal coliform, however, there is a definite threat from high nitrate and organic matter. This is especially evident in the area around the capital town.

The coastal area which supports the Negril tourism product is under stress from nutrient inflow; based on the values especially for nitrogen. Both nitrate and phosphate levels are considerably high when compared to the proposed marine standards. Faecal coliform is most often within the standard. However there is a cause for concern in areas to the south of the peninsular that are directly influenced by the South Negril River. This channel which drains the great morass and which polishes effluent from the Negril sewage treatment plant shows elevated levels of faecal coliform.

Lucea Watersheds

The Lucea Harbour and the coastal area in general are showing signs of stress from organic pollution. There are no municipal treatment facilities in the watershed. It should be noted that the fact that their

fresh water point inflows appears not to have high concentrations of nutrient, the absence of standard waste disposal means large volumes of unmeasured inflows enter the harbour and are unaccounted for in this process.

Great River Watershed

The Great River Watershed has a relatively narrow coastal area when compared to its overall size. The data collected from the coastal sites show that there is a high level of faecal coliform, organic matter, nutrients and solids (suspended and dissolved) entering the marine environment by way of this channel.

Montego River Watersheds

Sewage generated in the Greater Montego Bay and Rose Hall area is treated at the Bogue Sewage Treatment Plant; however, there is a considerable volume of untreated waste entering the marine environment via overland run off and also up welling in some areas.

The Bogue Lagoon which receives effluent from the municipal sewage treatment facility is showing signs of faecal stress, so too is the Bay. One major source of untreated inflow is the North Gully which connects the highlands to the coast. While this is not the only source, it is definitely one of the most significant contributors. All readings taken at this site returned high values for all parameters.

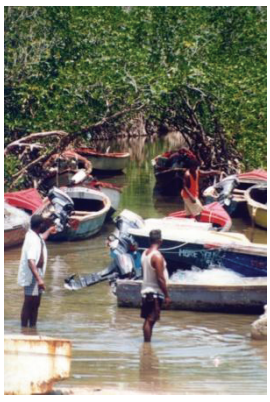
The Montego River, which enters to the western end of the city and the Pie River which lies still further west, also contribute to the nutrient and organic waste entering the Bay. The Montego River which is the larger of the two, drains an area of farming and large residential communities most of which have no formal means of waste disposal. The Pie River flows though an industrial/commercial centre and has been the site where a number of fish kills and oil spills occurred in recent years.

Fisheries

In Jamaican waters, the most important commercial species include groupers, parrotfish, goatfish, mullets, as well as the lower quality grunts, snooks, chub and some smaller wrasse and parrotfish species (CARICOM, 2006[31]). In addition, lobster, shrimp and conch are of significant importance to the country's fishing industry.

The Jamaican fishing industry is made up largely of artisanal fishermen operating from small boats powered by either outboard motors or oars. However, in the early 1980s, large companies and investors began processing and exporting conch and lobster caught on offshore banks, especially on the Pedro and Morant Banks.

PRESSURES ON JAMAICA'S FISHERIES



Jamaica's coastal waters are severely over-fished, with large species and most predators absent or very scarce. Monitoring has highlighted that the fish stock is comprised primarily of juveniles and low densities of commercially important species.

Poor Fishing Practices and Poaching

Many artisanal fishermen have few alternative sources of income, creating a high level of dependence on Jamaica's near shore fisheries. Use of fish pots or traps with small mesh sizes (trapping juvenile fish before they are of age to spawn), mechanization, and subsidies to the fishing industry, along with a rapid increase in spear-fishing and compressor diving have all exacerbated the overexploitation of Jamaica's reef fisheries. The open access of reef fisheries, typically with few regulations, makes reef fish particularly susceptible to overexploitation. Fishers selectively remove

[31] Jamaica National Marine Fisheries Atlas, 2000. CARICOM Fishery Report No. 4. 55p

larger fish/shellfish because of their greater value, and one typical sign of over fishing is a decline in the average size of target species. Because the largest individuals have the greatest reproductive output, removing them from the population reduces replenishment of the stock.

Destructive fishing practices such as dynamite and poison fishing continue to be employed. These methods not only compromise the quality of the fish product, but also destroy the fish habitat - the coral reefs.

For a long time, the Pedro Bank – located 80 km offshore – had remained a healthier fishery thanks to lower pressure from land-based pollution and fishermen alike. With Jamaica's mainland fishing grounds degraded, fishing pressure from Jamaicans is increasing on the Pedro Bank. Illegal poaching and inadequate enforcement also threaten the ecological sustainability of this offshore fishery. For example, the conch fishery – Jamaica's most strictly regulated fishery[32], is threatened by poaching done by foreign operators and underreporting of catches.

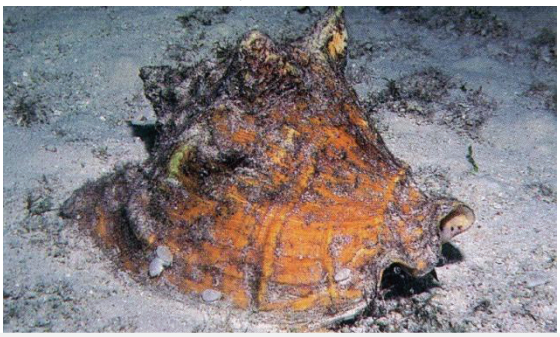


Photo of the Queen Conch *(Strombus gigus)* – the conch fishery is threatened by poaching by foreign operators and underreporting of catches.

Invasive Species

A further threat to the country's reef-related fisheries has been the recent arrival of the lionfish *(Pterois volitans)* – an invasive carnivorous species – in Jamaican waters. A native of the Indo-Pacific region, the lionfish has very few natural predators, has a voracious appetite for small fishes (thus competing with native predators such as snappers and groupers), and is capable of invading multiple coastal habitats, including reefs and mangroves. The lionfish population has greatly expanded across the Atlantic and Caribbean region since the 1990s, and this invasion has been a serious problem in Jamaica since 2009. With Jamaica's reefs already over-fished, and under other human pressures, an unchecked lionfish invasion could cause irreversible changes to the ecosystem and pose a grave threat to the country's reef-related fisheries.

Degradation of Supporting Habitats

Coral reefs, seagrass beds and mangroves provide critical habitat during different stages of the fish life cycle. Therefore, pollution and sedimentation that affect these ecosystems will also affect fisheries (see sections on Coral Reefs and Mangroves above).

CURRENT STATE OF JAMAICA'S FISHERIES

The proportion of fish stocks within safe biological limits has been selected as one of the Millennium Development Goals environmental indicators. Data shows that Jamaica's fish stock is comprised primarily of juveniles and low densities of commercially important species, leaving the main target species as small parrotfish and surgeonfish. Table 23 shows a summary of fish biomass and density of four commercially important fish species at thirteen reef sites in 2010. The data presented in Table 23

[32] Each year, regulations are enacted to declare the annual National Export Quotas for Queen Conch. The Fisheries Division and the Scientific and Management Authorities determine the Total Allowable Catch and National Export Quotas for the fishing season based on the last Queen Conch abundance survey conducted in 2007.

therefore supports the fact that Jamaica's fish resources are severely depleted and monitoring has highlighted that fish stock is comprised primarily of juveniles and low densities of commercially important species.

Table 23: Fish Biomass and Density of Four Commercially Important Fish Species at Thirteen Reef Sites in 2010

	Parrot Fish		Grunt		Snapper		Grouper	
	Biomass ($g/100m^2$)	Density (#)	Biomass ($g/100m^2$)	Density (#)	Biomass ($g/100m^2$)	Density (#)	Biomass ($g/100m^2$)	Density (#)
Total	2,122.64	77.86	473.92	13.54	323.59	5.34	180.51	7.28
Average*	163.28	5.99	36.46	1.04	24.89	0.41	13.89	0.56

* Average biomass is per fish; average density is average number of fish for a site

Source: National Environment and Planning Agency (Reef Check monitoring sites)

During the 2010 assessment of reef fishes (Reef Check monitoring sites) data was primarily collected from marine protected areas; and the sites assessed were located in and around the Oracabessa Bay Fish Sanctuary, the Ocho Rios Marine Park, the Discovery Bay Fish Sanctuary, the Montego Bay Marine Park (MBMP), Negril Marine Park, the Palisadoes Port Royal Protected Area, the Bowden Fish Sanctuary, Rocky Point, St. Thomas and Drapers, Portland.

The diversity of fish species on the reefs assessed varied from site to site. The number of species encountered and counted ranged from 27 species at Drunkenman's Cay shallow to 49 species at Ireland Pen. The highest overall average biomass was recorded at $163.3g/100m^2$ for parrotfish with an average density of approximately 6 $fish/100m^2$. The overall highest fish abundance according to location recorded was the Oracabessa Bay Fish Sanctuary where a biomass of $551.7\ g/100m^2$ was calculated for parrotfish at the Goldeneye Beach Bar site. The Bowden site located just outside the Bowden Fish Sanctuary recorded the second highest value of $277.9\ g/100m^2$ for parrotfish.

The data also showed that while countrywide fish abundance remains low, the densities for commercially important fish species and lobster are between 2 to 3.4 times more abundant inside marine parks and fish sanctuaries than in unprotected areas. The 2010 survey also showed that fish diversity and coral cover were higher inside the Montego Bay and Negril Marine Parks than in unprotected areas.

Tables 24 and 25 compare the commercial landing of the most important commercial fish (including lobster and shrimp) in Jamaican waters between 2007 and 2010*. Total marine fish production* in 2007, was 17,438 MT valued at US$ 57,018,739. This decreased to 15,825 MT in 2008, valued at US$ 50,795,753. The year 2009 saw the greatest production, with a reported 18,235 MT, valued at USD $ 59,602,939 while the 16,214 MT of fish caught in 2010 was valued at US$ 46,021,939.

* Includes Tilapia produced by aquaculture

Table 24: Jamaica Fish Production Trends (MT)

	2007	2008	2009	2010
Artisanal (Finfish)	11,048	9,475	12,544	11,390
Conch	640	400	400	440
Lobster (Industry)	150	150	150	200
Shrimp	-	-	105	284
Others	-	-	5.6	
Total Marine Fish Production	11,838	10,025	13,205	12,314
Total Tilapia Production	5,600	5,800	5,030	3,900
TOTAL Fish Production MT	**17,438**	**15,825**	**18,235**	**16,214**

Source: Fisheries Division

Table 25: Value of Domestic Landings in United States Dollars (US$)

	2007	2008	2009
Artisanal (Finfish)	36,538,739	31,335,753	41,486,939
Conch	4,160,000	2,600,000	2,600,000
Lobster	1,200,000	1,200,000	1,200,000
Shrimp	-	-	735,000
Total Marine Fish Value	41,898,739	35,135,753	46,021,939
Total Tilapia Value	15,120,000	15,660,000	13,581,000
TOTAL Production Value	**57,018,739**	**50,795,753**	**59,602,939**

Source: Fisheries Division

JAMAICA'S RESPONSE TO MANAGING ITS MARINE AND COASTAL RESOURCES

The Government of Jamaica developed and is currently implementing various laws, policies, plans and programmes to effectively manage the country's coastal and marine resources. These initiatives focus primarily on maintaining coastal habitat, proper land-use planning, protecting coral reefs, and managing fisheries and beaches. Jamaica also has signed a number of international agreements that address various aspects of coastal and marine management.

International Agreements and National Legislation

The international environmental agreements related to marine and coastal resources to which Jamaica is a signatory include the following:

- **Convention on Wetlands of International Importance (Ramsar)** – focuses on conservation of wetlands worldwide.
- **Convention on Biological Diversity (CBD)** – promotes conservation and sustainable use of biodiversity and the sharing of benefits arising from use of genetic resources. Implemented through the National Strategy and Action Plan on Biological Diversity and includes coastal and marine plants and animals.
- **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)** – aimed at ensuring that international trade in specimens of wild animals and plants does not threaten their survival. All import, export, re-export and introduction from the sea of species covered by the Convention have to be authorized through a licensing system, depending on the state of vulnerability of the species and therefore the degree of protection they need.
- **International Convention for the Prevention of Pollution from Ships (Marpol) –** addresses pollution from ships.

- **Protocol Concerning Pollution from Land-Based Sources and Activities (LBS)**[33] – a Caribbean regime which aims to reduce priority pollutants and promote co-operation in monitoring, research, and exchange of scientific and technical information on land-based pollution.

While these international environmental agreements and conventions provide an important framework for action at the national level, they do not have direct legal authority within the signatory countries and must be locally implemented through national legislation.

Legislation relating to marine and coastal resources include:

- The **Beach Control Act (1956)** – and associated regulations that address licensing, safety measures and hotel, commercial and public recreational beaches
- The **Wild Life Protection Act (1945)**
- The **Fishing Industry Act (1976)** and regulations, including the 2000 regulations for conch
- The **Maritime Areas Act (1996)**
- The **Aquaculture, Inland and Marine Products and By-products Act (1999)** – and associated regulations addressing inspection, licensing and export

The **NRCA Act Wastewater & Sludge Regulations (Proposed)** are a significant development in the Government of Jamaica's attempts to address water pollution. These Regulations provide the regime for regulating the construction, modification and operation of wastewater treatment facilities and the discharge of sewage and trade effluent. The Regulations will apply to all wastewater treatment facilities and will be implemented through the granting of Licences under the **NRCA (Permit and Licences) Regulations**. The Regulations provide the requirement for discharge fees which are payable based on the quality of the pollution load being discharged to the environment.

National Policies, Plans and Programmes

Protected Areas and Management Plans

A number of protected areas have been designated, in an attempt to manage key marine ecosystems and activities. These areas include fish sanctuaries and marine protected areas. In 2009 and 2010, the number of fish sanctuaries was expanded from 2 to 12 and a co-management framework established for the new fish sanctuaries. In December 2010, the Ministry of Agriculture and Fisheries signed Memoranda of Understanding with seven NGOs and CBOs to monitor the sanctuaries. Under the agreement, the Government committed US$265,000 to the local organizations for monitoring and patrolling. Although it is too early to assess the effectiveness of the new fish sanctuaries, studies have shown that increases in fish stocks can occur within one to three years after the establishment of effective no-take zones. ***For more details, see section on Protected Areas.***

NEPA recently adopted an **Action Plan for Corals and Reefs in Jamaica (APCAR)**. This plan builds on previous efforts and is in keeping with the International Coral Reef Initiative (ICRI) Call to Action and Framework for Action and the Tropical Americas' Agenda for Action. The Action Plan for Corals and Reefs outlines measures to better understand coral reef ecosystems through research and monitoring, and to address and reduce impacts of human activities through regulations, policies and implementation. It provides a framework for adopting an ecosystem-based adaptation approach that

[33]LBS is a protocol to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention) – a comprehensive, umbrella agreement that provides the legal framework for the protection and development of the marine environment. It is the only Caribbean region-wide environmental treaty that protects critical marine and coastal ecosystems.

encompasses both social and ecological aspects of the coastal environment. The plan also encourages active participation by citizens and sharing of responsibility to care for our reefs. This action plan identifies nine conservation strategies that will be pursued:

1. Creating a comprehensive coastal atlas which includes detailed maps of coral reef habitats
2. Conducting long-term monitoring and assessments of reef health and trends
3. Supporting strategic research to respond to the major threats to reef health
4. Incorporating the human dimension into coral reef conservation strategies
5. Creating an optimal network of Marine Protected Areas that have properly delineated use zones and No-take Reserves;
6. Reducing pollution and habitat destruction
7. Restoring damaged reefs
8. Creating an informed public for coral reef
9. Facilitating alternative livelihoods to reduce dependence on the exploitation of reef species

In order to address key fisheries-related issues, the Government of Jamaica developed a **National Fisheries Policy** in consultation with many stakeholder groups. The Policy, the first of its kind among Caribbean Community (CARICOM) member states, seeks to overhaul existing fisheries laws, moving from a system based on maximizing short-term fisheries production, to a system based on economic development through sustainable fisheries management. If the provisions of the draft policy become law, it has the potential to greatly improve fisheries management across the country. A National Fisheries Advisory Board was established in 2008 to oversee the management of this industry.

One of the objectives of the "Improving Jamaica's Agricultural Productivity (IJAP)" programme is to support sustainable fisheries through its **Sustainable Marine Fisheries Management** component. This component includes: the creation of artificial reef structures and lobster breeding sites to aid in lobster regeneration and reef rehabilitation; rehabilitation of beaches that were damaged in Hurricane Dean; and training of fisherfolk organizations and Fisheries Division staff in fisheries management practices.

The legislation and policies related to beaches, including the **draft Beach Policy**, primarily deal with issues related to access, provision of public bathing beaches, fishing beaches and hotel and resort beaches. Today, the priorities include the rehabilitation and maintenance of safe and healthy beaches, as well as the expansion of public access to beaches.

Adequate funding for implementation of marine and coastal policies – as well as the political will for effective law enforcement of regulations – will be critical if these initiatives are to improve the condition of Jamaica's marine and coastal resources.

Approaches to Management of Jamaica's Coastal and Marine Resources

Invasive Species Management

The National Environment and Planning Agency (NEPA) and the Ministry of Agriculture and Fisheries are both currently working to address the lionfish threat. NEPA's initiative includes monitoring locations of lionfish, determining what other fish species are the primary prey, developing trapping mechanisms, and implementing a public awareness and training program to teach people how to safely handle the lionfish from sea to plate. The Ministry of Agriculture and Fisheries is likewise promoting the consumption of lionfish to control its population and is developing a more thorough lionfish management plan with NGOs, the University of the West Indies, and the private sector. However, the Jamaican public still remains skeptical of the lionfish as a food source.

Rehabilitation of Fishing Beaches

The Government has developed a strategy to rehabilitate some 187 fishing beaches, from which approximately 40,000 fisherfolk and other stakeholders operate and earn their livelihood. To support this strategy, six major fishing beaches have been slated to be upgraded under the Sustainable Marine Fisheries Management component of the IJAP programme.

Eco-labelling Programmes

Four of Jamaica's beaches (and one marina) have been awarded the international "Blue Flag" designation. The Blue Flag Programme is a voluntary certification scheme for beaches and marinas that has proved to be effective in assisting and facilitating the implementation of environmental policies. The scheme has been operated since 1987 by the Foundation for Environmental Education in Europe. Blue Flags are awarded based on achievements in four areas: water quality; safety and services; environmental management; and environmental education and information. A successful Blue Flag programme is supported by national, local, and regional policies on safety, water quality, environmental education, waste management, management of nature-based recreation, siting of tourism facilities and other issues (www.unepie.org). In 2010, 8 beaches and 1 marina had Blue Flag Certification (NEPA).

The Blue Flag is a voluntary eco-label awarded to over 3650 beaches and marinas in 44 countries.

The Blue Flag works towards sustainable development of beaches and marinas through strict criteria dealing with water quality, environmental education and information, environmental management, and safety and other services.

Improved Sewage Treatment

Some progress has been made in the area of sewage management with the implementation of Soapberry, the new sewage treatment facility in 2007, designed to improve the water quality in the Kingston Harbour. Sewage from the Greenwich and Western Treatment Plants have been redirected to this treatment facility. The facility has, in general, resulted in improved water quality in the Harbour. Since 2007, there has been a decrease in the average values for BOD and phosphates at a number of locations within the Harbour; mean faecal coliform levels have decreased, but values remain above the standards for ambient marine waters. However, nitrates have increased since 2007.

Improvements to sewage treatment facilities across the island are contributing to improvements in coastal water quality.

FRESHWATER RESOURCES

Jamaica's land formations give rise to surface drainage through a large network of streams and rivers. On the Blue Mountain side of the island, surface drainage predominates and there is a dense network of rivers and streams. The remainder of the island is composed of limestone with a few scattered occurrences of igneous and metamorphic rocks. Here surface drainage is less dominant and limestone aquifers and subterranean rivers are common. Limestone aquifers provide the main source (84%) of Jamaica's freshwater resources, while the remaining 16% is provided by surface water. The average rainfall over the island is 21,526 million cubic metres per year (MCM/y).

Although the country would seem to be well endowed with freshwater resources, with 1512 cubic metres of water per person per year, the island is experiencing moderate water stress according to the Water Resources Authority. The great majority (75%) of Jamaica's freshwater is consumed by the agricultural sector so there is a need for greater water efficiency in this part of the economy.

Coverage of sewerage services in Jamaica has increased significantly in recent years, but it is less extensive than the coverage of water services. Significant investments and operational improvements are needed in this area. ***See the section on Waste Management for more information on wastewater/sewage management.***

PRESSURES ON JAMAICA'S FRESHWATER RESOURCES

Land-based Sources of Pollution

Nutrient and faecal pollution are the major issues that affect Jamaica's rivers and other surface waters. Rivers typically support several semi-rural and urban low-income communities especially in the lower reaches. Often, low percentages of these communities have environmentally sound means of domestic waste, solid waste and wastewater disposal. Additionally, there are often a number of medium and small businesses, including agricultural processing facilities, located in the upper reaches of the

watersheds. These activities contribute nutrients and other pollutants which accumulate along the length of the river. In 2010, there were three recorded incidents of uncontrolled releases from processing facilities into the Rio Cobre. Reducing the impact on river systems lies predominantly in the introduction of acceptable sanitation and agricultural practices by all residents, companies and other users of the river.

Rainfall Patterns

Irregular rainfall patterns contribute to eutrophication in rivers as algae growth overwhelms rivers in periods of drought. Periods of drought also reduce the amount of water available for recharging underground aquifers.

Salt Water Intrusion and Bauxite Waste Contamination

The largest contaminant of groundwater is sea water that has intruded into the aquifers due to over pumping, especially from the limestone aquifers along the south coast which are open to the sea. The improvement in the disposal of red mud from the bauxite/alumina process (stacking and drying/thickened mud) and the reuse of the liquid fraction has resulted in a reduction of aquifer area contaminated by 40km^2. The neutralization, draining and closure of the Mt. Rosser Red Mud Lake will further reduce the area contaminated by bauxite/alumina waste.

Rising sea levels also intensify flooding, and increase the salinity of rivers, bays, and groundwater tables. The salinity of both surface water and ground water will increase through salt water intrusion caused by rising sea levels.

CURRENT STATE OF FRESHWATER RESOURCES

Water Demand

The 'Exploitable Potential Water' is defined as the total reliable yields of all surface water sources and the groundwater safe yields of the aquifers. This totals 3,929.7 million cubic meters (MCM) per annum. In 2010, the volume of water resources allocated to industrial and domestic use amounted to 1203.0 MCM and the demand was 910.2 MCM, implying that there is an over-allocation of 292.8 MCM for 2010 (Figure 14). Note that a portion of the surface water is not exploitable as flows of 902.6 MCM/y are to be left in the rivers to meet ecological demands (Table 26). ***Therefore, the proportion of total "exploitable" water resources that represented consumption (i.e. the demand) in 2010 was 23.2%.***

Figure 14: Water Supply and Demand Status 2010

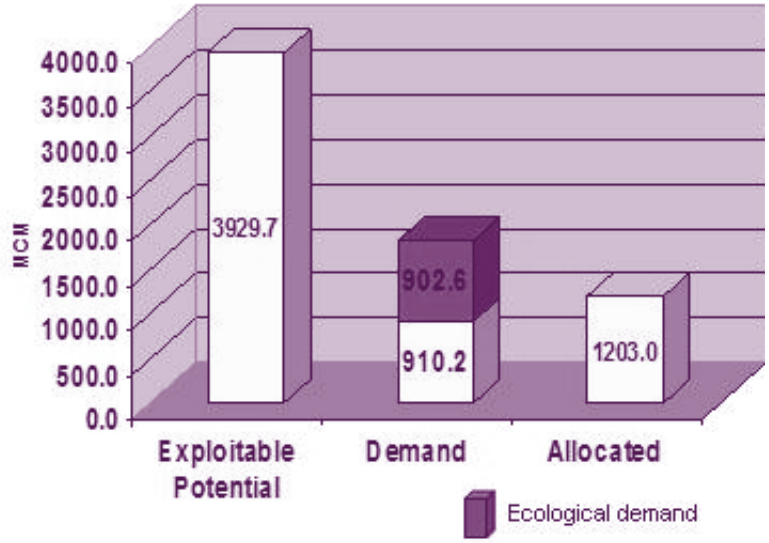


Table 26: Sectoral Demands for Water - 2010

Sector	Water demand (MCM)
Residential	236
Commercial/Export	57
Tourism	5
Agricultural	521
Industrial	91
Total	910.2
Environmental Flow	902.6
Grand Total	**1,813**

Source: Water Resources Authority

The current and future demand for water is greatest in the southern basins of the island. With the exception of the Kingston and Rio Cobre Basin, there is enough exploitable water resource in each basin to meet its local demands up to 2025. Intra-basin transfer and rainwater harvesting are possible strategies to augment the resources to meet demands in these basins.

Water Production

Table 27 shows the water production and billed consumption for the period 2007 – 2010 as reported by the National Water Commission. Non Revenue Water (NRW) represents all water that has not been accounted for and is comprised of authorized non-metered consumptions (loading bays, fire hydrants, etc.), commercial losses (e.g. water theft by illegal connections) and physical losses (e.g. leaking pipes). Note that in 2010, NRW accounted for 75% of all water production.

Table 27: Water Production and Consumption for 2007-2010

	2007	2008	2009	2010
Water Production (Million Gallons)	64,396.14	64,058.09	65,778.26	62,548.49
Billed Water Consumption (Million Gallons)	22,249.23	21,174.37	21,055.48	15,831.59
Non Revenue Water, NRW (Million Gallons)	42,146.91	42,883.72	44,722.78	46,716.90
Non Revenue Water, NRW as a % of production	65%	67%	68%	75%

Source: Water Resources Authority

Access to Water

Access to safe drinking water is critical to Jamaicans' health and well-being and this is reflected in the selection of the proportion of population using an improved drinking water source as one of the Millennium Development Goals environmental indicators. The National Water Commission (NWC) provides the majority of fresh water to households, industries and in some cases agriculture. Approximately 70% of potable water in Jamaica is provided by the NWC. However, Parish councils also provide potable water in some rural areas which also use springs, rainwater and wayside tanks. Private suppliers of water include the bauxite companies, some private estates and a few private water companies, which account for only a small portion of potable water produced. **Overall, about 85% of Jamaicans have access to safe drinking water.**

A girl fills a bucket with water from a community standpipe in the town of Duckensfield, Jamaica

Water Quality

Three sets of standards, each measuring specific parameters, are used to assess the quality and suitability of different types of Jamaica's freshwater resources shown in Table 28.

Table 28: Freshwater Monitoring Standards

Type of Water	Standard Established by	Parameters Measured
Drinking water	World Health Organization (WHO)	Nitrate, Chloride, Sodium, Sulphate, Total dissolved solids, Coliform
Irrigation water	National Irrigation Commission, based on criteria set by United States Department of Agriculture	Electrical Conductivity, Sodium Adsorption Ratio (SAR), % Sodium
Ambient waters (rivers, lakes, ponds)	NEPA: Jamaican National Ambient Water Quality Standards -Freshwater	Calcium, Chloride, Magnesium, Nitrate, Phosphate, pH, Potassium, Silica, Sodium, Sulfate, Hardness, Biochemical Oxygen Demand (BOD), Conductivity, Total Dissolved Solids (TDS)

Source: NEPA

Note that the ambient water quality standards for freshwater parameters may be quite different from that of coastal waters.

Based on these criteria, the surface and groundwater resources are presently of excellent quality throughout the country. Less than 10% of the island's water resources have been contaminated. In the areas of contamination there are drinking water use restrictions and strategies are in place to improve water quality and prevent further contamination.

During the period 2007-2010, 36% of the sites sampled showed deteriorated with respect to faecal coliform concentration when compared to the period 2003-2006. Table 29 shows the comparisons for faecal coliform and three other key parameters. Figure 15 below shows the change in water quality (as

determined by faecal coliform level) during the period 2007 – 2010 when compared with 2003-2006 at fresh water (river) sites across the island.

Figure 15: Comparison of Freshwater Faecal Coliform Averages in Jamaica between the periods 2003-2006 and 2007-2010

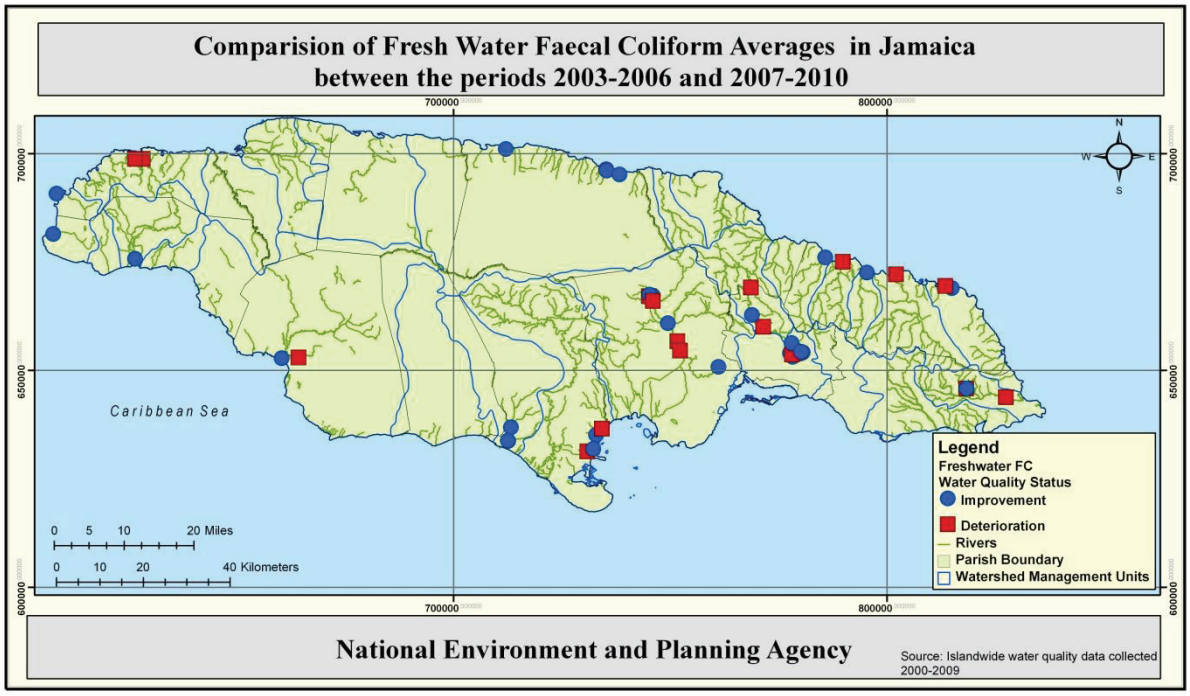


Table 29: Number of Sites (River Sites) Showing Deteriorating Water Quality for 2007 – 2010 Compared with 2003-2006 and the Number of Sites Meeting the Standards in 2010

Parameter	No. of sites	No. of Sites meeting standards (2010)	Standard	No. of sites showing deterioration *	%. of sites showing deterioration
Nitrate	52	38	0.10 – 7.5 mg/L	25	48%
Phosphate	50	36	0.01 – 0.8 mg/L	23	46%
Biochemical Oxygen Demand (BOD)	52	43	0.80 – 1.7 mg/L	18	34%
Faecal Coliform	47	...	...	17	36%

* % of sites with an increase in parameter concentrations compared with 2003-2006

Source: NEPA

JAMAICA'S RESPONSE TO MANAGING ITS FRESHWATER RESOURCES

The Government of Jamaica has a number of regulations, policies and plans that govern the freshwater sector. These initiatives address the provision of water and wastewater services as well as the monitoring and promotion of good water quality.

National Legislation and Policies

The **Water Resources Act (1995)** provides for the establishment of the Water Resources Authority whose responsibility is to regulate, control and conserve water resources. The **National Water Commission (NWC) Act (1980)** gives the NWC responsibility for public water supply systems and public sewerage and sewage treatment systems. The National Water Commission has developed various regulations under the National Water Commission Act, that are mainly concerned with the setting and collection of tariffs for water supply and sewerage services.

These pieces of legislation are supported by the **Jamaica Water Sector Policy (1999)** which articulates the Government's objectives in the provision of urban and rural water and sewerage. The policy seeks to ensure the "availability of the minimum necessary quantities of potable water and minimum standards of sanitation service to all, in a cost effective and efficient manner, with due regard to health and environmental considerations and at a price customers can afford." The revised **draft Water Sector Policy, Strategy and Action Plan (2004)** outlines the sewering of all major towns by 2020 and the rehabilitation of existing non-compliant facilities to achieve compliance with national environmental standards as key objectives.

Legislation and policies that focus on effluent and sewage include the **NRCA Permit and Licence Regulations 1996,** the soon to be promulgated **Wastewater and Sludge Regulations and the draft Jamaica National Sanitation Policy (2005)**. ***See the section on Waste Management for more information about these instruments.***

Approaches to Manage and Protect Jamaica's Freshwater Resources

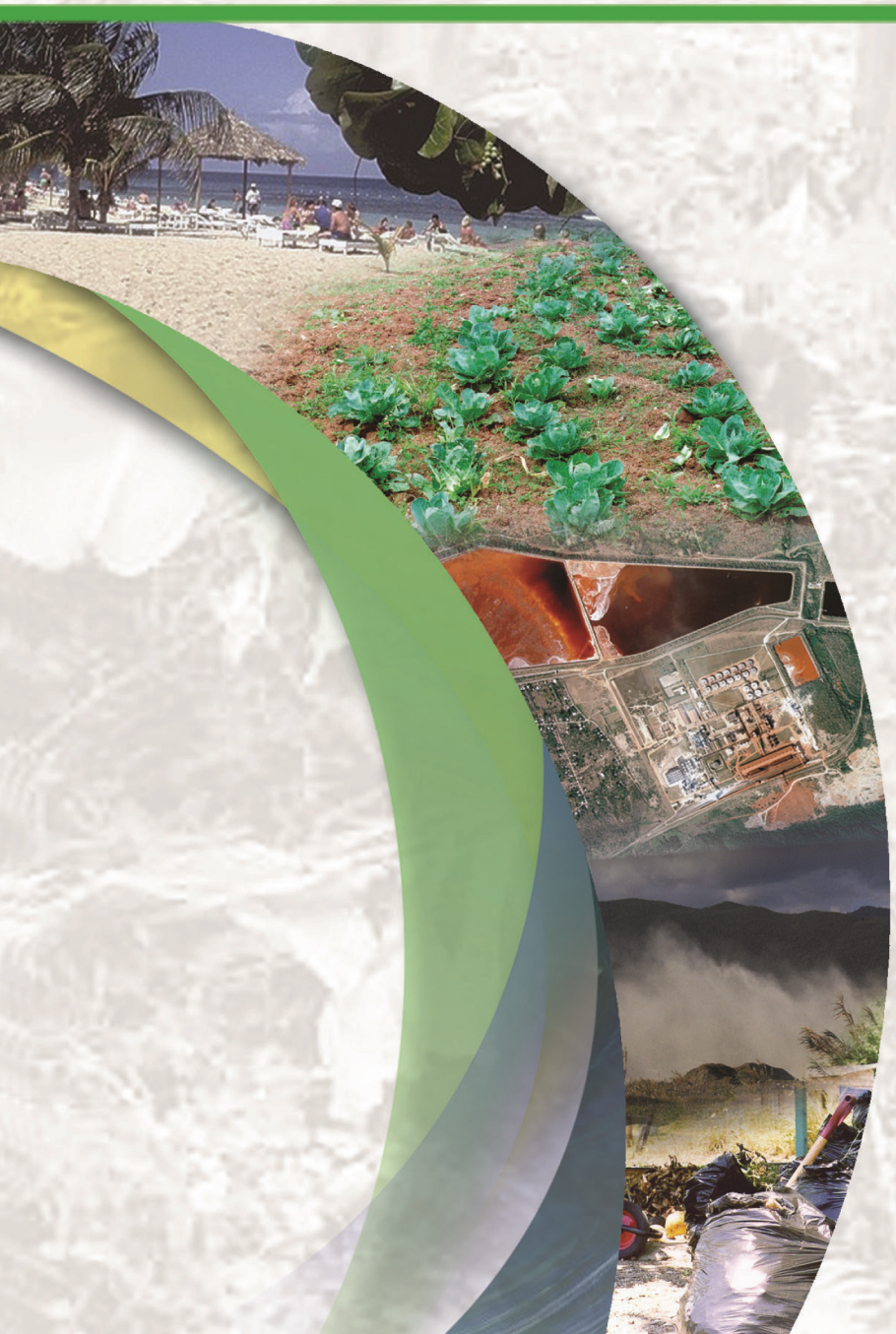
A range of approaches are being used to better manage the country's freshwater resources. Some of these included implementing programmes and projects which promote more sustainable agricultural practices, improving sewage treatment facilities and promoting improved water conservation practices among the population.

Monitoring and Enforcement of Effluent Limits

In order to ensure good water quality in the country's rivers, NEPA will continue its intensive monitoring and enforcement activities to ensure that facilities that produce effluent are regulated under the NRCA Permit and Licence Regulations.

Section 2:

Management and Sustainable use of the Natural Environment



AIR QUALITY

The state of our air – our air quality is an important factor in the quality of life in Jamaica's cities and rural areas. It affects the health of the community and directly influences the sustainability of our lifestyles and production methods. Good air quality refers to clean air, and clear air is essential to life – not just for humans, but also for wildlife, vegetation, water and soil. Poor air quality is a result of a number of factors, including emissions from various sources, both natural and man-made. Our everyday choices, such as driving cars and burning garbage, can have a significant impact on air quality.

Human activities influence the quality of the surrounding environment. The quality of the air is often impacted by increased population growth, increased demand for energy, increase in vehicle fleet as well as poor domestic and industrial practices. These activities often result in the release of harmful pollutants in the air which cause significant damage to human and environmental health.

PRESSURES ON JAMAICA'S AIR QUALITY

Ambient Air Quality

In Jamaica, the main contributors to poor outdoor air quality are emission of air pollutants from business and industry, motor vehicles, open burning of sugarcane fields and solid waste at dumpsites and in backyards. The quantities of these emissions are impacted by population growth, the level of energy use, the vehicle population, and poor domestic and industrial practices.

Types of Air Pollution

The most common air pollutants which are of concern to Jamaica and which have been noted to have environmental and human health concerns are listed in Table 30 below:

Table 30: Common Air Pollutants in Jamaica

Air Pollutant	Description
Total Suspended Particulate Matter (TSP)	These are fine particles suspended in air and are classified by their size, which include particulate matter less than ten microns (PM_{10}) and

Air Pollutant	Description
	particulate matter less than 2.5 microns ($PM_{2.5}$). PM is released from fossil fuel burning for electricity generation and industrial activity, from mining and quarrying activities, cement and lime manufacturing, road dust and open burning.
Sulphur Dioxide (SO_2)	Results from fuel combustion and is produced when fossil fuels such as coal and oil are burned during smelting or from other industrial processes.
Nitrogen Oxides (NOx)	From mobile sources and fuel combustion, mainly from cars and power plants
Volatile Organic Compounds (VOCs)	From refining, storage and use of petroleum products - they include hydrocarbons, alcohols, aldehydes and ethers. They play a role in ozone formation and are emitted by industrial processes and vehicles.
Photochemical Oxidants (ozone (O_3))	Created under certain weather conditions by VOCs and nitrogen. Ozone in the troposphere creates a photochemical smog and is toxic.
carbon Monoxide (CO)	An odorless gas emitted from vehicles without a catalytic converter, and from industrial fossil fuel burning.
Carbon Dioxide (CO_2)	A colourless, odorless, non-toxic greenhouse gas which is associated with ocean acidification. It is emitted from sources such as combustion and cement production.
Lead	Emitted from lead smelting and from vehicles burning leaded gasoline.

The major air pollutants which have continued to cause the most damage to the environment and human health in Jamaica are sulphur dioxide, nitrogen oxides and particulate matter.

Sulphur Dioxide - There are 32 facilities licensed by the Natural Resources Conservation Authority (NRCA) which are required to maintain specific percentages of sulphur content in their fuel. Once the production capacity of these facilities remains the same, it is not expected that the sulphur dioxide emissions will increase from these sectors. Although the emissions of SO_2 have been recorded as being the largest pollutant being emitted, it is however not recorded as the greatest ambient air pollutant based on ambient monitoring results from 2009.

Nitrogen Dioxide - Nitrogen dioxide is affected not only by the nitrogen content in fuel but also by the heat of combustion of the fuel. Nitrogen emissions are therefore controlled by appropriate process control and source management which have been addressed in the national regulations and are being monitored by the NEPA.

Particulate Matter - Particulate matter has shown the largest accumulation in ambient air. Fugitive particulate matter is estimated to be the cause of this, but it is extremely difficult to be captured in inventories utilized by the NEPA. Fugitive emissions most times occur from poor housekeeping on industry properties or process upsets during operation.

Industrial Sources of Air Pollution

The industrial sources of emissions are categorized in five sectors as follows:

- Alumina Industry Sector – this sector includes the four alumina refineries in the country along with their mining and port operations, as well as the bauxite drying and shipping facility.
- Cement and Concrete Sector - this sector includes the major cement refinery, a lime producing facility and the two “hot mix” asphalt plants in the country

- Electric Power Generation Sector - this sector includes one cogeneration plant and the six major power producing facilities which currently supply the country's electricity grid.
- Refined Petroleum Products and Bulk Storage Sector- this sector includes the major refinery on the island
- Other Sources - This comprises the two privately owned Sugar Factories and Distilleries, the major Brewery, the two Ethanol Processing Plants as well as some food and feed producers who operate industrial boilers

The contributions of the industrial sources of the major pollutants are shown in Table 31. It can be seen that the electric power generation sector is the main source of both sulphur dioxide and nitrogen oxides. However, emissions from the alumina industry may have been reduced due to closure of operations of three of the five alumina plants during 2009. The alumina industry is the main source of particulate matter, due to inadequate emissions control at facilities, fugitive emissions from mining, loading and equipment movement, and to the many open bauxite residue disposal areas (red mud lakes) which emit particulate matter on a daily basis.

Table 31: Contribution of Major Pollutants by Industrial Sector in 2009

Pollutant	Alumina Industry	Electric Power Generation	Cement and Concrete	Refined Petroleum Products and Bulk Storage	Other Sources
Sulphur Dioxide (SO_2)	46%	47%	1%	4%	2%
Nitrogen Oxides (NO_x)	16%	75%	5%	3%	1%
Particulate Matter	53%	23%	15%	0%	9%

Source: NEPA

Greenhouse Gases

Greenhouse gases (GHGs) are a special category of air pollutants which absorb infrared radiation and trap heat within the atmosphere. Some of the heat in the warmed atmosphere is transferred back to the Earth's surface, warming the land and oceans. This is necessary for life on Earth and many of these GHGs exist naturally. However, increased emissions of GHGs due to human activities trap too much heat and contribute to the global climate change. The main greenhouse gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons and ozone depleting substances.

The main sources of GHGs in Jamaica are from:

- The Energy sector: burning of oil and other fossil fuels during energy generation; energy consumption by households and businesses; burning gasoline, diesel and other fuels in the transportation sector;
- Industrial Processes and Product Use: emissions due to energy consumption as well as the industrial processes, especially in the energy-intensive alumina industry and the cement industry
- Agriculture, Forestry and Other Land Use: removing vegetation which absorbs CO_2 from the atmosphere; generation of methane from livestock farming
- Waste: generation of methane from dump sites

Ozone-Depleting Substances

Although ozone is a pollutant derived from human activities and found in the lower atmosphere (the troposphere), it is a naturally produced, essential element in the upper atmosphere (the stratosphere). The stratospheric region with the highest concentration of ozone is known as the ozone layer. It protects the Earth's surface from harmful ultra-violet rays. The primary chemicals responsible for ozone depletion – known as ozone depleting substances – are a group of man-made organic compounds containing chlorine, bromine and fluorine. Ozone depleting substances used in Jamaica include:

- Hydro-chlorofluorocarbons (HCFCs) – found in some refrigerators and air-conditioning units
- Methyl bromide – used as a pesticide
- Halons – found in some fire extinguishers
- Chloro-fluorocarbons (CFCs) – found in some refrigerators and air-conditioning units

The phase-out process for HCFCs will begin as of 1 January 2013. This will entail a freeze in importation at the average import levels for 2009 and 2010. Subsequent reduction targets will achieve the phase-out date of 1 January 2030. Methyl bromide was phased out in 2009 except for use in quarantine and pre-shipment applications, as suitable alternatives are limited. Importation of Halons and equipment containing same is prohibited. An exemption exists for importation of equipment containing Halons by the Jamaica Defence Force and the aviation industry. Importation of CFCs and CFC containing equipment is prohibited except for importation of CFC based metered dose inhalers.

Indoor Air Quality

Environmental reporting is most concerned with outdoor or ambient air quality. However, many Jamaicans spend the majority of their time indoors, and indoor air pollution is becoming a concern in Jamaica's businesses, industrial facilities and some homes. Indoor air quality problems can result in sick building syndrome and in some cases cause significant human health problems such as respiratory illness and even cancers. Improving indoor air quality involves proper ventilation of buildings and eliminating indoor pollutants. Sources of indoor pollution include biological contaminants like mould and pollen, tobacco smoke, household chemicals and pesticides, gases such as radon and carbon monoxide, and materials used in the buildings such as asbestos, formaldehyde and lead. Jamaica, through its Ministry of Social Security is currently in the process of finalizing a National Indoor Air Quality Policy

CURRENT STATE

Air Quality Standards

The Jamaican air quality is measured by the ambient concentrations of Criteria Air Pollutants which are listed as sulphur dioxide (SO_2), nitrogen dioxide (NO_2), lead (Pb), carbon monoxide (CO), ozone (O_3), total suspended particulates (TSP) and particulate matter less than 10 microns (PM_{10}) These pollutants have been assigned ambient air quality standards which are reflected by time-based averaging periods. Table 32 provides the current Jamaica Ambient Air Quality Standards.

Table 32: Jamaica Ambient Air Quality Standards, 1996

Pollutant	Averaging Time	Standard (maximum concentration in $\mu g/m^3$)[1]
Total Suspended Particulate Matter (TSP)[1]	Annual 24h	60 150

Pollutant	Averaging Time	Standard (maximum concentration in µg/m^3)[1]
PM_{10}[2]	Annual 24h	50 150
Lead	Calendar Quarter	2
Sulphur Dioxide	Annual 24h 1h	80 primary, 60 secondary[3] 365 primary, 280 secondary 700
Photochemical Oxidants (Ozone)	1h	235
Carbon Monoxide	8h 1h	10,000 40,000
Nitrogen Dioxide	Annual 1h	100 400

Source: NRCA (Ambient Air Quality Standards) Regulations 1996

1. All particles and aerosols with aerodynamic diameters of 100 micrometers or less can be measured by the high volume sampling method.
2. Refers to particles with an aerodynamic diameter of 10 micrometers or less as measured by the PM10 sampler.
3. The secondary standards for sulphur dioxide are designed to protect public health and welfare. They represent the long-term goal for air quality and provide the basis for an anti-degradation policy for unpolluted areas of the country and for continuing development of pollution control technology.

Air Pollutant Emissions Data

The emissions reported on in this Chapter do not include data from the state-owned sugar industry and a number of smaller sources that are permitted, such as incinerators, cement batching plants and quarries, solid waste disposal sites, the construction industry and transportation.

The data presented are from cement manufacturing, ethanol processing, co-generation, bauxite and alumina refining, power and electricity production, feed production, breweries, petroleum refining, distilleries and food manufacturing.

In December 2009, the NRCA granted Air Pollutant Discharge Licences to 30 facilities across the country. By the end of 2010 there were 32 facilities licensed. The Licenses stipulate specific conditions which require these facilities to conduct air quality monitoring in areas designated by the NRCA.

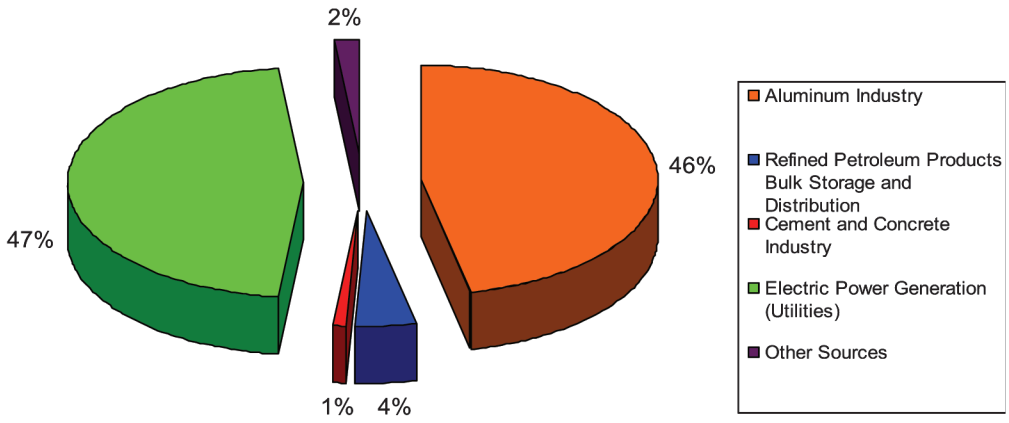
Criteria Air Pollutant Emissions from NRCA Licenced Facilities

During 2009, sulphur dioxide (SO_2) was the major polluter of the atmosphere from the licenced facilities. SO_2 was calculated at 79,903 tonnes, and nitrogen dioxide (NO_2) at 41,527 tonnes. Particulate matter was calculated at 13,000 tonnes while other criteria pollutants such as Volatile organic compounds (VOCs) and carbon monoxide (CO) averaged below 10,000 tonnes. These annual emissions values were calculated based on stack emission results.

The major releasers of the pollutants sulphur dioxide and oxides of nitrogen are the electric power generation sector and the alumina industry sector (Figures 16 and 17). The electric power generation sector is responsible for the largest portion of both gases. They overshadowed the alumina Industry during 2009. This may be as a result of the closure of operations of three of the five alumina plants during 2009. The fuel of choice for both sectors is Bunker C oil and diesel oil with maximum allowed sulphur content of 3% and 0.5% respectively. The sulphur emissions in the electric power generation

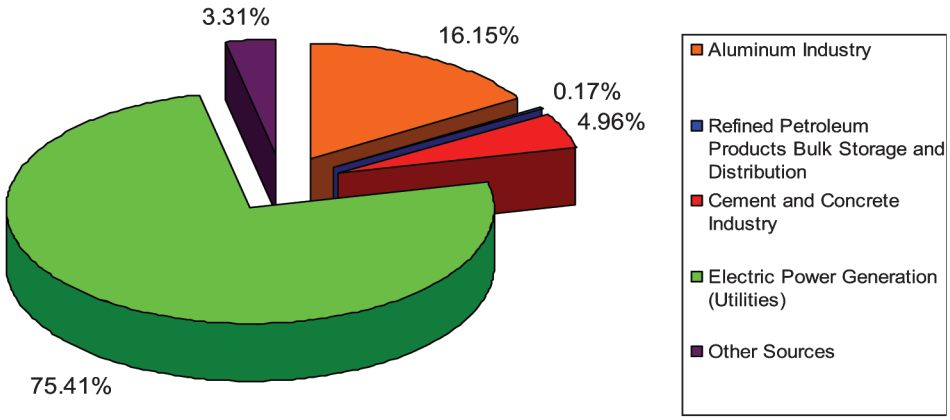
sector are expected to decrease during 2010 with the retirement of some of the older boilers at the country's electricity producer. However emissions from the alumina sector are expected to increase with the restart of some facilities in the sector.

Figure 16: Total Estimated Sulphur Dioxide Emissions by Regulated Sector, 2009



Source: NEPA

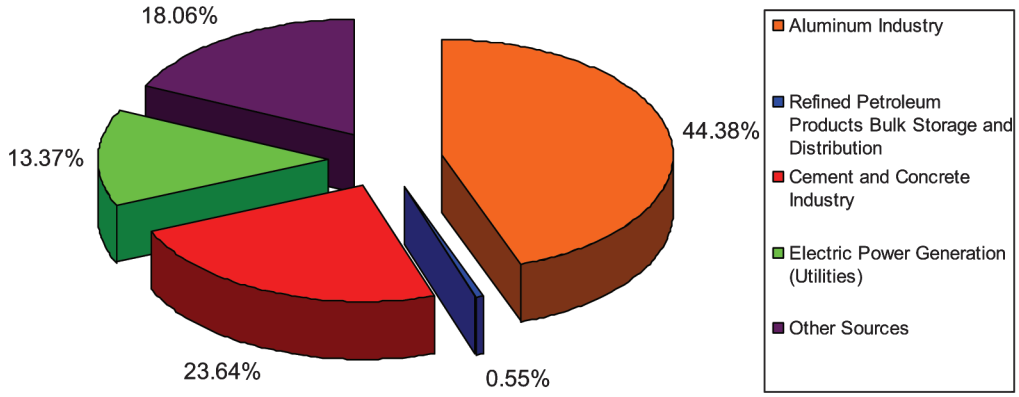
Figure 17: Total Estimated Nitrogen Emissions by Regulated Sector, 2009



Source: NEPA

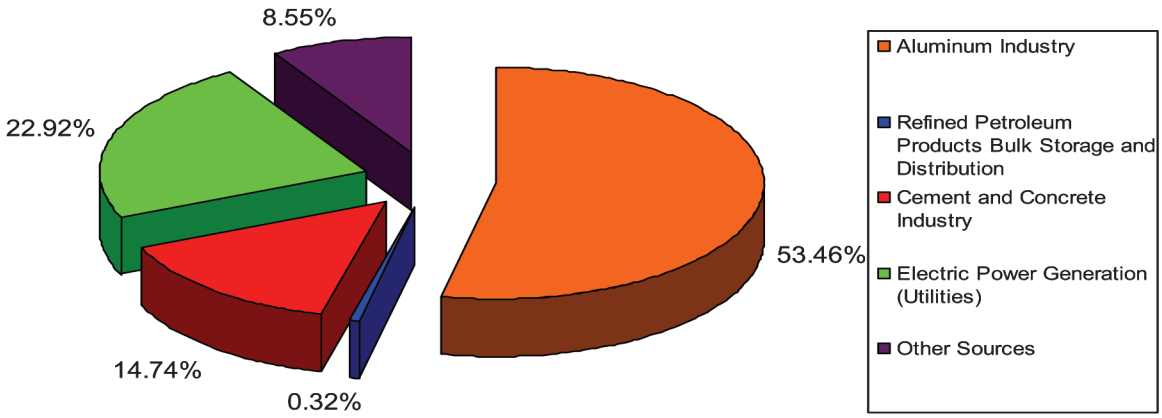
The alumina industry is responsible for 44% of the carbon monoxide emissions during 2009 (see Figure 18). Carbon monoxide is produced mainly from fuel combustion and in large amounts when there is incomplete fuel combustion. The data points to the inefficient operation of sources and the poor burning of fuel. Poor fuel management is also evident in the smaller industries which are the third largest polluters with 18% of the carbon monoxide emissions. The number may increase in 2011 with the restart of the plants that are presently shut down in the sector.

Figure 18: Estimates of Carbon Monoxide Emissions by Regulated Sector, 2009



The alumina industry is the leading contributor of the emissions of particulate matter (see Figure 19). The industry still faces a number of challenges despite the fact that more than half the sector was not in operation during the period 2008-2010. The industry has many open bauxite residue disposal areas (red mud lakes) which emit particulate matter on a daily basis based on wind speed and direction. Control devices at most of these facilities need constant maintenance and in many instances emissions control is sacrificed for production. Fugitive emissions from mining, loading and equipment movement is significant and cause nuisance and short term public health impacts.

Figure 19: Estimates of Particulate Matter Emissions by Regulated Sector, 2009



Source: NEPA

Ambient Air Quality Monitoring

Jamaica currently has 57 air quality monitoring stations spread across the island. Forty six (46) of these stations are located outside of the Kingston and St. Andrew region. The Bauxite companies own and operate 41 of these stations which represent 72% of all stations and 90% of the ambient air monitoring activities done in the parishes outside of the country's capital. Although there are 57 stations in the country, 16 of them are multi-stations that monitor more than one pollutant.

NEPA has been monitoring and assessing the ambient air quality in the parishes of Kingston and St. Andrew since 2006 on the following parameters: total suspended particulates (TSP), particulate matter less than 10 microns (PM_{10}), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2).

The criteria air pollutants (CAPs) being measured currently have been the main focus of monitoring because:

- These pollutants are the main emissions produced from the air pollution discharge sources existing on the island
- The country's main energy source is oil which produces significant quantities of these pollutants
- Equipment and technology is more affordable and available to monitor these types of pollutants
- Air Dispersion Models done for all the major industries in the country show these pollutants have created significant impacts on the environment and human health

Particulate Matter

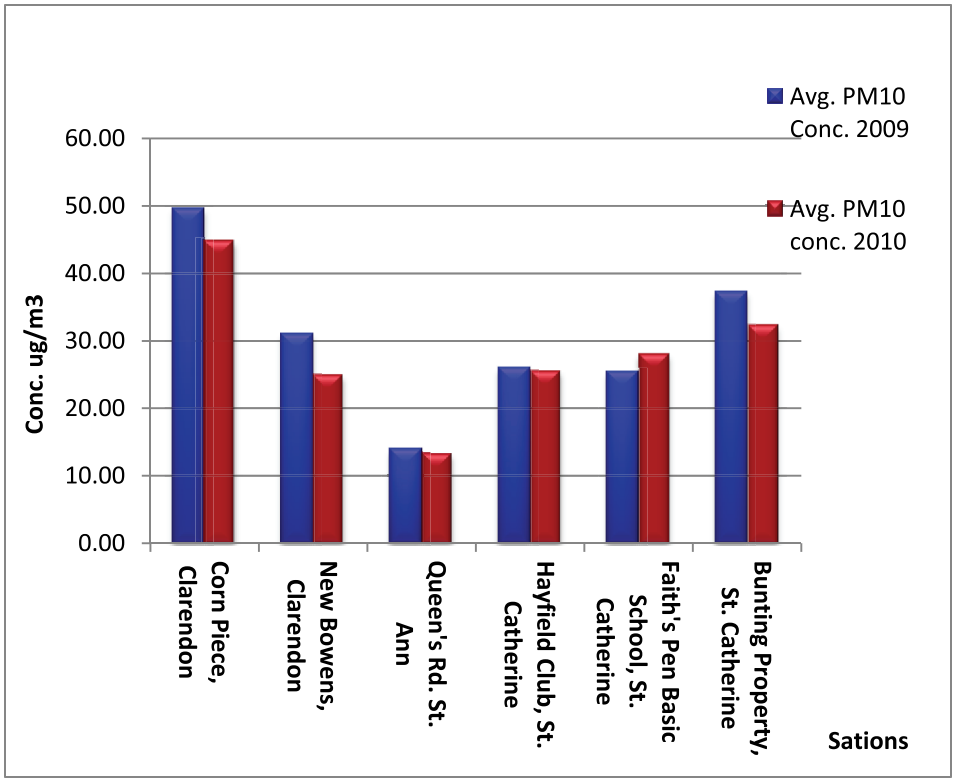
Ambient concentration levels of particulate matter in the Kingston and St. Andrew area appear to be trending upwards and at some of the sites they are well above the ambient limit for human exposure.

Particulate matter levels outside of the Kingston and St. Andrew area is driven by the bauxite sector and the down turn experienced by the sector in this period has impacted the levels both negatively and positively. The positive, is that fugitive dust from mining, stack emissions and refinery operations have been reduced, leading to a reduction in ambient levels. However, on the negative side, the vast open red mud disposal (mud lakes) areas have dried up and become in most cases dust-bowls. These areas can only be managed by continued wetting and during dry seasons become increasingly difficult to manage leading to the high levels of particulate matter reported during 2010.

In general the ambient air in the Kingston and St. Andrew area with respect to particulate matter is medium to poor. This however improves further inland from the Kingston Harbour where most of the industries are located. There are also impacts from the major traffic road ways and these impacts compromise the ambient air for some of the areas further inland.

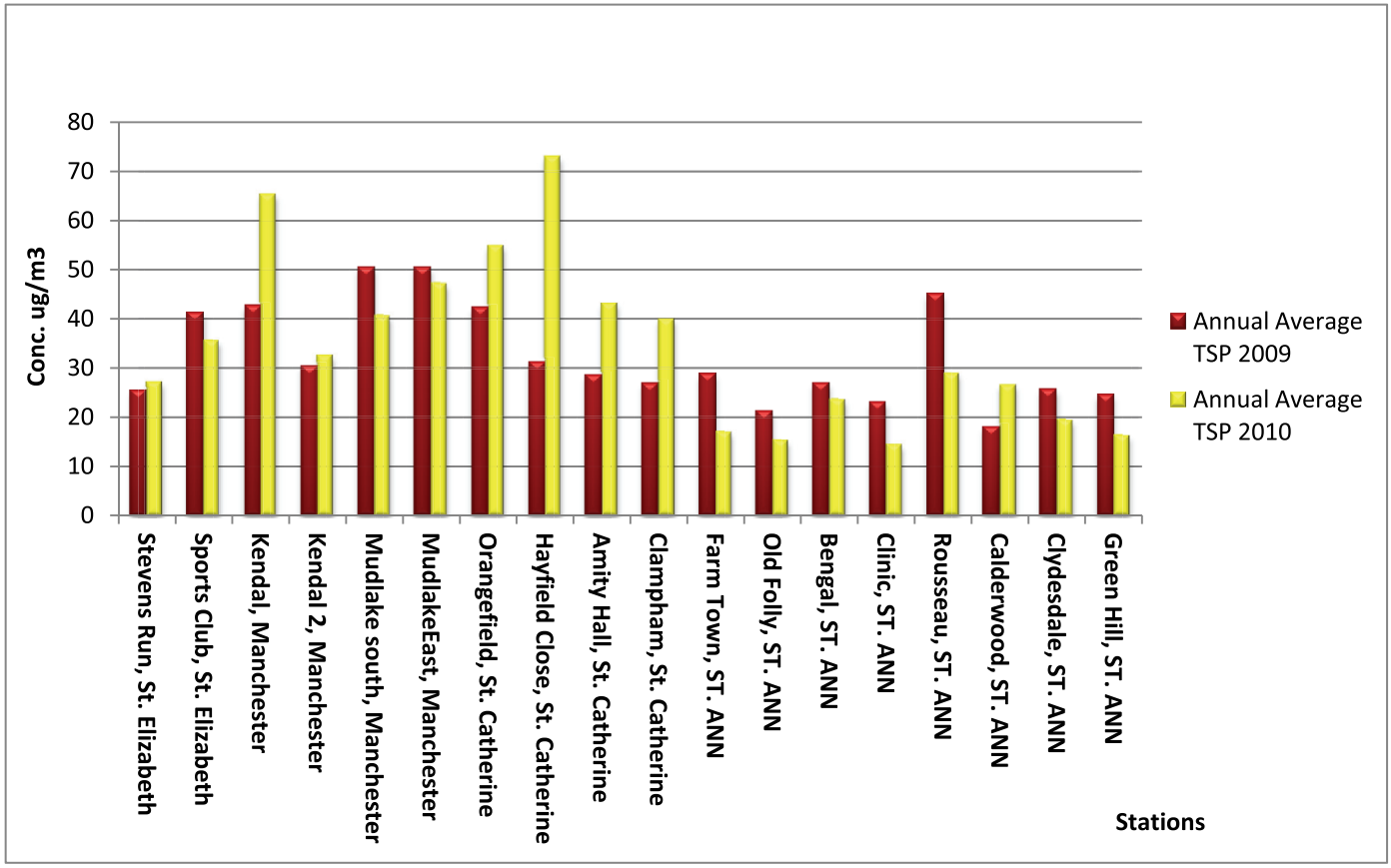
The other parishes in the island have relatively good ambient air quality with respect to particulate matter (see Figures 20 and 21). The conditions improve as the radius around the bauxite refineries and mining areas increases. However, the monitoring network in the rest of the country needs to be improved to incorporate impacts from sugar cane harvesting and refining, other industrial activities and traffic.

Figure 20: Average Annual PM_{10} Concentration Trend from 2009-2010 for Stations Outside of Kingston and St. Andrew



Source: NEPA

Figure 21: Average Annual Concentration Trend in TSP from 2009-2010 for the Stations outside of Kingston and St. Andrew

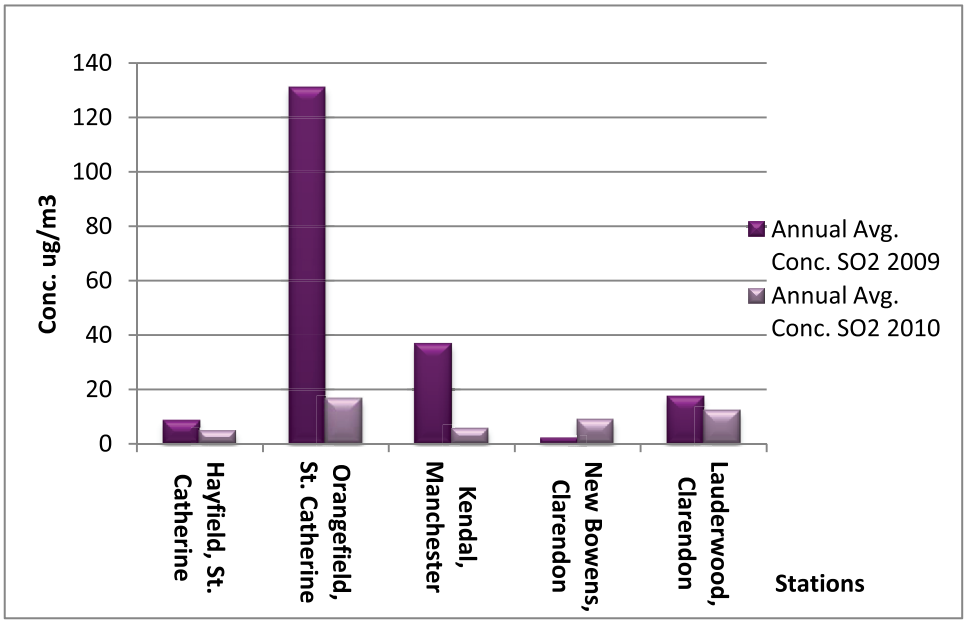


Source: NEPA

Sulphur Dioxide and Nitrogen Dioxide

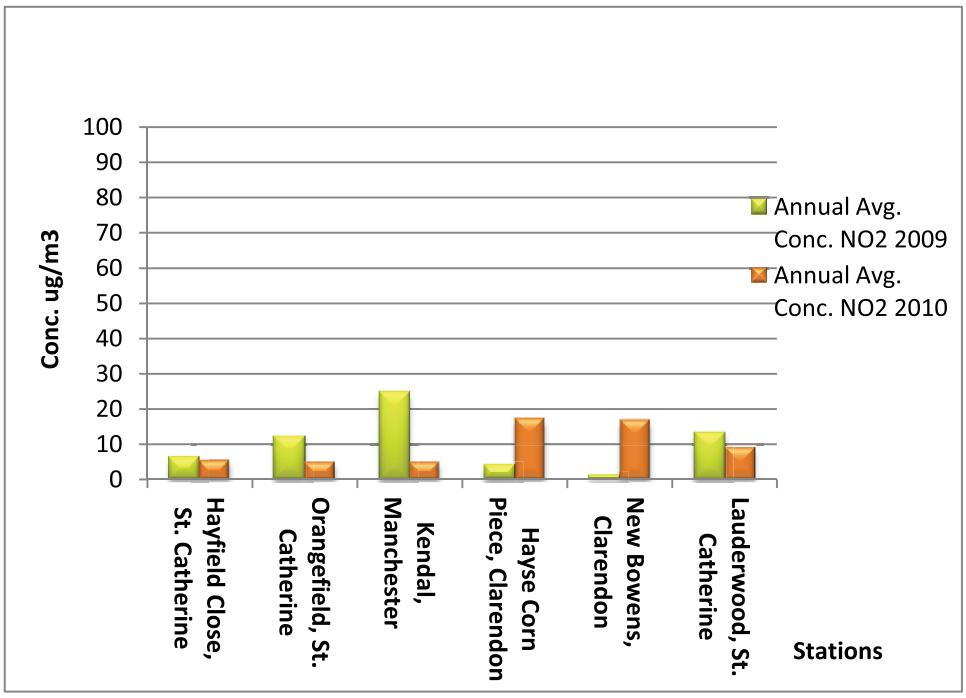
The entire island recorded on average good ambient air quality for sulphur dioxide and nitrogen dioxide (see Figures 22 and 23). There is however an increasing trend for both nitrogen dioxide and sulphur dioxide in the Kingston and St. Andrew area.

Figure 22: Annual Average Concentration for SO_2 Stations Outside of Kingston and St. Andrew for 2009-2010



Source: NEPA

Figure 23: Annual Average Concentration Trend for NO_2 for Stations Outside of Kingston and St. Andrew 2009-2010



Source: NEPA

Greenhouse Gas Emissions

Jamaica's National Greenhouse Gas (GHG) Inventory was completed in 2009 for submission with the National Communication to the United Nations Framework Convention on Climate Change (UNFCCC). The direct GHGs are namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6), and the indirect GHGs (which contribute to tropospheric ozone formation): non-methane volatile organic compounds (NMVOCs), carbon monoxide (CO), nitrogen oxides (NO_x), and sulphur dioxide (SO_2). Inventories were compiled for the years 2000 to 2005 for the following four sectors: Energy; Industrial Processes and Product Use; Agriculture, Forestry and Other Land Use; and Waste.

The trends in the GHG emissions show overall annual emissions for CO_2, CH_4 and N_2O increasing from 2000 to 2005, with only a minor drop in 2004.

Between 2000 and 2005:

- CO_2 emissions increased consistently from 9,531 Gg in 2000 to 13,956 Gg in 2005.
- CO_2 emissions in the energy sector increased by 46% due to increases in fuel consumption in the manufacturing (bauxite and alumina industry) and transportation categories.
- There was little change in the magnitudes of the sources and sinks for CO_2 in agriculture, forestry and other land use
- In the industrial processes and products use sector, the CO_2 emissions from the cement industry increased but those due to lime manufacture declined.
- CO_2 emissions in the waste sector increased. The contribution from managed disposal sites decreased while that from unmanaged sites increased. Note that there was a similar pattern for methane (CH_4) emissions in the waste sector; overall, CH_4 emissions rose from 31.1 Gg to 41.9 Gg.

JAMAICA'S RESPONSE TO MANAGING AIR QUALITY

The Government of Jamaica has developed and is currently implementing a range of regulations, policies and plans to ensure that its citizens are provided with good air quality. These include the establishment of ambient air quality standards and emissions targets and standards, and permit and licensing systems for facilities. Jamaica has in place an Air Quality Management Programme, guided by the multi-sectoral Air Quality Evaluation Committee, to coordinate efforts to ensure good air quality in Jamaica. To complement these efforts, technical capacity has been built in air quality management at NEPA.

Air Quality Regulations

The **Natural Resources Conservation (Air Quality) Regulations (2006)** establishes emission standards for facilities; provides an air pollution discharging licensing system; makes provision for licensed facilities to be charged an annual discharge fee based on actual emissions; requires annual reports of emissions and pollution-related incidents and pollution prevention activities; and makes provisions for punitive sanctions such as warnings, control orders, administrative penalties and prosecution.

Air Quality Monitoring

Ambient air quality monitoring has been streamlined and standardized. As of 2010, fifty four (54) privately operated ambient monitoring stations complement the three stations operated by NEPA. Through this effort the country is able to establish baseline ambient readings for 2010 with an aim to move towards a fully developed Air Quality Index by 2016.

Emissions Permit and Licensing System

Through the Natural Resources Conservation (Air Quality) Regulations (2006), Jamaica has established targets for stack emissions as well as standards for new emission sources.

Reporting on air quality measurements by industry became mandatory in 2009. In December 2009 the NRCA granted Air Pollutant Discharge Licences to thirty (30) facilities across the country. By the end of 2010 there were thirty two (32) facilities licensed. The Licenses stipulate specific conditions which require these facilities to conduct air quality monitoring in areas designated by the NRCA. The licences also provide the industry with emission limits. Limits of fuel characteristics for sulphur content are also given to industry, effectively capping the release of sulphur emissions from fuel oils. This licensing system is expected to improve efficiency of operations and eventually reduce emissions. This system enforces the Polluter Pays Principle and includes the verification of the reported emissions and discharge fees.

The collection of air quality data during 2009-2010 has resulted in the first national emissions inventory of the major and significant sources in the country. All baseline data of facilities sources, operation and fuel use were gathered for use in the country's Pollutant Release and Transfer Register.

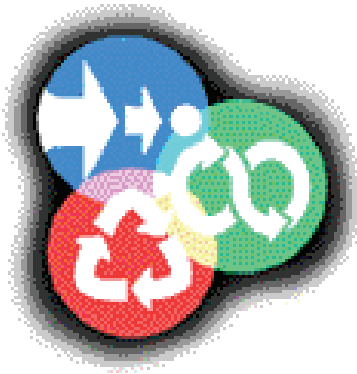
International Agreements

Jamaica is a signatory to the **Vienna Convention for the Protection of the Ozone Layer** and has ratified the associated **Montreal Protocol on Substances that Deplete the Ozone Layer.** The National Ozone Unit, formed in 1997, is responsible for the execution of projects with the objectives to phase out the use of ozone depleting substances. Jamaica has completed its phase-out Management Plan and is implementing an accelerated phase-out schedule for HCFCs in which the first control measure is the freeze in importation in 2013 at the average import levels for 2009 and 2010. Reductions in importation will continue until complete phase-out in 2040.

Environmental Stewardship Programme and Policy

Jamaica is developing a National Environmental Stewardship Policy which will address the environmental impacts of government operations. The draft policy addresses, among other issues, energy conservation and efficiency (thereby reducing emissions) as well as comfort and productivity in the workplace and indoor air policies. It includes actions that can be undertaken in GOJ ministries, departments and agencies to improve indoor air quality and conserve energy – the latter being expected to reduce the overall carbon footprint of GOJ.

WASTE MANAGEMENT



Globally, waste generation is on the rise with significant increases being observed in developing countries. In Jamaica the average per capita waste generation has risen from 0.74 kg/day in 2007 to 0.86 kg/day in 2009 (ESSJ 2010). Socioeconomic and demographic factors influence the type and quantity of waste being produced. These factors include population size and structure; consumption patterns and lifestyles; changes in household size and composition; changing gender roles; urbanization; and, shifts and expansion of economic activities.

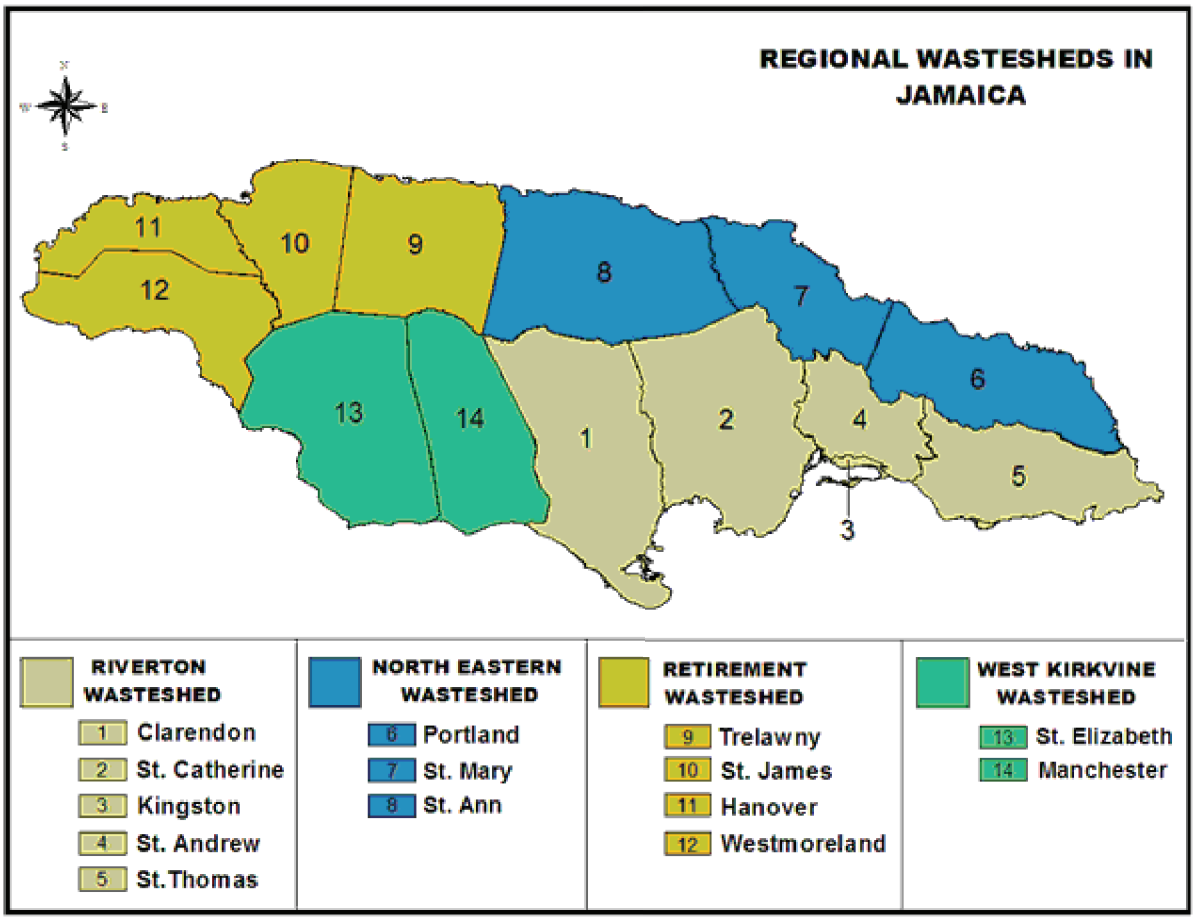
The main waste streams include municipal and non-municipal solid waste[34], sewage and industrial wastewater and hazardous waste[35]. Sewage and industrial wastewater have high biochemical oxygen demand (BOD), total suspended and dissolved solids. The management of waste includes several different processes such as collection, transport, processing, recycling, disposing, and monitoring. Without proper management there may be negative effects on the environment and human health.

Jamaica's consumption patterns are becoming very similar to those in developed countries and therefore the quantities and types of waste generated are similar. There has also been a change in the composition of waste with more non-biodegradable and hazardous waste being generated, both of which can have negative impacts on human health and the environment. Due to an increase in the use of computers and other electronic equipment, there is a significant increase in the amount of electronic wastes (e-wastes) generated. There are usually hazardous components contained in e-wastes.

[34] Solid waste is broadly defined as non-hazardous, industrial, commercial and domestic refuse including household organic trash, street sweepings, hospital and institutional garbage, and construction wastes.
[35] Waste that is hazardous has properties that make it dangerous or potentially harmful to human health or the environment (United States Environmental Protection Agency, 2006)

The National Solid Waste Management Authority has demarcated the country into four (4) regions known as wastesheds (Figure 24): The Riverton, Retirement, West Kirkvine (Southern) and Northeastern wastesheds. Each wasteshed is made up of two or more parishes with accompanying disposal sites for the proper disposal of solid waste to ensure environmental protection, solid waste disease and pest or nuisance control.

Figure 24: Regional Wastesheds in Jamaica



Source: National Solid Waste Management Authority

ISSUES RELATED TO WASTE MANAGEMENT IN JAMAICA

There are a various issues that impact proper waste management in Jamaica. These are highlighted below. The main environment-related issues as it relates to the management of waste in Jamaica are:

- Lack of a comprehensive and integrated waste management policy
- Limited options for the environmentally sound management of solid waste
- Low levels of public awareness
- Limited collection efficiency which contributes largely to the improper disposal of waste (disposal in gullies etc. and burning). Most waste disposed of in gullies eventually ends up in

coastal areas which not only results in poor aesthetics, but more importantly the depletion of coastal resources.

- Pollution due to fires at the waste disposal site as well as the discharge of leachate and the emission of methane which is characteristic of waste disposal sites compared to sanitary landfills

Wastewater Management

The country's groundwater continues to be polluted as a result of soak-aways and absorption pits – traditionally the most common method for onsite treatment of wastewater (residential and commercial black and grey water). The contamination of the groundwater is due in part to the predominant limestone geological formation which allows sewage to empty into the groundwater table. This has resulted in a number of wells in Kingston becoming unusable, for the most part because of the high level of nitrates present in the ground water.

Absorption pits as standalone treatment/disposal options are no longer sanctioned for new housing developments and in areas with high water tables (this latter prescribed by the WRA), only methods effecting tertiary treatment are allowed.

Hazardous Waste Management

The main sources and types of hazardous waste generated in Jamaica are:

- Industrial – e-waste, solvents, waste oil, asbestos, heavy metals
- Agricultural – pesticides
- Commercial – e-waste, paint, toners, asbestos, car batteries (lead acid)
- Household – cleaners, disinfectants, paints, dugs, batteries, e-waste, fluorescent bulbs
- Medical – contaminated needles, bandages, drugs, radioactive material

The main issue regarding the management of hazardous waste in Jamaica is an overall lack of suitable treatment and disposal options. The larger industries, such as bauxite, petroleum and the lead acid battery sector export their hazardous wastes for recycling, recovery or disposal (MAJ, 2007). However, the cost to export this waste is prohibitive for many small and medium-sized enterprises. The lack of necessary local infrastructure has therefore resulted in illegal dumping of these toxic materials, leading to contamination of soil and water.

CURRENT STATE

Solid Waste

Solid Waste Characterization

The last waste characterization study conducted at the Riverton Waste Disposal Site was in 2006. It showed that 69 per cent of the solid waste produced in Jamaica is organic and represents approximately 1.01 million tonnes by volume (Table 33). It should be noted that this organic waste is either compostable or recyclable and therefore presents an opportunity for Jamaica to engage in economic activities related to composting and recycling, thereby reducing the amount of waste to be collected and transported to disposal sites.

Table 33 – Solid Waste Generation at Riverton by Volume, 2006

Category	Percentage	Volume (tonnes)
Compostable (organic)	69	1,010,094.8
Paper	5.9	86,370.5
Plastic	13.9	203,482.9
Metal/ Tin	2.3	33,669.8
Cardboard	3.7	54,164.5
Glass	2.4	35,133.7
Textile	2.3	33,669.8
Wood board	0.3	4,391.7
Other	0.2	2,927.8
Total	**100**	**1,463,905.5**

Source: PIOJ – Management of Hazardous and Solid Wastes in Jamaica

Waste characterization studies were carried out by the NSWMA in 2007 to 2009 in the Retirement (Trelawny, St. James, Hanover, Westmoreland), Southern (Manchester and St Elizabeth) and the North-eastern (St Ann, St Mary and Portland) Wastesheds (Tables 34 and 35).

Solid Waste Generation

In 2010, approximately 762,623 tonnes of solid waste were produced from residential sources, a decrease of 7.2% from the previous year (See Table 34). If solid wastes from outside residential sources are taken into account, the data show that the average per capita waste generation increased from 0.74 kg/day in 2007 to 0.86 kg/day in 2009.

It is estimated that the Riverton Waste Disposal Site receives approximately 60% of the total waste collected.

Table 34: Solid Waste Produced by Residential Sources

Site Name	Waste Produced (tonnes)			
	2007	2008	2009	2010
Riverton (Kingston)	370,888	501,451	492,426	469,623
Retirement (St. James)	187,409	196,844	169,314	148,464
Martin's Hill (Manchester)	48,585	46,814	57,274	54,837
Myersville (St. Elizabeth)	42,223	33,218	30,313	24,785
Tobolski (St. Ann)	11,440	9,202	10,390	7,744
Haden (St. Ann)	33,894	40,769	39,645	34,804
Doctors Wood (Portland)	9,882	17,598	22,542	22,366
Total	**704,321**	**845,896**	**821,903**	**762,623**

Note: Church Corner – the disposal site located in St. Thomas has its waste recorded in Riverton and is therefore not included in this table under sites

Source: National Solid Waste Management Authority

Table 35: Average Generation Rate per Capita in Three Wastesheds 2007-2009

Waste Fractions	Retirement Wasteshed Average Generation Per Capita (kg/day)			Northeastern Wasteshed Average Generation Per Capita (kg/day)			Southern Wasteshed Average Generation Per Capita (kg/day)		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
Compostable	0.52	0.35	0.31	0.28	0.38	0.28	0.28	0.24	0.27
Paper	0.07	0.11	0.09	0.03	0.06	0.03	0.05	0.02	0.04
Plastics	0.1	0.12	0.07	0.1	0.1	0.12	0.17	0.07	0.13
Glass	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
Cardboard	0.02	0.01	0.01	0.02	0.03	0.02	0.03	0.03	0.02
Wood/Board	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.0	0.0
Metal/Tin	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02
Textile	0.02	0.02	0.03	0.01	0.01	0.02	0.02	0.01	0.02
E-Waste	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.00	0.00
Total Waste Stream	**0.78**	**0.66**	**0.56**	**0.49**	**0.62**	**0.51**	**0.63**	**0.41**	**0.53**

Source: National Solid Waste Management Authority

Non-Biodegradable Waste

There has been in increase in the importation of plastic goods within the last four years. The greatest increase can be seen in the importation of plastic bottles which is as a result of the increasing popularity of bottled drinks, especially bottled water. Table 36 below shows the imports of selected plastic goods in the country between 2007 and 2010 and also shows that there was an increase in plastic imports by approximately 27% in 2010 compared to 2007.

Table 36: Imports of Selected Plastic Goods 2007 – 2010

	kg			
Types of plastic goods	2007	2008	2009	2010
Plastic sacks and bags (incl. cones) of polymers of ethylene	216,192	230,123	402,481	628,162
Other plastic sacks and bags (incl. cones) not of polymers of ethylene	5,091,162	5,052,351	5,040,503	4,147,831
Plastic bottles	4,784,085	5,930,751	6,914,966	8,438,119
Carboy flasks and similar articles of plastic	138,523	80,927	68,273	26,390
Plastic lids and caps	2,134,254	1,275,193	1,428,889	2,588,507
Other plastic articles of conveyance or packing of goods	1,086,350	1,541,344	1,423,335	1,224,387
Total	13,450,566	14,110,689	15,278,447	17,053,396

Source: STATIN

Solid Waste Collection

The National Solid Waste Management Authority (NSWMA) estimates that 70 to 75% of the country's household waste is collected, while the remainder is uncollected due to inaccessibility, competing disposal practices and improper waste management practices.

Collection by garbage trucks and burning are the predominant methods of garbage disposal and treatment. Garbage collection in the Kingston Metropolitan Area (KMA) and other towns has been more efficient than in other areas of the country. Collection is particularly low in rural areas where the main method of treatment and disposal is burning. Other disposal methods include burying and dumping on open lots and in gullies.

70 to 75% of the country's household waste is collected, while the remainder is uncollected due to inaccessibility, competing disposal practices and improper waste management practices

Landfills and Disposal Sites

Jamaica has no sanitary landfills but has 8 authorized disposal sites which are managed by the NSWMA. According to the NSWMA, the country's disposal sites received about 940,000 tonnes of garbage during the year 2006 and this figure is projected to increase to 1.2 million tonnes by 2010. According to the NSWMA, it takes about US$100 per tonne to collect and dispose of solid waste in Jamaica. Over the past ten years, municipal solid waste dumped at disposal sites across the island has grown by an annual average rate of 6% per year.

Private waste management firms establish long-term contracts with businesses, hotels and residential complexes for garbage removal. Jamaica's disposal sites are divided into cells, and tractors are used to compact the garbage on a daily basis. Hazardous wastes, such as motor vehicle batteries, are separated from the general waste stream. Additionally, work has been initiated to separate and bale used tires.

It is estimated that by 2014, the Riverton Waste Disposal Facility will reach its maximum capacity therefore it is imperative that systems are put in place to facilitate recovery, reuse and recycling of waste at source. See Table 37 below for solid waste generation at Riverton by volume, 2006.

Table 37: Solid Waste Generation at Riverton by Volume, 2006

Category	Percentage	Volume (tonnes)
Compostable (organic)	69	1,010,094.8
Paper	5.9	86,370.5
Plastic	13.9	203,482.9
Metal/ Tin	2.3	33,669.8
Cardboard	3.7	54,164.5
Glass	2.4	35,133.7
Textile	2.3	33,669.8
Wood board	0.3	4,391.7
Other	0.2	2,927.8
Total	**100**	**1,463,905.5**

Source: PIOJ – Management of Hazardous and Solid Wastes in Jamaica

Studies show similar waste composition for the Retirement, Northeastern and Southern wastesheds during the period 2007 to 2009. It can be seen that the majority of waste collected across the island is either compostable or recyclable and therefore represents a wasted resource.

Hazardous Waste

Although there is limited data on the actual quantities generated, the general view is that the quantity of hazardous waste is increasing. In 2010 the proportion of the population that own computers and mobile phones increased by 9.3% when compared to the previous year. There has been a 45% decline in motor vehicle imports from 2007 to 2010 and a corresponding decrease in the quantity of lead acid batteries imported.

Although a large quantity of hazardous waste ends up un-separated at the disposal facility, there are some categories of hazardous waste that are collected for reuse and recycling. Reuse and disposal of certain hazardous materials occurs as follows:

- Used petroleum oil – Used as a supplemental fuel and lubricant; also used inappropriately in pest control (in drains to control mosquitoes and on animals to eradicate ticks) and for dust control
- Asbestos – Asbestos waste is accepted by the NSWMA at the Riverton site once it is packaged according to NEPA's requirements and it is disposed of in a designated area
- E-waste – NSWMA receives and stores discarded computers in a designated area at the Riverton Disposal site
- Medical waste – Much of the medical waste generated is separated and incinerated, however, some medical waste does end up in municipal disposal sites.

The Transboundary Movement of Hazardous Waste

The exportation of hazardous waste for safe disposal is regulated through the Natural Resources Conservation (Hazardous Waste) Control of Transboundary Movement Regulations 2002. These Regulations require that an Environmental Permit is obtained from NEPA for any export out of or transit of hazardous waste through Jamaica. It is illegal to import hazardous waste into the country.

Used Petroleum Oil
An Example of a Hazardous Waste

The improper disposal of used petroleum oils has been a persistent issue in Jamaica. During the period 2006-2008, 7 documented pollution incidents involving used petroleum oils occurred. It is important to note that there have been several unreported incidents discovered during the course of investigations conducted by NEPA.

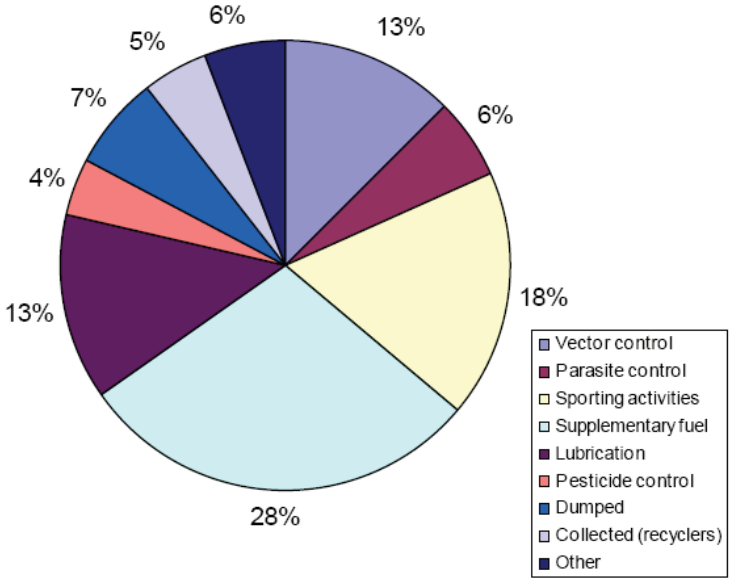


Figure 25: Disposal Methods for Used Petroleum Oils
Source: NEPA Used Oil Assessment, 2008

In 2008, a Used Oil Assessment conducted across the island by NEPA revealed that local generators and users of used petroleum oils are not adequately sensitized to the impacts of inappropriate disposal methods for used oils and the opportunities for reuse and recycling of used oils. In addition, temporary storage and collection of used petroleum oils are inadequate. It was also found that waste oil is used inappropriately on a wide scale. Examples of this misuse are, in pest control, both in drains to control mosquitoes and on animals to eradicate ticks and for dust control

The parishes of Kingston & St. Andrew, St. Ann and St. James account for 89% of the volumes of used petroleum oil generated. The most dominant practice for the disposal of used petroleum oil is its use as a supplementary fuel. Its use as a supplementary fuel accounts for 28% of the total disposal methods identified in Figure 25.

Electronic Waste
An Example of a Hazardous Waste

There is no facility in Jamaica for the proper disposal of e-waste and so a large portion ends up at disposal sites and is sometimes mixed with the municipal waste. The rapid rise in the use and upgrade of computers has exacerbated this issue and many companies are forced to store them in rooms or warehouses. The NSWMA receives many requests to dispose of computers from the public and has attempted to respond by receiving and storing discarded computers in a designated area at the Riverton Waste Disposal site.

The Environmental Management Division of the NSWMA and mobile phone service providers are in discussions to establish systems for the collection of cellular phones and their batteries for proper disposal. Digicel started a collection drive for old cellular phones in August 2009.

Medical Waste

The most common method of handling medical waste in Jamaica is incineration. Much of the medical waste generated is separated and handled accordingly, however some ends up in municipal disposal sites. The Southeast Regional Medical Waste Treatment Facility commenced waste collection and treatment services in January 2009. It currently treats medical waste generated at 20 Ministry of Health healthcare facilities within the southeast region. It also serves as a contingency treatment facility for healthcare facilities within the southern and northeast health regions. The total quantity of medical waste treated for the period January to October 2009 was approximately 172,159 kg, an average of 17,215 kg per month or 861 kg per day.

Wastewater and Sewage

Access to Wastewater Facilities

The proportion of population using an improved sanitation facility has been selected as one of the Millennium Development Goals environmental indicators. In Jamaica, ***almost all households (98.9%) surveyed in 2007 had access to water closets and pit latrines, which are defined as acceptable forms of toilet facility.***

Water Closets (Flush Toilets) were the main type of facility, accounting for 64.3% of households. Some 42.4% of households with flush toilets were not linked to wastewater treatment facilities (sewers), indicating that soil absorption systems are the predominant means of sewage disposal for the country. Approximately 25% of Jamaica's population is served by sewerage systems operated by the NWC. The remaining 75% of Jamaica's sewage wastes are disposed of through soak away systems, septic tanks, tile fields, pit latrines etc. However, soakaway pits may lead to contamination of groundwater, as seepage reaches aquifers through the porous limestone base.

Sanitation services exist in most major urban areas, and are being improved. In the Kingston Metropolitan Area (KMA), 92% of households have flush toilets, while in other towns 60% of households have this facility. The great majority of households without flush toilets use pit latrines. In order for a national system to be developed to process wastewater sludge for energy generation, centralized wastewater treatment plants are necessary. However, while coverage of sewerage services has increased significantly in recent years, only 20% of the population island-wide is connected to sewage treatment facilities. In the KMA the percentage is considerably higher with 60% of households linked to

sewer systems, while in other towns only 11% of households are connected, most of which are in housing developments. The NWC is currently implementing a programme to expand the sewer connections in the KMA, and has recently completed the construction of a new sewerage system in the Montego Bay area.

The National Water Commission (NWC) is a statutory organization charged with the responsibility of providing wastewater services for the people of Jamaica. However, there are a number of entities that own and operate wastewater treatment facilities in Jamaica. The NWC operates the largest number of plants and has a fairly large network of sewerage systems in major cities and towns.

Sludge is left behind from the process of treatment of wastewater and is suitable to generate energy through processes such as gasification to produce syngas, incineration to generate electricity, or anaerobic digestion.

Sewage Treatment Facilities

There are presently 306 sewage treatment plants in Jamaica. Sixty eight (68) are owned by the National Water Commission (NWC), the largest provider of sewerage services in Jamaica (see Figure 26). Of the 165 plants monitored by the Environmental Health Unit between January and September 2010, only 66, or 40%, were in compliance (see Table 38). Of the 65 NWC plants monitored, only 17, or 26%, were compliant (see Table 39).

In addition to the NWC, sewage treatment plants are owned by hotels, strata corporations and public housing development agencies. Major urban centres such as Kingston and St. Andrew, St. James and St. Catherine account for approximately 90% of the waste handled by the NWC.

Jamaica's wastewater sector generally has a low level of performance, and sewage effluent quality from most treatment plants has generally not been unable to meet the NRCA's sewage effluent standards. This is mainly due to issues such as improper plant designs, old technology, overloading, lack of maintenance, and improper operations. This problem has been alleviated somewhat by the 2007 commissioning of the first phase of the Soapberry Treatment Ponds that provide tertiary treatment of sewage from Kingston and St. Andrew and South East St. Catherine (Portmore).

Figure 26: Distribution of NWC Wastewater Treatment Facilities

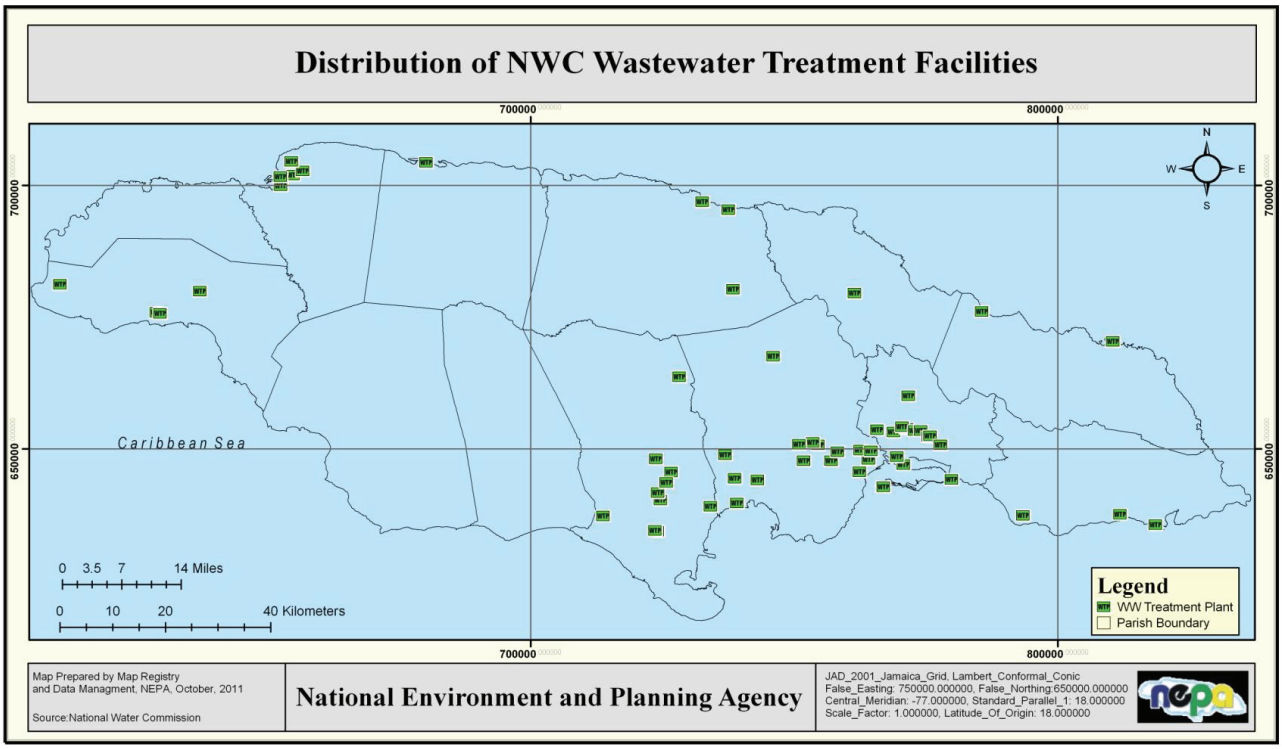


Table 38: Sewage Treatment Plants in Compliance, January - September 2010

Region/Parish	No. Plants	Compliant	% Compliant
KSA	18	10	55.6
St. Thomas	4	4	100.0
St. Catherine	33	9	27.3
St. Ann	20	14	70.0
Portland	7	2	28.6
St. Mary	8	3	37.5
St. Elizabeth	4	2	50.0
Clarendon	20	7	35.0
Manchester	6	2	33.3
St. James	17	6	35.3
Trelawny	6	1	16.7
Westmorelamd	15	3	20.0
Hanover	7	3	42.9
TOTAL	**165**	**66**	**40%**

Source: Environmental Health Unit, Wastewater Status Report for January to October 2010

Table 39: STPs in Compliance, January - September 2010, by Ownership Groups

Owner Group	No. Plants	No. Compliant	% Compliance
NWC	66	17	26
Hotel	28	17	61
Government	38	14	37
Hospitals	9	0	0

Source: Environmental Health Unit, Wastewater Status Report for January to October 2010

Industrial Wastewater Treatment

Wastewater is also generated from agri-businesses. However, industrial wastewater treatment facilities in the agro-industrial sector are also plagued with poor trade effluent discharge quality. This is of particular concern in the sugar industry, coffee industry, distilleries, and abattoirs. Codes of Practice have been developed for the coffee and sugar industries which aim to improve the quality of effluents. Industrial wastewater treatment facilities in the agro-industrial sector, where end-of-pipe treatment options are typically used as the first solution, generally have poor trade effluent discharge quality.

JAMAICA'S RESPONSE FOR MANAGING ITS WASTE

The Government of Jamaica has a number of regulations, policies and plans that govern the management of solid waste, wastewater/sewage (many of which address the provision and protection of potable water) and hazardous waste. Jamaica is also a signatory to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

National Legislation

With regards to solid waste management the most important statute is the **National Solid Waste Management Act (2001),** which addresses collection, storage, transportation and disposal of solid waste.

With regards to wastewater management the most important statute is the **Natural Resources Conservation Authority (NRCA) Act (1991)**, which regulates effluent discharges. Through the **NRCA Permits and Licences Regulations (1996),** it is required that a permit be obtained from the NRCA for the construction and operation of a new wastewater treatment facility and that a licence be obtained for the discharge of trade and sewage effluent.

There are established standards for sewage and trade effluent quality and meeting the standards is a condition of every licence granted by the Authority (NRCA) through NEPA. It should be noted that there are currently two standards for sewage effluent, standards for some existing facilities (which are defined as facilities in operation prior to 1997) and those for new facilities (licensed after 1996).

When the **draft NRCA Wastewater and Sludge Regulations** are promulgated, the Government of Jamaica will have a tool that can significantly enhance wastewater management. The wastewater and sludge regulations are intended to allow the safe management, treatment and disposal of sewage and industrial sludge. The main elements of the regulations are establishment of strict pathogen and heavy

metal content limits for treated domestic sewage sludge and wastewater discharge fees. The regulations are based on the approach of self monitoring by the waste generator, the performance of an auditing function by NEPA, the polluter pays principle, economic incentives for development of environmentally sound alternative uses for sludge and effluents, and progressively severe penalties.

Other relevant statutes include:

- The **Public Health Act (1974),** amended in 1985 – addresses air, soil and water pollution and the sanitary collection and disposal of garbage and other waste matter
- The **National Water Commission Act (1963)** amended in 1965, 1973 and 1980 – gives the NWC responsibility for public water supply systems and public sewerage and sewage treatment
- The **Water Resources Act (1995)** – governs the use and quality of Jamaica's groundwater

With regards to hazardous waste management the most important statutes are:

- **Natural Resources Conservation (Permits and Licences) Regulations (1996) and Amendment (2004) Regulations** – make provision for the issuance of a permit for the storage, transportation or disposal of hazardous wastes.
- **Natural Resources Conservation (Hazardous Waste) Control of Transboundary Movement Regulations (2002)** – require an Environmental Permit to be obtained from NEPA for any export out of or transit of hazardous waste through Jamaica. It is illegal to import hazardous waste into the country.

National Policies

The **National Solid Waste Management Policy (2000)** establishes the framework for standard setting and the regulatory agency, the National Solid Waste Management Authority (NSWMA) which facilitates the private sector as the principal service provider. The policy also emphasizes cost recovery options, establishments of sanitary landfills, and solid waste management.

The **Water Sector Policy, Strategy and Action Plan (2004)** has as its main objectives to ensure that all households have access to water and to sewer all major towns by 2020. Also, the policy aims to rehabilitate existing non-compliant facilities to achieve compliance with national environmental standards.

The landmark **Draft Jamaica National Sanitation Policy (2005)** is the first of its kind in the Caribbean. It aims to ensure that acceptable water supply and sewage and excreta disposal systems will be available in all homes, schools and public places. Other policies that have been drafted and support improved sanitation include the **Health Policy** (Ministry of Health); the **Squatter Management Policy** (Ministry of Housing, Environment, Water and Local Government); and the **Social Housing Policy** (Ministry of Housing, Environment, Water and Local Government).

A **National Hazardous Substances and Hazardous Waste Management Policy** is being developed by the Government of Jamaica for the management of oxic substances and wastes.

Approaches for Waste Management in Jamaica

Waste Minimization

Jamaica's National Solid Waste Management Policy promotes waste minimization as the top priority of the "Waste Management Hierarchy" – an internationally recognized strategy for management of municipal solid wastes. It places greatest emphasis on strategies and programmes for avoiding and reducing waste, with treatment and disposal being the least favoured options[36].

Recycling

While recycling is not widespread in Jamaica, there are several companies in Jamaica that are involved in the collection and exportation of recyclable materials. The main items that have been collected for export for recycling include paper (including newsprint), cardboard, plastic, glass bottles and metal.

Reportedly one company exported 7,273 tonnes of plastic between 2007 and 2010. In addition another recycling company exported 7,995 million tonnes of glass between 2007 and 2010 and 924.3 million tonnes of paper between 2008 and 2010.

Although a large quantity of hazardous waste ends up un-separated at the dumpsites, there are some categories of hazardous waste that are collected for reuse or recycling. Used lead acid batteries and used petroleum oil are two types of hazardous waste that are officially collected for reuse and recycling. Also, programmes are being developed to collect mobile phone batteries and computer waste for safe disposal.

Energy-from-Waste

Jamaica's Energy-from-Waste Policy actively promotes the development of initiatives to generate energy from waste materials. Bagasse (waste from the sugar cane industry) already constitutes over 30% of the country's renewable energy sources. This policy provides a framework to expand energy-from-waste capacities to include incineration of municipal solid waste, capture of landfill gas, production of bio-diesel, production of biogas using animal wastes and wastewater sludge. This approach will not only reduce the volume of waste that must be disposed of, but will also generate clean energy.

The Natural Resources Conservation Authority (NRCA) Wastewater and Sludge Regulations (draft) provide for the disposal of sludge other than in a landfill, which should be done in accordance with the management practices set out in a guideline document to be issued by the NRCA. The conversion of sludge to energy would be addressed in the guideline document.

Expansion and Improvement of Sewage Treatment Plants

Many of the sewage treatment plants owned by the NWC or taken over from private developers were built over 50 years ago and are malfunctioning. The NWC has an ongoing programme to upgrade, rehabilitate and replace 44 of its 66 sewage treatment plants. Activities to rehabilitate and upgrade 14 sewage plants are underway. Some of these works include undertaking major sewer expansion work in the KSA – replacement of sewage treatment plants in Independence City, Bridgeport, Caymanas Garden and Hamiliton Gardens and the sewering of Paddington Terrace, Wiggan Loop, Dillsbury and Jacks Hill.

[36] UNEP, Integrated Waste Management Scoreboard – A tool to measure performance in municipal solid waste management, December 2005

An additional 12 plants are considered urgent and requests for proposals to upgrade these plants have been published in the newspapers. It is expected that these activities will span the period 2009 to 2014.

The new Soapberry sewage treatment facility, built in 2007, replaced the malfunctioning Greenwich and Western treatment plants in order to improve the quality of the Kingston Harbour.

E-waste Collection Programmes

The Environmental Management Division of the NSWMA and mobile phone service providers are in discussions to establish systems for the collection of cellular phones and their batteries for proper disposal. Digicel started a collection drive for old cellular phones in August 2009.

Composting

In 2009, composting activities commenced at the Riverton and Retirement Disposal Sites. This project involves the use of grass cuttings from roadways, garden, waste, and market vegetable refuse. The materials are broken down naturally producing a refined product which will then be used as a potting mix to help boost the texture and nutrient content of plant growth. The finished product will be sold to nurseries, individuals and the Parks and Gardens Division of the NSWMA.

Scrap Metal

The scrap metal industry has been vibrant in recent years. Nearly all disposal sites have scrap metal stockpiles, with Riverton and Retirement Disposal Sites having the largest. Over the period 2007 to 2010, the country exported over 441 million kilograms of scrap metal. Scrap metal exports were valued at US$100 million in 2009 (See Table 40 below). While this industry provides income generation for communities and provides an incentive for recycling waste materials, it has a negative side. Trade in scrap metals is posing a threat to some of the country's important infrastructure due to theft of telephone and traffic light cables; removal of drain and manhole covers; and removal of bridge rails and road sidings. Recognizing this problem, in April 2010, the Government of Jamaica placed a ban on trade in scrap metal[37]. However, the GOJ realizes the importance of this industry to local communities and the country in general and is in the process of formulating strategies aimed at formalizing, regulating and improving this industry.

Table 40: Scrap Metal Exports 2007 – 2010

Type of Waste and Scrap Metal	Kg.			
	2007	2008	2009	2010
Waste & scrap of cast iron	1,904,030	16,870,603	41,748,511	28,046,315
Waste & scrap of stainless steel	107,547	86,293	121,328	72,954
Waste & scrap of alloy steel other than stainless steel	462,900	3,802,495	911,444	593,043
Waste and scrap of tinned iron or steel	43,460	1,695,570	989,716	376,080

[37] This ban exempts manufacturers who generate their own material, and do not buy from other sources.

Type of Waste and Scrap Metal	Kg.			
	2007	2008	2009	2010
Turnings, shavings, chips, milling waste, sawdust, filings, trimmings and stampings, whether or not in bundles	95,000	420,000	0	0
Other ferrous waste and scrap	124,420,030	96,435,933	46,467,711	72,544,647
Copper waste & scrap	199,146	170,452	1,095,538	179,136
Aluminium waste and scrap	1,638,992	1,110,833	753,887	580,508
Other metal waste and scrap	105	60,000	37,252	20,488
Total	**128,871,210**	**120,652,179**	**92,125,387**	**102,413,171**

Source: STATIN

Environmental Codes of Practice for Industries

Environmental Codes of Practice have been developed for the coffee and sugar industries in order to minimize the amount of waste generated as well as to reduce consumption of water and energy. NEPA has been encouraging other waste generators to look at waste minimization and cleaner production as alternative solutions which usually end up saving scarce financial resources as water and energy consumption are reduced.

Beach Clean-ups

Each year, Jamaica participates in the Ocean Conservancy's International Coastal Cleanup Day. Hundreds of Jamaicans across the island collect debris from the country's beaches on that day, recording the number and type of each piece collected. This exercise results in cleaner beaches and increased awareness about the links between land-based pollution and the coastal and marine environment. The data collected is a critical component of this exercise. With knowledge about the most prevalent components of marine debris, elected officials can make informed policy decisions, and community leaders can more effectively tailor and expand recycling and other waste reduction programmes.

KEY ECONOMIC SECTORS AND LINKAGES WITH THE NATURAL ENVIRONMENT

The economic and social well-being of Jamaica is directly linked to the state of its natural resources and the quality of the environment. The island's economic activities (tourism, mining etc.) if not carefully undertaken, can negatively impact on the quality of the environment and natural resources. For example, the tourism sector can be negatively impacted if the natural environment is degraded. There is the need to consider resource utilization in more sustainable terms. Additionally, each of Jamaica's important economic sectors has significant environmental aspects and impacts. This section will focus on the impacts of the energy, mining and tourism sector on the environment, and programmes and projects that are being implemented in this sector to reduce their impacts on the natural environment.

Energy

Jamaica has provided almost all its citizens with access to electricity; 90% of households have access. However, the country is almost completely dependent on imported petroleum to meet the energy needs of its businesses and industries, municipalities and households. Due to the energy intensity of the aluminum/bauxite industry, per capita energy consumption is high when compared with most developing countries. The dependence on imported fuels makes the country vulnerable to external price shocks and in 2009, the oil import cost surpassed Jamaica's export earnings of US$ 771.3 million for the year, for the first time. Consumption of this fossil fuel also leads to significant environmental impacts, including air pollution. However, there have been recent efforts to diversify the energy sector and

further develop alternative fuels as well as to increase energy efficiency and conservation, thereby reducing the consumption of petroleum.

CURRENT STATE OF THE ENERGY SECTOR

Energy Consumption

Jamaica currently consumes about 60,000 barrels of oil per day to meet its diverse needs. Over the past decade, the level of annual oil imports moved from 23.6 million barrels in 1999 to about 22.1 million barrels in 2009, representing an overall average annual decline of one percent per annum. Table 41 shows the energy consumption per capita and per unit GDP during the period 2007-2010.

Table 41: Energy Consumption 2007 – 2010

	2007	2008	2009	2010p
Population	2,682,100	2,692,400	2,698,800	2,707,800
Total Energy Consumption (boe)	29,322,210	27,230,679	21,225,213	19,847,761
Consumption per capita (boe/capita)	10.9326	10.1139	7.8647	7.3298
ENERGY USE PER UNIT OF GDP				
Real GDP (J$million) - 2003 prices	509,249	504,422	490,569	485,173
Total value of petroleum imports, USD	2,007,801,340	2,706,725,130	1,363,235,541	1,619,862,453
Annual Wtd Average FX exchange rate, JMD:USD	69.06	72.92	88.49	87.38
Total value of petroleum imports, J$million	138,659	197,374	120,633	141,544
Petrolum imports as % of GDP	27%	39%	25%	29%

Notes:

(1) Population figure for 2010 was not available. Figure was extrapolated

(2) Real GDP (J$million) for 2010 was not available. Figure was calculated based on an estimated growth rate of -1.1%

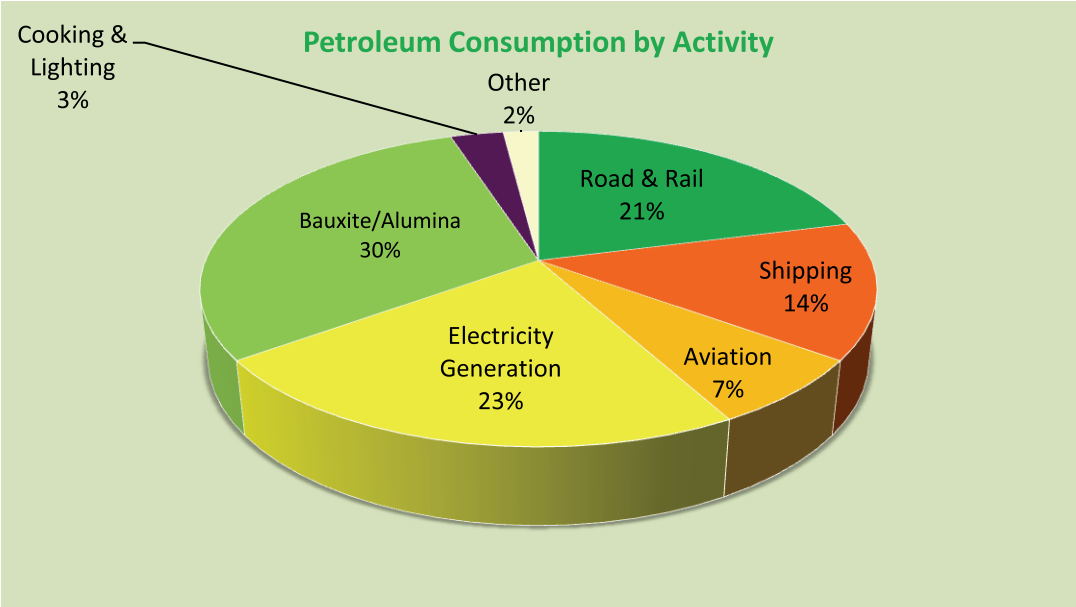
(3) p - preliminary

(4) exchange rate: BOJ

Source: Statistical Institute of Jamaica (www.statinja.com), Economic and Social Survey Jamaica (ESSJ), Planning Institute of Jamaica (www.pioj.gov.jm)

Petroleum provides 91% of the country's energy needs with renewable energy providing 9%. As shown in Figure 27, petroleum consumption is concentrated in three areas, namely: bauxite/alumina, power generation and transport, where transport accounts for 42% of the total.

Figure 27: Consumption of Petroleum by Activity

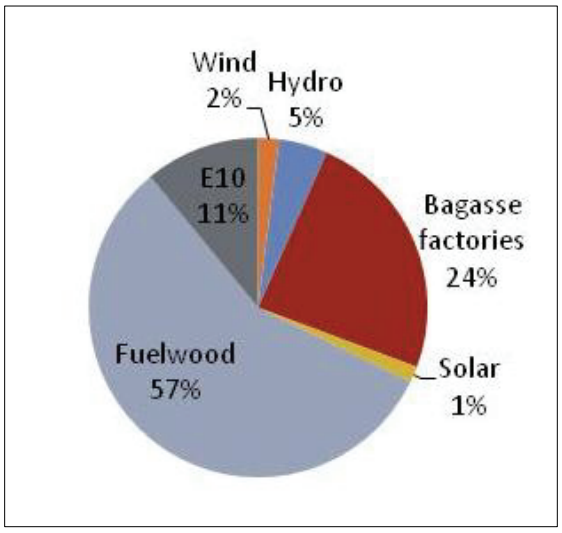


Source: Ministry of Energy and Mining

Renewable Energy

Jamaica has abundant renewable energy sources and is relatively advanced in the development of renewable energy, surpassing a number of Caribbean countries. These resources include wind, biomass, mini-hydro, photovoltaic and solar energy as well as new sources such as energy generation from waste and biofuels. The proportion of renewable energy increased from 5% in 2008 to 7.5% in 2009 and 9% in 2010 due primarily to the development and implementation of various programmes such as the use of E10 in motor vehicles (MEM, 2009). Figure 28 shows the contribution of different types of renewable energy sources to the mix.

Figure 28: Breakdown of Renewable Energy in Jamaica 2009



Source: Ministry of Energy and Mining

Energy Efficiency

Jamaica is very inefficient in its use of energy. This is due to a range of factors, including: the high energy use of the bauxite and alumina industry; an inefficient public electricity system; inefficient energy technologies in manufacturing and other productive sectors; inefficient energy use in the public sector; low public awareness of the importance of energy conservation; and an inadequate policy framework to promote energy conservation and efficiency.

Jamaica's energy intensity index has increased steadily in recent years, and now indicates that the economy requires up to 20,000 British thermal units (BTUs) to produce US$1.00 of output, compared to a global average of 4,600 BTU.

IMPACT OF ENERGY SECTOR ON THE ENVIRONMENT

There are environmental impacts from all aspects of the energy sector: generation of electricity, transport of fuels, consumption/burning of fuels, and disposal of waste oils.

The burning of fossil fuels is the single biggest contributor to emissions of greenhouse (GHG) gases such as carbon dioxide and nitrous oxide that contribute to climate change and global warming. While Jamaica's contributions of GHGs is negligible on the global scale, other pollutants are emitted from the burning of fossil fuels which lead to local air pollution which impact human health, most often causing respiratory illnesses. ***The section on Air Quality provides more details about air pollution due to energy consumption.***

RESPONSE OF ENERGY SECTOR TO REDUCE ENVIRONMENTAL IMPACTS

National Energy Policies and Plans

The **National Energy Policy 2009-2030** is the guiding document for the sector. The Policy is designed to ensure that Jamaica achieves "a modern, efficient, diversified and environmentally sustainable energy sector…" and provides goals and targets related to diversification of fuels, promotion of energy conservation and efficiency and renewable energy of all forms, and improving the country's energy infrastructure and governance. The policy will be operationalized by a series of three-year action plans which provide specific tasks that need to be executed. The first plan, the **National Energy Policy Action Plan #1 2009 – 2012,** has been developed and includes the priority actions that must be taken in order to ensure the successful implementation of the policy.

To support the implementation of the National Energy Policy, the following six draft policies have been developed:

- National Renewable Energy Policy 2010 – 2030
- National Energy-from-Waste Policy 2010 – 2030
- National Biofuels Policy 2010 – 2030
- National Energy Conservation and Efficiency Policy 2010 – 2030
- National Policy for the Trading of Carbon Credits 2010 – 2030
- National Electricity Policy

These inter-related sub-policies collectively seek to improve the efficiency and effective governance of the energy sector, while reducing Jamaica's carbon footprint and its dependence on imported petroleum.

There are several other policy and regulatory initiatives concerned with energy use and environmental protection. The **Policy on Environmental Stewardship of Government Operations** has been drafted as is part of the Government of Jamaica's goal of enabling GOJ entities to become more efficient in their operations, generating significant cost savings while eliminating or minimizing adverse impacts on the environment. The Environmental Stewardship Policy speaks to among other things, Energy Conservation, Water Conservation and Fleet Management - aspects of government operations that have an impact on the overall use of energy.

Approaches to Reducing Environmental Impacts of the Energy Sector

Further Development of Renewable Energy

The Government, in collaboration with other stakeholders in academia and the private sector, is actively promoting the further development of solar, wind and hydro energy and use of biofuels. The focus of the biofuels effort is on the development of ethanol from sugarcane, further use of bagasse for co-generation, production of biodiesel from vegetable oils, and generation of biogas from animal wastes. Energy-from-waste is regarded as "renewable" energy and efforts to promote this are underway as well. Currently, the Petroleum Corporation of Jamaica is in discussion with an investor to construct two plants to generate energy from waste incineration near the Riverton and Retirement dumpsites.

Energy Conservation and Efficiency

As indicated above, the Environmental Stewardship policy is being developed to actively encourage energy efficiency and conservation. Energy efficiency refers to getting the same output from less energy

used, for example by using fluorescent instead of incandescent bulbs. Energy conservation is using less energy by changing behaviour, for example, by turning lights off when not in use. Also, many NGOs and CBOs are engaged in efforts to promote energy efficiency and conservation in businesses, households and with the general public. Not only will these efforts help to protect the environment, but they will save money as well.

Carbon Credit Trading

Jamaica is seeking to implement projects that will generate carbon credits so that it can participate in carbon trading regimes including the Clean Development Mechanism (CDM) of the Kyoto Protocol as well as voluntary carbon schemes. Qualifying projects are in three categories: alternative energy – including renewable energy – that replaces or reduces the consumption of high carbon content fossil fuels; energy efficiency; and afforestation and reforestation. By implementing these projects, Jamaica will not only generate carbon credits and subsequent access to finances, but will realize several of its own development and environmental goals.

Mining

The mining and quarrying sector is important to Jamaica's economy. Since 1985, the minerals industry has contributed at least 4.5% to Jamaica's annual Gross Domestic Product. Between 2001 and 2007 the industry's annual average growth was 3.2%. However, in 2009, the contribution from the mining and quarrying industry declined by 50.2%. The industry contributed 2.0% of GDP when compared with 3.8% the previous year.

In terms of employment, during the period 2001 – 2008, the industry directly employed between 4,570 and 6,200 persons on a full-time and part-time basis, which represents between 42% and 59% of the employed labour force. Furthermore, minerals operations are located primarily in rural and semi-rural areas and therefore play a major role in sustaining the economic and social fabric of communities in these areas.

The mining and quarrying industry clearly depends on exploiting the country's natural resources and cannot be pursued without negative environmental impacts. However, it is the industry's responsibility to minimize negative impacts of mining operations where possible, for example by reducing energy and water use and to ensure the health of persons in nearby communities.

CURRENT STATE OF MINING SECTOR

The mining and quarrying industry is concerned with extracting and producing raw minerals and producing value-added mineral products for various sectors of the economy. Types of minerals and mineral-based products found in Jamaica are bauxite, limestone, marble, sand and gravel, gypsum and shale, volcanic materials such as pozzolan, gold, clay and dolomite.

Reserves

Table 42 provides estimates of the volume of some mineral deposits being mined in Jamaica, including bauxite. An estimated four per cent of Jamaica's lands are 'bauxite lands' (420,000 ha).

Table 42: Estimated Deposits of Certain Minerals in Jamaica

Mineral	Estimated Volume (million tonnes)
Alluvial Sand and Gravel Deposits	1,336,500[a]
Clay	158.9
Limestone	2,782,000
Gypsum Anhydrite[b]	21,000 7,000
Sand	16,373,000
Marble	0.350
Bauxite	2,000[c]

Source: National Minerals Policy 2010-2030

Notes:

a. Data on reserves of sand and gravel are difficult to measure as the reserves can change from year to year. The figure in this table is the volume extracted in a year.

b. Anhydrite is formed when water is evaporated from gypsum and is a harder and rarer mineral than gypsum.

c. One billion tonnes are determined to be economically viable since some bauxite is not accessible due to the high cost of mining.

Production

Most quarries are in rural areas of Jamaica. The majority of sand and stone quarries are in the eastern part of the island mainly along the Rio Minho in Clarendon and St. Catherine; limestone quarries are mainly in the western parishes (see Tables 43 and 44). At the end of 2010, there were 243 quarries with licences, an increase of 11.5% over the number in 2005.

The country's quarries mainly produce material used in the construction industry for roads and buildings and also for the production of cement and blocks. Table 45 shows the volume of industrial minerals produced during the period 2007 - 2010. It is estimated that 20 per cent of the real demand for sand and about 10 per cent of limestone for construction purposes is supplied through illegal quarrying.

Table 43: Number of Quarries by Parish - 2005 and 2010

Parish	2005	2010
Kingston	1	1
St. Andrew	9	13
St. Thomas	19	28
Portland	10	11
St. Mary	18	19
St. Ann	16	11
Trelawny	10	16
St. James	15	16
Hanover	6	9
Westmoreland	16	17
St. Elizabeth	17	21
Manchester	11	14
Clarendon	37	25
St. Catherine	33	42
TOTAL	218	243

Table 44: Number of Quarries by Type - 2010

Parish	2010
Limestone/Marl Quarries	154
Sand & Stone Quarries	77
Clay Quarry	1
Dune Sand Quarries	2
Gysum Quarry	1
Pozzolan Quarries	2
Cobble Stones Quarries	2
Sand Stone Quarry	1
Andesite Quarry	1
Beach Sand	1
Shale	1
TOTAL	243

Source: Mines and Geology Division

IMPACT OF MINING SECTOR ON THE ENVIRONMENT

The minerals sector has very significant impacts on the environment. Mining produces dust and noise pollution, effluent such as red mud residues and causes land degradation and reduction of forest cover. These result in a loss of habitats and biodiversity, threats to watersheds, increased sediment loads to surface waters, coastal waters and the marine environment as well as the relocation of communities.

Bauxite mining, in particular, is very land-intensive and often results in clearing forested land to build roads to access the sites and to conduct open-pit mining. Of great significance, is that these access roads provide a conduit into these forested areas and often enable illegal removal of trees around mining sites. Jamaica has a particular problem with sand mining. Constant mining in riverbeds may change the features of the river and create increased flood risk.

The country's quarries mainly produce material used in the construction industry for roads and buildings and also for the production of cement and blocks. It is estimated that 20 per cent of the real demand for sand and about 10 per cent of limestone for construction purposes is supplied through illegal quarrying.

Table 45: Production of Industrial Minerals in Jamaica 2007 – 2010

Mineral	Production in tonnes			
	2007	2008	2009	2010
Limestone	2,950,000	2,527,480	1,913,767	1,956,056
Marl/Fill	3,228,248	2,740,000	2,055,000	2,155,000

Mineral	Production in tonnes			
	2007	2008	2009	2010
Pozzolan	114,481	124,304	132,470	139,548
Silica sand	14,460	14,818	6,792	12,964
Marl and fill	3,228,248	2,740,000	2,055,000	2,155,000
Sand and gravel	3,611,347	2,985,000	2,600,000	2,750,000
Shale	168,354	200,301	164,471	202,335
Clay (m^3)	663,844	101,198	81,001	5,000

Source: Mines and Geology Division

Table 46 shows production of the three major minerals: bauxite, alumina and gypsum during the period 2007-2010. Bauxite and alumina production was noticeably reduced during 2009, suffering a 28% and 56% decrease, respectively from the previous year. This decline was as a result of the global recession and its negative impact on the price and demand for aluminium, resulting in the closure of two of its key plants, Windalco and Alpart in 2009 and the reduction in bauxite production from the St. Ann Bauxite Company, the lone exporter of crude bauxite on the island.

In 2010, production of bauxite increased by 35% over 2009 levels, almost returning to 2007 and 2008 levels due to the re-opening of WINDALCO's Ewarton plant and an increase of bauxite production from the Noranda plant in 2010. However, alumina production decreased even further (by 10% of 2009 levels). Between 2007 and 2010 gypsum production showed a steady decline with a reduction of 35% from 2007 to 2010.

Table 46: Production of Minerals in Jamaica 2007 – 2010

Mineral	Production in tonnes			
	2007	2008	2009	2010
Bauxite	4,417,925	4,452,009	3,200,095	4,318,785
Alumina	3,940,591	3,995,358	1,776,667	1,590,659
Gypsum	227,697	204,609	156,877	147,103

Source: Mines and Geology Division

RESPONSE OF MINING SECTOR TO REDUCE ENVIRONMENTAL IMPACTS

National Legislation

Under the **Mining Act (1947)** regulates the bauxite industry. The Act governs the issuing of exploration and exploitation licences. Also, under the Act, bauxite companies must adhere to land reclamation regulations set out by the Jamaica Bauxite Institute. Deep craters must be refilled and the miners must restore the land by placing at least six inches of top soil in mined-out areas. The **Quarry Control Act** governs the quarrying of minerals other than bauxite.

The mineral exploiting sectors are required to comply with environmental legislation such as the **Natural Resources Conservation Authority (NRCA) Act**, the **Wild Life Protection Act** and the **Beaches Control Act**, where port facilities would be of significance. **The 2006 Ambient Air Quality Regulations and**

Guidelines require continuous monitoring, assessment and verification of emissions and the development and application of dispersion modelling for each major facility, including mining facilities.

The NRCA Act requires that development projects for the exploitation of mineral and non-mineral resources with environmental permits may require an Environmental Impact Assessment (EIA) Report and a Health Impact Assessment (HIA) Report.

National Policies and Plans

The **National Minerals Policy 2010 – 2030** guides the development and operation of the minerals industry. The approach underpinning this policy is concerned with employing technology to find new reserves, transforming resources to reserves, recycling metals and construction aggregates, substituting one mineral for another, embracing cleaner technology, import substitution, integration into the local economy, minimizing waste and effectively rehabilitating mined lands. Additionally, it involves the application of visionary management to invest the proceeds of mineral exploitation in other sectors of the economy and so protect and guarantee sustainable livelihoods. It also includes, where necessary, foregoing mining owing to critical environmental, cultural and social issues.

Approaches to Reducing Environmental Impacts of the Mining Sector

Increasing Energy Efficiency in the Bauxite Industry

The Government and key stakeholders in the bauxite industry continue to look at strategies to address the high operating cost of these plants. In 2010, Noranda announced a US$165.6 million investment in upgrading works over the six year period 2009-2014. The Ministry of Energy and Mining is promoting the Liquefied Natural Gas (LNG) project within the industry to encourage the use of LNG as a replacement for heavy fuel oil.

Industry Compliance with Environmental Standards and Guidelines

The operators within the sector are expected to comply with codes of practice, guidelines, standards and regulations for the maintenance and improvement of the environment, including the controlled release of substances into the environment and the trans-boundary movement of hazardous wastes; dispose of ship-generated wastes in an environmentally sound manner; and engage conservation, management practices in their activities to reduce the risk to disasters and the negative impacts of climate change.

Land Information Systems

In order to facilitate informed physical planning and land management, the Office of the Prime Minister has continued to work towards the establishment of the National Spatial Data Infrastructure (NSDI). A fundamental component of a NSDI is the existence of a geospatial clearing house/portal that provides access to spatial information.

In 2008, a national geospatial metadata portal was created to serve as the single point of contact for anyone wishing to know which geospatial data sets are available for the island. [38] This is supported by a network of 13 high precision GPS base stations used to collect positioning data (X and Y coordinates).

The portal currently has data from five organizations, available to the public for viewing. The Ministry aims to have at least twenty government agencies publishing their metadata records via the portal by the end of 2010.

[38] The portal and home website addresses are: www.licj.org.jm and www.licj.org.jm/geonetwork/srv/en/main.home.

Geochemical Mapping of Soils

The International Centre for Environment and Nuclear Sciences (ICENS) at the University of the West Indies continues its work on analyzing the geochemistry of Jamaica's soil. Geochemical maps of the distribution of cadmium and other heavy metals are being produced and will find increasing use in a wide variety of agricultural, environmental and economic applications and studies. Geochemical data will be applied to urban and rural planning through the integration of land use plans with geochemical and geological maps. ICENS databases now contain over 200,000 analytical data records, and over 45,000 text, maps, photographs and satellite imagery records, including one-metre resolution IKONOS® images[39] for the entire island. These computer readable databases provide standard database, document, photo and multi-media content that, with GPS and GIS allow spatial assessments, interpretations and predictions, and have been used to prepare geochemical maps of the distributions of several elements including cadmium, a heavy metal of particular interest to Jamaica because of the unusually high concentrations of its occurrence in Jamaican soils and the potential threat to trade and health that this could pose for the island.

Land Rehabilitation

The bauxite industry is required by law to rehabilitate mined-out lands. The mining process begins with careful removal of the top soil, to be replaced after the mine is closed. However, the water retention ability of this top soil is often compromised, thereby making it less able to support the original type of land use (often agriculture).

Since the amendments to the Mining Regulations in August 2004, there has been an increase in the level of compliance in respect of the restoration of mined-out lands. A significant increase in the areas being certified as having been satisfactorily restored has been recorded – 150 hectares certified in 2003 versus 580 hectares in 2006. Table 47 shows the area of mined out lands that have been certified as having been satisfactorily restored between 2006 and 2008.

Table 47: Area of Land Certified as Reclaimed by the Mines and Geology Division

Year	Reclaimed land presented for certification (ha)	Reclaimed land certified[a] (ha)	
		Area (ha)	% of land presented
2006		580	
2007	578	513	88.8
2008	701	678	96.7

a. Certified by Mines and Geology Division as having been satisfactorily restored.

Source: Mines and Geology Division

With regard to land management in the bauxite sector, between 1952 and the end of 2010, a total of 8,422 hectares of land were mined, representing 0.8% of Jamaica's total land area of roughly 1 million hectares. At the end of 2010, approximately 6,033 hectares, 71.6% of the total area mined, had been certified by the Commissioner of Mines as being satisfactorily restored. The reclaimed rehabilitated lands have been used for pasture, agriculture, resettlement housing and playfields, basic schools and communities.

39Satellite images taken by IKONOS®, the world's first sub-metre commercial satellite.

Tourism

Tourism plays an important role in Jamaica's economy. The tourism industry contributes a large percentage to the national gross domestic product (GDP), government revenue, and foreign exchange earnings and is a source of employment. In 2010, tourism earnings of just over US$2 billion represented 20% of total GDP and represented well over 50% of foreign exchange earnings and a quarter of all jobs. This growth was achieved at a time when many Caribbean destinations were experiencing double-digit declines. However, Jamaica lost its place among the world's top 60 travel destinations, dropping five places in its ranking according to the Travel & Tourism Competitiveness Report 2011 issued by the World Economic Forum. The report showed that Jamaica now ranks 65th out of 139 countries. The report highlighted four sub-indices of uncompetitive performance by the island, which ranks 104th in the world for safety and security; 105th for cultural resources; 110th for natural resources, and 116th for environmental sustainability. Regionally, Jamaica ranked 12th in a group led by the US, Canada, Barbados, Mexico, Costa Rica and Puerto Rico.

While tourism provides considerable economic benefits it is also responsible for adverse environmental impacts. Environmentally sustainable tourism development requires that local natural resources be used to meet the needs of present tourism development activities without unduly compromising the ability of future residents to draw upon those same resources. Therefore, the proper management of natural resources and land use within coastal areas is therefore essential to mitigate environmental degradation associated with tourism activities. Based on Jamaica's ranking of 110th with respect to treatment of natural resources and 116th for environmental sustainability, it can be seen that there is a significant need for the country to improve in this regard.

CURRENT STATE OF TOURISM SECTOR

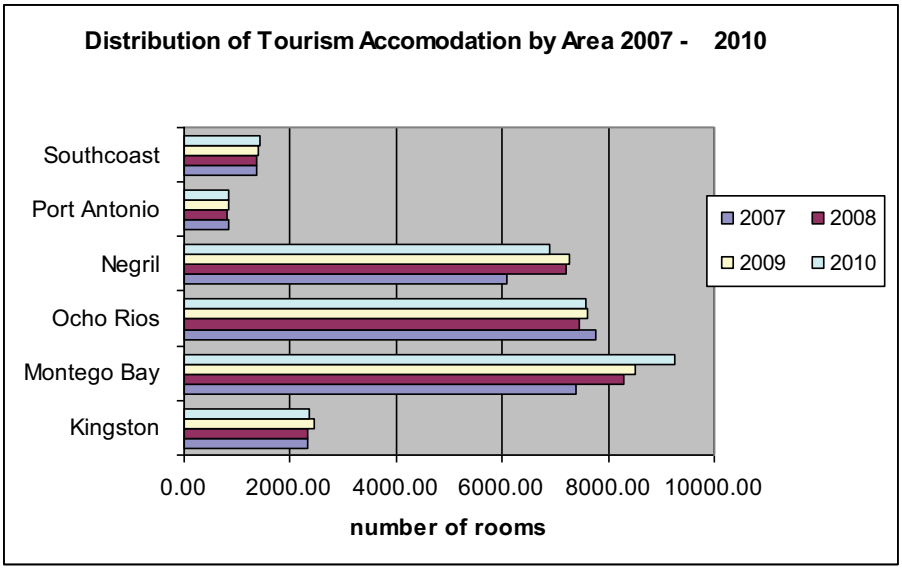
Indicators that provide a picture of the scale and scope of the tourism industry can be used to determine the impact on the country's infrastructure and natural environment.

Accommodation and Occupancy

The number of tourism-related accommodations (in terms of rooms) and occupancy levels (in terms of number of bed nights sold) can be used to estimate the use of various resources and impact on carrying capacity of specific locations by the industry.

Between 2007 and 2010, approximately 2,560 additional rooms were added to the accommodation sector representing an 18.5% increase in rooms available for occupancy. This brings the total number of rooms available in 2010 to 18,759. Figure 29 indicates that the resort area which received the greatest increase was Montego Bay with some 1,859 rooms added. Negril experienced a 12.8% increase in new rooms, while Ocho Rios experienced a decrease in rooms available for occupancy.

Figure 29: Distribution of Accommodation by Area 2007 – 2010



Source: Annual Travel Statistics 2010, Ministry of Tourism

Cruise Ship Tourism

Jamaica's tourism industry depends not only on the "land-based" sector but also on cruise ship arrivals. As Table 48 shows, the number of stopover visitors has increased during this period, while the number of cruise ship passengers has decreased. This decrease has occurred despite an increase in the number of cruise ships calling on Jamaican ports in Montego Bay and Ocho Rios during this time.

Table 48: Stopover and Cruise Ship Arrivals 2007 – 2010

Year	Stopover arrivals	Cruise Ship Arrivals
2007	1,700,785	1,179,504
2008	1,767,271	1,092,263
2009	1,831,097	922,349
2010	1,921,678	909,619

Source: Annual Travel Statistics 2010, Ministry of Tourism

IMPACT OF TOURISM SECTOR ON THE ENVIRONMENT

Jamaica's tourism industry is inextricably linked to environmental conservation, particularly since an unspoiled environment plays a significant role in the choice of destination of many European and United States visitors. The ecosystems upon which our tourism product is based are generally fragile ecosystems, including beaches, coral reefs, seagrass beds which are susceptible to the pressures which have accompanied the development of the tourism industry in Jamaica.

The majority of Jamaica's tourism infrastructure is located in the coastal areas, thus disturbing fragile marine and terrestrial ecosystems such as mangrove forests, sand dunes and seagrass meadows. These environmental impacts manifest at different stages of the hotels operation, particularly the disturbance of coastal and marine ecosystems during construction, leading to degradation of sensitive ecosystems and loss of marine and terrestrial habitat and biodiversity; while during the operational phase the impacts are identified as deterioration of coastal water quality; the demand for scarce and/or expensive water and energy, and the generation of wastes from land and sea-based sources.

Recreational activities related to tourism also exert pressure on the environment particularly with regards to disturbance of nesting sites for endangered marine turtles. Other recreational activities such as snorkeling, diving and boating have impacted marine and coastal resources. Table 49 further illustrates the actual and potential impacts of tourism on the environment.

Cruise tourism can result in damage to the marine environment. The development of deep-water ports to accommodate cruise ships requires extensive dredging, excavation, and construction, degrading fragile coastlines, coral reefs, and ocean floor ecosystems. The development of the Cruise Ship Pier in Falmouth, Trelawny, completed in 2010, involved the removal of wetlands and coral reefs. During operation, cruise ships emit sewage-containing effluent which has potential impacts on the coastal and off shore water quality, and thus on all aspects of the marine environment.

Table 49: Actual and Potential Impacts of Tourism on the Environment

Activities Related to Tourism		Actual and/or Potential Impacts
Resort development and construction		Removal of coastal resources – seagrass, mangroves, coral reefs Increased sedimentation impacting marine environment
Resort operation	Sewage disposal Fertilizer runoff Irrigation	Nutrient enrichment impacting coral reefs
	Solid waste disposal	Leaching of toxic substances from land fills Inappropriate waste disposal
Seafood consumption		Over-exploitation of high-priced resource species
Demand for marine curiosities		Exploitation of rare/ endangered/ vulnerable species such as Queen Conch shells, coral, turtles
Construction of artificial beaches and beach replenishment		Increased sedimentation (from sand removal or from beach instability)
Airport construction or extension		Increased sedimentation from dredging and infilling
Marina/ Port construction		Increased sedimentation from dredging , removal of coastal/marine resources
Marina operation		Pollution from inappropriate disposal of oils and paint residues Pollution from fueling
Motor boating, yachting, diving and snorkling		Pollution from fueling Disturbance of marine wildlife Damage to coral reefs from anchor and boat groundings
Cruise ships		Nutrient enrichment from illegal disposal of effluent Increased probability of marine environmental accidents and introduction of invasive species Demand on freshwater water resources and waste disposal

The tourism industry is notable for the high volume of solid waste generated and the high consumption of energy and water. The water and energy demands of tourism increasingly compete with those of the resident population as the degree of tourism development increases. In 1999, a study was conducted by the United Nations Environment Programme (UNEP) to estimate the demand for water and energy as well as solid waste generated by the tourist industry in the region (UNEP, 1999). Table 50 provides these for Jamaica for the 1990-1999 period. In Jamaica, all three parameters increased by approximately 43%. UNEP has pointed out that as a result of tourism, the Caribbean has one of the highest per capita water withdrawal rates in the world.

Table 50: Estimated Solid Waste Generation and Water and Energy Demand for the Tourism Industry in Jamaica 1990-1999

Parameter	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Solid waste generation (tonnes)	5024	5409	5769	5908	6165	6520	6859	7162	7086	7197
Demand for water (million gallons)	301.4	324.5	346.1	354.5	369.9	391.2	411.5	429.7	425.2	431.8
Energy demand (million kWh)	36.3	39.1	41.6	42.7	44.5	47.1	49.5	51.7	51.2	52.0

Source: UNEP

RESPONSE OF TOURISM SECTOR TO REDUCE ENVIRONMENTAL IMPACTS

National Policies and Plans

The Master Plan for Sustainable Tourism 2002 is the guiding document for the industry. The Plan gives specific guidelines and makes recommendations on how infrastructural development in the industry should be pursued. It also recommends ways in which the tourism product can be improved while balancing environmental sustainability.

The Plan states that the starting point for achieving long-term sustainability of the industry lies in the physical location of the industry as this determines the stress put on the environment. The strategic vision therefore involves ensuring that visitor numbers are kept at a level within the carrying capacity of resort areas. The Master Plan, however, acknowledges that "resort centres have already exceeded their carrying capacity and that increasing social and physical infrastructure and improving environmental management are pre-conditions to further growth" (Gleaner 2008).

Approaches to Reducing Environmental Impacts of the Tourism Sector

Sustainable Tourism

"Sustainable tourism" is often equated with nature or eco-tourism; but it inherently means more than protecting the natural environment. It involves proper consideration of host peoples, communities, cultures, customs, lifestyles, and social and economic systems. It is tourism that truly benefits those who are on the receiving end, and that does not exploit and degrade the environment in which they live and from which they must earn a living.

Financial Incentives and Funding for Sustainable Tourism

Tourism is a very competitive global business where profit margins are key. As in many other areas of environmental protection, sustainable tourism may require the removal of perverse subsidies that reward environmentally degrading activities, and their replacement with positive incentives to undertake market activities which meet environmental objectives at the same time. This is where

Regulatory Impact Assessments of policies, plans and programmes developed in and for the tourism sector will be extremely instructive.

Eco-tourism and **community-based tourism** are two aspects of sustainable tourism that are being promoted in Jamaica. Ecotourism is a form of tourism to relatively undisturbed natural areas for the main purposes of admiring them and learning more about them. Eco-tourism also seeks to reduce its impacts on the area visited.

Community-based tourism may be defined as meaningful interaction that enriches both hosts and visitors, supports and promotes responsible tourism and sustainable livelihoods, and creates economic, social, cultural and environmental benefits for local communities. Presently, estimates indicate that there are approximately 40 community-based tourism enterprises islandwide. They offer an alternative tourism product which focuses on nature, heritage and culture and are located predominantly on the south coast of the island. The Ministry of Tourism and the Jamaica Social Investment Fund have embarked on the development of a Jamaica Community-Based Tourism Policy & Strategy.

Upgrade of Sewage Treatment Plants in Major Resort Towns

In an effort to preserve the coastal environment and aquatic biodiversity of some of the major resort areas, new wastewater management infrastructure has been constructed. In Ocho Rios and Negril wastewater treatment plants were completed in 1998. Subsequently, however, deficiencies however were found in the collection and treatment systems. Further maintenance and upgrade works are to be undertaken by the National Water Commission on both sewage treatment plants commencing in 2010[40.]

In St James, the Bogue Sewage Treatment Plant has a total capacity of 10.5 million gallons per day and currently handles 4.5 million gallons per day. The National Water Commission is currently expanding the sewerage network to include more buildings within the Greater Montego Bay Area[41].

Environmental Impact Assessments

Environmental Impact Assessments (EIAs) are required of hotel developments and are an important tool for improving project design to reduce potential environmental impacts. Table 51 shows the EIAs undertaken for tourism-related development during the period 2007 – 2010.

Table 51: EIAs Conducted for Tourism-related Development 2007 – 2010

Year	Development	Location
2010	none	
2009	none	
2008	Archaeological Assessment - Grand Palladium Lady Hamilton Resort and Spa	Hanover
2007	Golf Course	Duncans, Trelawny,
2007	Martha Brae Theme Park	Martha Brae, Trelawny
2007	Falmouth Cruise Ship Pier	Falmouth, Trelawny
2007	Treasures of Trelawny Resort Development	
2007	Proposed Hotel/Resort Development	Coral Spring, Trelawny

[40] EU Project Fiche JAMAICA - Rehabilitation Negril & Ocho Rios Wastewater Treatment Plants
[41] SEA Rose Hall Developments Sewage Treatment Plant Master Plan – ESL Ltd 2008

Year	Development	Location
2007	Heritage Bay – Hotel and Marina Resort	Salt River Bay, Clarendon
2007	Hotel, eco-tourism, residential/Commercial	St Elizabeth
2007	Dolphin Park - Attraction	Paradise, Hanover
2007	Seawind Key - Resort	Montego Bay, St James
2007	Hotel and Condominiums	Montego Bay, St James
2007	Negril Peninsula - Resort	West End Negril, Westmorelend
2007	Phase 17th Harbour Development – Marina and Entertainment Complex	Kingston

Source: NEPA 2011

The Tourism Enhancement Fund

The Tourism Enhancement Act, 2004 provided the legal basis for the ministry responsible for tourism to establish a mechanism for the collection of a fee from incoming airline and cruise passengers to be paid into a dedicated Tourism Enhancement Fund (TEF). The Fund, established in 2005, accords the highest priority to projects falling within the following classifications:

- Heritage Tourism – Built and Natural
- Resort Enhancement (product development, beautification)
- Community Tourism
- Sports and Entertainment
- Environmental Management
- Culture

The TEF has funded several projects including improvement works to Devon House, the Hope Gardens and Zoo and Port Royal in Kingston and St Andrew, the Lord Rodney Memorial and Colonnade, Spanish Town, Old Seville in St. Ann and the Montego Bay 'Hip Strip' Resort Plan. To date however, no projects directed at conservation of the natural resources have been funded.

Environmental Certification

Within the tourism sector, Green Globe and Blue Flag are two environmental certification programmes which are internationally known and accepted. Green Globe Certification indicates that a hotel has met standards related to sustainability policy, energy consumption, potable water consumption, solid waste production, social commitment, resource conservation and cleaning chemicals used. Blue Flag certification indicates that beaches and marinas have met criteria dealing with water quality, environmental education and information, environmental management, and safety and other services. A number of international environmental standards also have been applied to the tourism industry, for example, the International Organization for Standardisation (ISO) international voluntary ISO 14001 standard for environmental management systems. These are all designed to improve the entity's environmental performance and to reduce costs, while contributing to the improvement of the natural resources upon which they depend. It must be noted that these certification schemes require annual renewals at which time all criteria must continue to be met.

Currently, there are 15 hotels with Green Globe Certification and 8 beaches and one marina which are blue flag certified as shown in Table 52.

Table 52: Tourism Entities with Environmental Certification – 2010

Green Globe Certification	Blue Flag Certification
• Jakes Treasure Beach (St. Elizabeth) • Rockhouse Hotel (Negril) • The Ritz Carlton Golf & Spa Resort Rose Hall (St. James) • The Tryall Club (St. James) • Half Moon, A Rock Resort (St. James) • Round Hill Hotel & Villas (St. James) Runaway Bay Heart Hotel & Training Institute (St. Ann) • Sandals Resorts (island-wide) • Mockingbird Hotel (Portland) • Couples Sans Souci (St. Ann) • Couples Negril • Grand Pineapple Beach (Negril) • Grand Palladium Jamaica and Lady Hamilton Resort & Spa (St James) • Beaches Boscobel Resort & Golf Club (St. Mary) • Green Grotto Caves (St. Ann) • Chukka Caribbean Adventures (St. Ann)	• Bluefields Beach (Westmoreland) • Couples (Negril) • Couples Swept Away (Negril) • Long Bay Beach Park (Negril) • Merrils 1 (Negril) • Merrils 2 (Negril) • Travelers Beach Resort (Negril) • Ocho Rios Bay beach (St. Ann) • Errol Flynn Marina (Portland)

Sources: http://greenglobe.com/members, www.hotelmockingbirdhill.com, www.sandals.com/difference/eco-friendly-resorts.cfm, http://www.earthcheck.org/clients/member-search.aspx, www.blueflag.org

Agriculture

Jamaica's agricultural sector accounts for approximately 6% of GDP (which increases to almost 12% when the value of agriculture in forward and backward linkages is taken into account) and employs almost 20% of the country's labour force. In 2009, there were approximately 230,000 farmers producing crops and livestock for domestic use and for export. Significantly, the agricultural sector plays an important role in alleviating rural poverty by transferring money from urban to rural areas. Also, the vitality of the sector is important to achieve food security.

CURRENT STATE OF THE AGRICULTURE SECTOR

Agricultural land

The most recent census of agriculture for Jamaica conducted in 2007 identified approximately 319,000 hectares of land in farms. This represents 29 per cent of the total land area of approximately 1.099 million hectares. As Table 53 shows, there has been a continued decrease in the proportion of land allocated to agriculture since 1978. Population growth, leading to increased demand for land for housing, together with industrial and commercial expansion are two main factors contributing to this decline.

Table 53: Land in Farms - 1978, 1996, 2007

Census Year	Total Land Area ('000 ha)	Land in Farms	
		Total Area ('000 ha)	% of Total Land Area
1978	1,099.0	533.8	48.6
1996	1,099.0	421.6	38.4
2007	1,099.0	319.2	29.0

Source: Statistical Institute of Jamaica

There is limited information on the total area of agricultural land that has been converted to non-agricultural use. However according to the Ministry of Agriculture and Fisheries[42], of the 17% of Jamaica's land area that is flat and arable (186,155 ha), approximately 25% has been lost to other forms of development. The parishes with the most agricultural land are Clarendon (14% of area in parish), St. Elizabeth (12%), St. Ann (11%) and St. Catherine (11%). Table 54 shows the arable land in these parishes which have been converted to urban/residential uses between the 1950s and 2008. Table 55 shows the arable land that is planned for conversion from agricultural use for the construction of Highway 2000.

Table 54: Conversion of Arable Land to Urban Uses in Select Parishes

Parish	Total Arable Land in the 1950s (ha)	Total arable land used for urban purposes (2008)	
		Area (ha)	% of arable land
Clarendon	31,806	3,174	10
St. Elizabeth	32,169	1,359	4
St. Ann	-	-	-
St. Catherine	23,557	-	-

Source: Ministry of Agriculture and Fisheries

Table 55: Arable Land to to be Convereted from Agriculture for Highway 2000

Parish	Total Arable Land in the 1950s (ha)	Total arable land to be converted from agriculture	
		Area (ha)	% of arable land
Clarendon	31,806	12,936	41
St. Catherine	23,557	16,144[a]	69

a. Of the 7, 413 ha proposed to be retained for agriculture, 4,284 Ha (58%) is saline (St. Catherine Soil Survey 1986)

Source: Highway 2000 Project Land Use Plan

Approximately 61 per cent of the farmlands identified in the 2007 census may be classified as active farmland; that is, land allocated to crops and pasture (see Table 56). The table shows that in actual land area, the pattern is one of shrinkage of area in crops and pasture. Farming in Jamaica is dominated by small holders. In 2007, about three quarters of farms account for only 15 per cent of area in farm land. A total of 151,931 farms of under one hectare were reported with total area of 47,713 hectares. Farms of

[42] Raynor-Williams, Petre (July 28, 2010), Leave Agricultural Lands Alone. *The Jamaica Observer*, retrieved August 29, 2011 from http://www.jamaicaobserver.com/environment/Leave-agricultural-lands-alone_7829955

50 hectares and more totalled 368 (0.2% of all farms), but occupied 125,578 hectares (40.6% of total farm land).

Table 56: Utilization of Land in Farms: 1978, 1996, 2007

Farm Land	1978	1996	2007
	Area in thousands of hectares		
Land in Farms	**533.8**	**421.5**	**319.2**
Active farmland	311.6	273.2	195.5
• Crops	230.8	177.6	149.7
• Pasture	80.8	95.6	45.8
Inactive farmland	222.2	134.2	114.4
Use not reported	-	14.1	9.2
	Percentage of land categorized as farms		
Land in Farms	**100**	**100**	**100**
Active farmland	58.4	64.8	61.2
Inactive farmland	41.6	31.8	35.8
Use not reported	-	3.4	3.0

Source: Statistical Institute of Jamaica

The distinction between small and large farms is important. Small farmers typically engage in subsistence farming, growing a variety of crops not primarily for sale. Farming practices would generally involve what is termed 'shifting cultivation' which consists of burning and clearing of vegetation, cultivating a plot of land, exhausting its fertility before moving on to another location. Historically, these small farms occupy the less productive hillsides, and are not mechanized. The larger farms tend to occupy the best lands on the plains, are engaged in the growing of one crop and employ more mechanized and energy-consuming farming methods. These large farms also often apply more fertilizers and pesticides, generate more waste and produce more emissions than the small units.

Pesticide Use

Table 57 presents data showing the quantity of pesticides imported into Jamaica between 2005 and 2010. Increasing use of pesticides can indicate that increased areas are being cultivated and/or that increased levels of pesticides are being used per area being farmed. If more environmentally friendly farming practices are employed, a decrease in the amount of pesticides would be a positive indicator for the agricultural sector.

Table 57: Quantity of Pesticide Imported by Type 2005 – 2010

Type of Pesticide	Quantity (Tonnes)				
	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Herbicide	978.67	1,582.71	1,418.92	1,396.22	1,200.09
Fungicide	547.37	706.94	620.77	343.39	406.74
Insecticide	829.48	843.14	1,003.93	1,203.60	730.45
Nematicide	9.37	83.91	72.78	8.32	12.50
Rodenticide	87.67	97.22	59.04	50.51	61.15
Others	60.21	80.38	95.82	54.27	40.37
TOTAL	**2,512.77**	**3,394.30**	**3,271.26**	**3,056.31**	**2,451.3**

Source: Pesticide Control Authority

Fertilizer Use

Organic fertilizers are natural materials of either plant or animal origin, including livestock manure, green manures, crop residues, household waste, compost, and woodland litter. Inorganic (or mineral) fertilizers are fertilizers mined from mineral deposits with little processing (e.g., lime, potash, or phosphate rock), or industrially manufactured through chemical processes. Inorganic fertilizers usually contain more nutrients, and are associated with higher crop yields but can have detrimental effects on the soil and even the plants themselves if over-used. Table 58 shows the amount of fertilizers imported during the period 2007 – 2010. The imports of organic fertilizers into the country are considerably less than inorganic. However this is in no way an indication of the use by farmers as organic sources are much more accessible and many need not be purchased.

Table 58: Quantity of Fertilizers Imported by Type 2007 - 2010

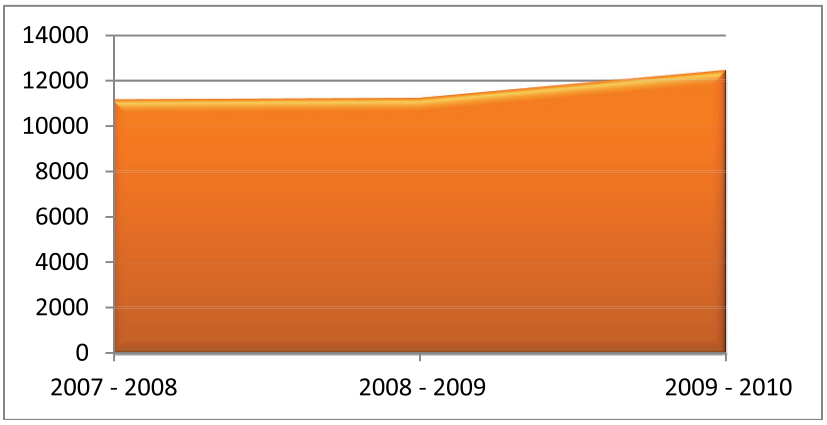
Fertilizer Imported	Quantity (tonnes)			
	2007	2008	2009	2010
Organic	0.8	Not available	1.2	1.0
Ammonium sulphate	2,291.01	10,254.15	11,078.16	10,542.09
Ammonium nitrate	1,375.58	788.23	518.63	216.02
Diammonium phosphates	1.83	4,061.41	4,367.86	4,320.44
Potassium chloride	17.18	0.16	1.20	181.82
Potassium sulphate	0.01	0.63	10.05	0.12
Other phosphorus or phosphate-containing fertilizers	3,530.92	4,859.09	6,051.70	2,185.01
Urea	6,193.31	4,061.41	2,358.14	3,167.77
Other fertilizers	7,636.22	9,345.71	6,478.81	3,123.23
TOTAL	**21,046.06**	**33,370.79**	**30864.55**	**23736.5**

Source: Statistical Institute of Jamaica

Irrigated Land

In 2010, 30,682 ha (or 12%) of cultivated land was irrigated. This represents an increase of 11% over the previous year (see Figure 30). About 50% of these irrigated lands are served by public irrigation systems managed by the National Irrigation Commission (NIC); and the other half are on commercial estates, and individual private systems. The NIC supplies irrigation water to its customers by two methods, pressurized, and open canal (surface irrigation). Pressurized water which is derived from deep wells and delivered in closed systems is used by farmers via drip or sprinkler systems. The main types of irrigation are surface irrigation (75%), followed by sprinkler irrigation system (17%), and drip irrigation system (8%).

Figure 30: Area of Cultivated Land under Irrigation



Source: National Irrigation Commission

IMPACT OF THE AGRICULTURE SECTOR ON THE ENVIRONMENT

Jamaica's agriculture industry is dependent on the quality of the country's land and soils as well as the quantity and quality of freshwater. The agricultural sector also is extremely vulnerable to shocks including weather conditions and the impact of natural disasters. Agriculture has a positive impact on Jamaica's environment by creating areas of vegetation that act as carbon sinks, removing CO_2 from the atmosphere. However, this industry also has negative environmental impacts exacerbated by the fact that a large proportion of farmers employ poor agricultural practices especially as it relates to land clearing, tillage, soil conservation, pest management, pesticides management, application of fertilizers and slope management.

Decrease in Water Quality and Availability

Irrigation of agricultural lands is by far the largest use of the country's freshwater, accounting for 55% of the anthropogenic use of water. Water logging, salinity, disruption of water tables and damage to fisheries, plants, wildlife and water supply systems are some of the more damaging consequences of the practice.

Waste Generation and Pollution

Many sources of waste and pollution are generated from agricultural activities. These include sewage from manure (e.g. pig farms), adverse effects from pesticides and fertilizers, improper disposal of dunder as a byproduct of rum production and the emission of harmful air pollutants as a result of practices such as sugar cane burning. When stored in open lagoons agricultural waste releases methane, a GHG that is 21 times more potent than carbon dioxide. Heavy rainfall can create pollution in water bodies from these storage areas.

Soil Exhaustion and Erosion

Many agricultural practices can greatly accelerate soil erosion including, improper hillside farming practices such as construction of drains downwards on slopes and maximum tillage of soil. When this soil enters waterways, it causes pollution.

Land Degradation and Deforestation

The decline in land/ soil productivity is attributed to many factors including wind and water erosion of exposed topsoil, loss of soil organic matter and water holding capacity, salinization of soil and irrigation water, and overgrazing. Deforestation results from the clearing of hillsides, conversion to monoculture farming and uncontrolled harvesting. The impacts of deforestation include watershed and water quality degradation, increased soil erosion, siltation of coral reefs, loss of biodiversity and habitats, and increased flooding effects.

Loss of Biodiversity, Wildlife and the Fragmentation of Habitats

Agriculture affects biodiversity through the impact of land cultivation on habitats and fragile ecosystems. In addition, biodiversity may be affected in the future by the introduction of genetically modified crops. Agricultural activities, especially in primary forests, cause habitat fragmentation which can also lead to a loss of biodiversity and wildlife.

RESPONSE OF THE AGRICULTURE SECTOR TO REDUCE ENVIRONMENTAL IMPACTS

International Agreements

Jamaica is a signatory to the **Rotterdam Convention**, which promotes shared responsibilities in relation to importation of hazardous chemicals, and the **Stockholm Convention on Persistent Organic Pollutants** (POPS)[43], which protects human health and the environment from chemicals that remain intact in the environment for long periods. Currently, activities are underway to phase out certain pesticides, for example endosulfan, widely used in the local coffee industry and carbofuran, used to control insects in a wide variety of field crops.

National Policies and Plans

The Government has developed, or is in the process of developing, a number of policies which will improve the agricultural sector and reduce its negative environmental impacts.

The **draft Agricultural Land Use Policy** is being developed to spur the use of arable lands across the country. These lands have lain fallow for decades and represent an opportunity lost to the island. The **National Biofuels Policy 2009-2030** creates a framework for the further development of the use of crops to generate energy and the National Energy-from-Waste Policy 2010 – 2030 governs the generation of energy from agricultural wastes. A **Draft National Organic Policy** is being developed to govern organic food and farming systems. It will address development of national organic standards and legislation that will govern the production and trade of organic food.

The **National Irrigation Development Master Plan for Jamaica** proposes 51 projects for implementation by the year 2015. The objective of the Master Plan is to promote a sustainable approach to irrigated agricultural development. The 51 projects identified cover approximately 20,702 hectares of land concentrated primarily on the southern plains of the southern parishes of St Catherine and St Elizabeth.

[43] POPs are a set of toxic chemicals that are persistent in the environment and able to last for several years before breaking down (UNEP/GPA 2006a).

Jamaica's involvement in genetically modified organisms (GMOs) is governed under its commitments to the **Cartagena Protocol on Biosafety** to the **Convention on Biological Diversity**. Although Jamaica has not yet ratified the Protocol, the country intends to subject its import and export of GMOs to the provisions of the agreement. Presently, Jamaica is developing its **National Biosafety Framework** and a **BioSafety Policy**, which will provide the institutional framework for biotechnology and GMOs in Jamaica.

Approaches to Reducing Environmental Impacts of the Agriculture Sector

Permit and Licence Systems

Agricultural plants are required under the NRCA Act to obtain an environmental permit and/ or license from NEPA to ensure that the effluent discharged meets certain standards set by NEPA. In addition, coffee industry operators must obtain a Works License to process coffee from the Coffee Industry Board. During the period 2005 to 2010, three environmental permits for the construction of wastewater treatment plants (systems) and one environmental license for the discharge of effluent were issued to coffee processors.

Agriculture as a Source of Energy

Bagasse is already widely used as a source of energy, providing 24% of Jamaica's renewable energy (see Figure 27 in the section above on Energy). Approximately 600,000 tonnes of bagasse (equivalent to about 940,000 barrels of oil at a value of US$37.5 million) are used per annum (as of 2003) in co-generation in Jamaica's sugar factories. It is estimated that excess electricity of approximately 300 GWh per year would be available with bagasse combustion alone, resulting in about 68 MW of available capacity.

The sugarcane industry has a critical role to play in the indigenous production of ethanol to meet national E10 requirements and through bagasse as a source of biomass for electrical power generation. Sugarcane is recognized as having the highest energy balance of any crop used for ethanol production. The production of the Jamaican publicly owned sugar industry has been in a state of decline and uncertainty for the last three decades. Indigenous production of ethanol and efficient co-generation that can provide power to the grid could revitalize the sugarcane industry which may come to be known as the "energycane" industry.

The Government also is promoting the development of other biofuels such as biodiesel from plant oils and biogas from livestock wastes. The biofuels sector is largely in the research phase. The Scientific Research Council has been involved in the development of biogas plants using animal wastes in the agricultural, small manufacturing, educational and residential sectors. A total of 250 of these plants are in operation across the island, though cultural barriers are still to be broken in order to gain full acceptance of biogas as a fuel for cooking. However, this approach could lead to more viable options for farmers and at the same time, deal with the problem of disposal of agricultural wastes.

The capture of landfill gas is another potential source of energy. Landfills produce gas – mainly methane and carbon dioxide – directly in proportion to the total quantity of organic material contained in them. Therefore, Jamaican dumpsites generate large volumes of gas since 69% of the municipal waste stream consists of organic matter. The volume of methane available for recovery from the Riverton dump site is estimated at 200 l/kg of refuse over a period of 30 years.

Environmentally-friendly Farming Practices

The Government is encouraging best management practices such as increasing irrigation and fertilizer efficiency, introducing disease and pest resistant varieties and mulching. The Rural Agricultural Development Agency (RADA) regularly conducts training for extension officers and farmers in areas such

as plant health, food safety, pest identification, soil conservation and Integrated Pest Management (IPM). RADA has conducted sensitization sessions on the importance of treatments such as contour barriers, grassed waterways, check dams, tree orchards, intercropping and minimum tillage. These best practices will conserve water, reduce chemical applications, and reduce soil erosion. Biologically based IPM methods are often necessary to control pests that affect key crops such as citrus and papaya. Furthermore, IPM reduces the risk of pesticide residues for fruits destined for the export market. This is critical for Jamaican farmers to have access to the European export market which has stringent requirements for agricultural market access.

The sugarcane and coffee industries have developed environmental codes of practice that cover all areas of operation which have potential negative impacts on the environment, including field and factory operations, product handling and storage, and support services.

Green Cane Harvesting

Under the Stockholm Convention, Jamaica is required to take measures to minimize all sources of persistent organic pollutants (POPs). A major source of POPs is cane burning which emits furans and dioxins into the atmosphere. Cane burning is common even though sugar from cane harvested green is of a higher quality and therefore has a higher market value. This is because green cane harvesting is a slower process which requires the engagement of more cutters for a given area of crops. The complete elimination of burnt cane harvesting will depend on a full mechanization of the process.

Wastewater Management

The sugar industry is currently involved in a programme to provide technical assistance for the management of wastewater from the rum and sugar industries in order to strengthen environmental compliance and economic sustainability of the rum and sugar industries. Programmes to handle dunder and to recycle factory wastewater are also being implemented. At Worthy Park Sugar Estate, approximately 80% of the water is recycled.

Organic Farming

The Jamaica Organic Agriculture Movement (JOAM) is a non-profit, non-governmental organization created to foster an organic agriculture industry in Jamaica. Widely interpreted in Jamaica to mean "grown without fertilizers", organic production is far more than that. Organic production contributes to conservation of biodiversity, aids survival of pollinators, and enhances soil quality (FAO, 2008[44]). Organic standards ban burning for land clearance and demand that farmers protect land from soil erosion. Thus far JOAM farms have sustained less long-term damage from flood events and have had swift recuperation after hurricanes compared to conventionally managed farms.

With funds from the FAO/EU Food Facility Project, JOAM has been assisted in the development of 12 newly created demonstration farms across the island, which are serving as learning sites for farmers in those areas. Farms already certified also serve as demonstration sites for field trips and workshops. As well as the demonstration farms, a island-wide training programme was undertaken for RADA officers, who have the responsibility for providing advice and support to organic farmers, and to large numbers of farmers who availed themselves of the opportunity to learn.

Greenhouse Farming

Greenhouse production was introduced to Jamaica on a wide scale in 2005. The method provides growers with the ability to achieve significantly higher yields than open field production. This is mainly

[44] Environment and Natural Resources Series #4. 2008

due to the enclosed structure and protective antiviral netting which protects plants from pests, diseases and harsh elements as well as the use of drip irrigation and a fertilization program that ensures good plant nutrition and an increased capacity to bear more. The technology also involves the use of less land area compared to open field production, more efficient use of water resources; and far less use of chemicals to control pests and diseases.[45]

At mid 2009 there was a 30% increase over the previous year in greenhouse capacity. That resulted in 303 tonnes of tomatoes, sweet pepper, lettuce and cucumbers.[46]

Introduction of Genetically Modified Organisms

Genetically modified organisms (GMOs) are organisms whose genetic material has been altered, using genetic engineering techniques. Many GMOs currently being grown were designed for a number of reasons including: pest resistance, herbicide tolerance, disease resistance, cold tolerance, drought tolerance, and enhanced nutrition. Some GMOs being developed in Jamaica include a papaya resistant to viral infection from the papaya ringspot virus and a virus-resistant tomato. [47]

Environmental Certification Systems

Out of 19 companies which are ISO-14000 certified, 10 of these are food and beverage companies, i.e. associated with the agriculture sector. These include companies that produce spices and condiments, canned ackee and callaloo, as well as natural juices, soft drinks, beer, wines, spirits, and liqueurs. ISO-14000 certification is granted when companies implement approved environmental management systems. The Bureau of Standards also is developing a scheme to certify farmers.

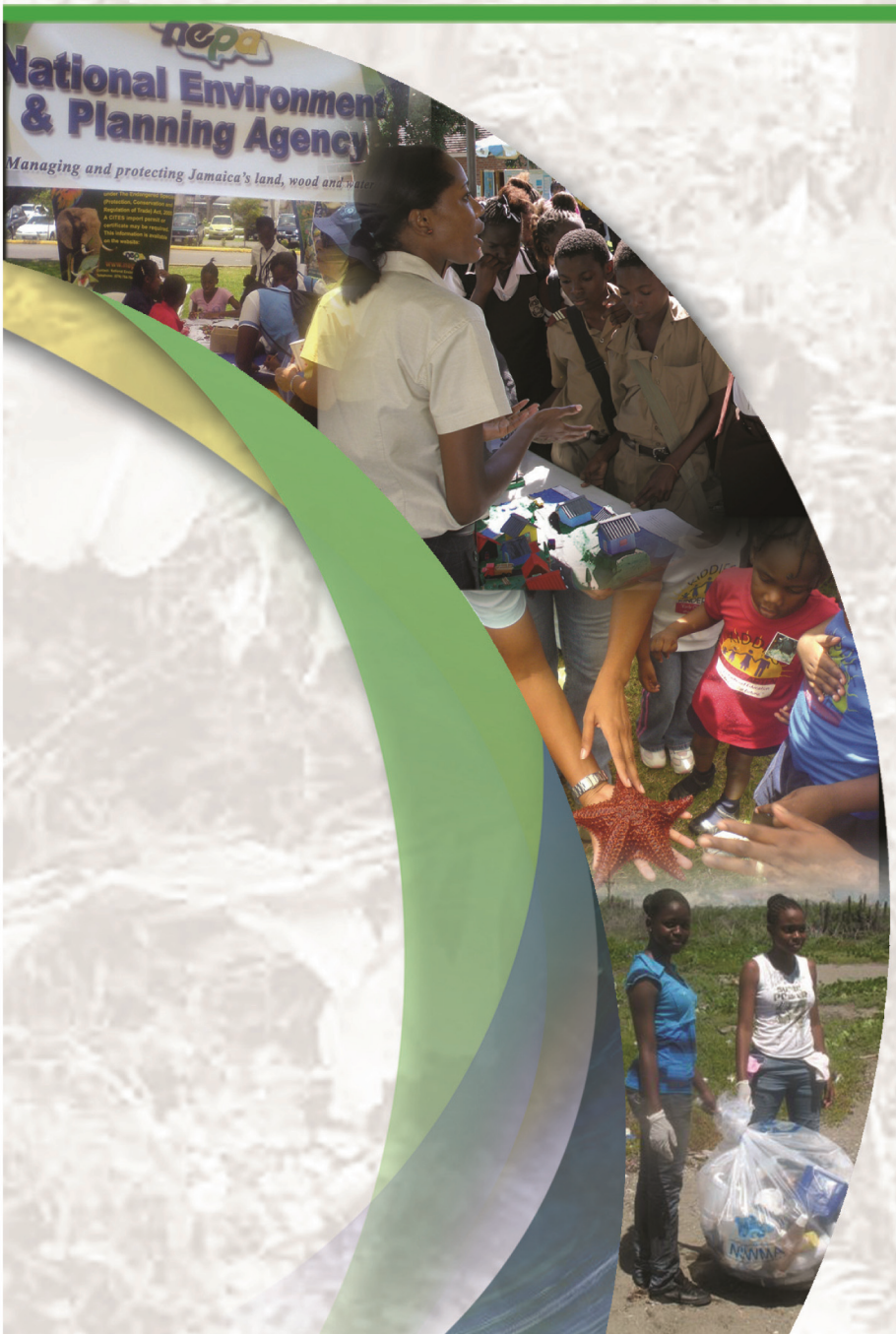
[45] Jamaica Greenhouse Growers Association Handbook retrieved August 30, 2011 fromhttp://www.iica.int/Eng/regiones/caribe/jamaica/IICA%20Office%20Documents/Greenhouse%20Production%20Handbook.pdf

[46]Inter-American Institute for Cooperation on Agriculture Office in Jamaica (March 2010), Annual Report 2009

[47] From "GMOs – Building better food", http://jamaica-gleaner.com/gleaner/20080918/news/news6.html accessed November 11, 2011

Section 3:

Governance



ENVIRONMENTAL ACTIONS, POLICIES AND LEGISLATION

The National Environment & Planning Agency (NEPA) is the primary government agency with overarching responsibility for managing and protecting the natural resources of Jamaica. Currently the Agency falls under the responsibility of the Ministry of Housing, Environment, Water and Local Government. While NEPA coordinates and implements several areas of activities on behalf of the Government of Jamaica, it also provides technical advice and recommendations in other areas that may fall under the mandate of other agencies. Other public ministries, departments and agencies in Jamaica that play a role in the management and protection of Jamaica's natural resources and its environment include the following:

- Forestry Department
- Fisheries Division
- Jamaica National Heritage Trust
- Ministry of Health
- Water Resources Authority
- Jamaica Bauxite Institute
- National Land Agency
- National Solid Waste Management Authority

This chapter provides an update on several areas including:

- Projects, Programmes and Policies
- Legislation and Regulations

ISSUES AND CHALLENGES

Over the past few years, a number of challenges were faced in the development and implementation of projects and programmes as well as in the promulgation of legislation. These are listed below.

Absence of Critical Environment and Planning Legislation

The National Environment and Planning Agency has continued to operate under multiple laws that predate the organization. There is no legislation to give legal authority to the Agency and it continues to depend on the Natural Resources Conservation Authority to make legally-binding decisions based on the NRCA Act and associated regulations. There are a number of regulations and additional legislation that have either not been finalized or operationalized.

The Agency also has developed a number of polices which have not been efficiently handled by the various portfolio ministries to which they have been assigned over the years, hence they remain in draft form,[48] sometimes for many years.

Together with the implementation of the environment and planning legislation, the finalization of these regulations and policies will further empower the Agency to achieve its mandate as the lead government body responsible for the management of the country's natural resources.

Resource Constraints

In the past four years, implementation of environmental policies and legislation were affected by the country's economic situation which was as a result of the global economic crisis. Partially, as a result of obligations under the multilateral loan agreement with the International Monetary Fund (IMF), the Government cut expenditure in a range of areas, including environmental management, which consequently limited the quantity and quality of resources available to agencies carrying out the mandate for environment and planning.

As a result, a number of functions, including monitoring and enforcement, were impacted due to strict restrictions imposed on the staffing and travelling budget. The enforcement arm of the NEPA which was identified as a major area that needed additional staff to enforce environmental legislation and to carry out routine and post-development monitoring was clearly affected. Up to financial year 2009/2010, the enforcement arm of the Agency had a total of 18 enforcement officers to carry out monitoring activities for well over a thousand developments.

Low Levels of Enforcement and Compliance

The regulatory and compliance arm of the government continues to face several challenges toward enforcing environmental legislation.[49] Some of these include the need for better coordination and communication between and amongst certain agencies in addressing enforcement issues.

[48] Knight P. (n.d) Overview of NEPA

[49] The primary regulatory body is NEPA, which works alongside several other organizations such as Water Resources Authority, Ministry of Health, Ministry of Agriculture, Jamaica Defence Force, Island Special Constabulary Force, Marine Police, Local Planning Authorities and Environmental Non Governmental Organizations

CURRENT STATE

International and Regional Environmental Agreements

Jamaica has joined other countries in the Caribbean and throughout the world, in making a commitment to global efforts in environmental protection to promote sustainable development. Jamaica is a signatory to a number of international and Caribbean environmental agreements. These are listed in Table 59.

Table 59: International and Regional Environmental Agreements to which Jamaica is a Party – 2010

International Agreement	Date of Accession for Jamaica	Date of Entry into Force for Jamaica
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (as amended), London, Mexico City, Moscow, Washington, 1972	22 March 1991	21 April 1991
International Convention for the Prevention of Pollution from Ships, (Marpol) London, 1973	13 June 1991	12 September 1991
Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, London, 1973	13 June 1991	12 September 1991
United Nations Convention on the Law of the Sea, Montego Bay, 1982	21 March 1983	16 November 1994
Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985	31 March 1993	29 June 1993
Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987	31 March 1993	29 June 1993
London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London, 1990	31 March 1993	29 June 1993
Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Copenhagen, 1992	7 November 1997	4 February 1998
Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1997	24 September 2003	22 December 2003
Beijing Amendment to the Montreal Protocol on Ozone Depleting Substances, Beijing, 1999	24 September 2003	22 December 2003
United Nations Framework Convention On Climate Change, New York, 1992	6 January 1995	5 April 1995
Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 1997	28 June 1999	16 February 2005
Convention on Biological Diversity, Rio de Janeiro, 1992	6 January 1995	5 April 1995
Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Montreal, 2000	4 June 2001	
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	22 July 1997	23 April 1997
Convention on Wetlands of International Importance especially as Waterfowl Habitats (Ramsar)	7 October 1997	7 February 1998
United Nations Convention to Combat Desertification, Paris, 1994 (UNCCD)	12 November 1997	16 March 1998
Convention on Transboundary Movement of Hazardous Waste and their	23 January 2003	23 April 2003

International Agreement	Date of Accession for Jamaica	Date of Entry into Force for Jamaica
Disposal (Basel Convention) Basel, 1989		
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Rotterdam, 1998	20 August 2002	24 February 2004
Stockholm Convention on Persistent Organic Pollutants, Stockholm, 2001	23 May 2001	1 June 2007
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Cartagena de Indias, 1983 (Cartagena Convention)	24 March 1983	1 April 1987
Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region, 1983	24 March 1983	1 April 1987
Protocol to the Cartagena Convention on Specially Protected Areas and Wildlife (SPAW Protocol), 1983	18 January 1990	under consideration
International Plant Protection Convention, Rome, 1951	24 November 1969	
Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972	14 June 1983	
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies, London, Moscow, Washington, 1967	10 August 1970	
Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea Bed and the Ocean Floor and in the Subsoil Thereof, Washington, 1971	30 July 1986	
Treaty on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, London, Moscow, Washington, 1972	30 July 1986	
Convention on the Territorial Sea and the Contiguous Zone, Geneva, 1958	8 October 1965	
Convention of the High Seas, Geneva, 1958	October 1965	30 October 1962
Convention on Fishing and Conservation of the Living Resources of the High Seas, Geneva, 1958	16 April 1968	20 March 1966
Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, Moscow, 1963	13 August 1963	22 November 1991
Convention on Civil Liability for Bunker Oil Pollution Damage, 2001	28 July 2003	21 November 2008
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990	30 January 2001	
International Convention for the Safety of Life at Sea (SOLAS) 1974	15 October 2001	
Protocol Concerning Pollution from Land-based Sources and Activities (LBS Protocol) to the Cartagena Convention, 1999		under consideration
Convention on Migratory Species (CMS), Rome, 2008		under consideration

Source: Ministry of Housing, Environment, Water & Local Government, National Environment and Planning Agency

Environmental Legislation

Jamaica has several pieces of legislation which govern various aspects related to conservation and protection of the country's natural environment, natural resource management, physical planning and development. These are listed in Table 60. Some of these pieces of legislation are currently being revised while other pieces of legislation which are currently being drafted. Many new pieces of legislation have been developed to support the country's commitments to the international agreements to which it is a party.

Table 60: Environmental, Planning and Development Legislation in Jamaica

Environmental, Planning and Development Act or Regulation
The Aquaculture, Inland and Marine Products and By-products (Inspection, Licensing and Export) Act 1999
The Aquaculture, Inland and Marine Products and By-products (Inspection, Licensing and Export) Regulations 2000
The Beach Control Act 1956
The Beach Control (Hotel, Commercial and Public Recreational Beaches) Regulations 1978
The Beach Control (Licencing) Regulations 1956
The Beach Control (Safety Measures) Regulations 1957
The Clean Air Act 1964
The Country Fires Act 1942
The Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000
The Exclusive Economic Zone Act 1993
The Fishing Industry Act 1976
The Fishing Industry Regulations 1976
The Fishing Industry (Conservation of Conch (Genus Strombus)), Regulations 2000
The Flood Water Control Act 1958
The Forest Act 1996
The Forest Regulations 2001
The Jamaica National Heritage Trust Act 1985
The Land Development and Utilisation Act 1966
The Local Improvements Act 1914
The Maritime Areas Act 1996
The National Solid Waste Management Act 2001
The National Solid Waste Management (Public Cleanliness) Regulations 2003
The Natural Resources Conservation Authority Act 1991
The Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations 2003
The Natural Resources (Marine Park) Regulations 1992
The Natural Resources (National Park) Regulations 1993
The Natural Resources (Permit and Licences) Regulations 1996
The Natural Resources (Wastewater & Sludge) Regulations 2005
The Pesticides Act 1987
The Public Health Act 1985
The Public Health (Nuisance) Regulations 1995
The Quarries Control Act 1984
The Quarries Control (Amendment) Act 1994
The Town and Country Planning Act 1958
The Town and Country (Control of Advertisements) Regulations 1978

Environmental, Planning and Development Act or Regulation
The Trade Act 1955
The Water Resources Act 1995
The Watersheds Protection Act 1963
The Wildlife Protection Act 1945
The Wildlife Protection (Amendment) Act Order 1998
The Wildlife Protection (Game Bird Hunting Limit) Regulations 1992
The Wildlife Protection (Hunters Licences) Regulations 1973
The Wildlife Protection (Hunters Returns) Regulations 1999
The Wildlife Protection (Shooting Season) Order

Source: Ministry of Housing, Environment, Water & Local Government, National Environment and Planning Agency

Expenditures on Environmental Programmes

Four primary areas are shown in the Estimates of Expenditures for the allocation of resources to environmental conservation, protection and management. These areas are identified as: Environmental Protection and Conservation, Forestry Ecosystems Management, Solid Waste Management and Water Resources Management. Each of these areas is represented by key Ministries, Departments and Agencies (MDAs) that are legislatively mandated to implement the relevant government policies.

The key MDAs include the National Environment and Planning Agency (NEPA), the Environmental Management Division (EMD) of the Ministry of Housing, Environment, Water and Local Government; Forestry Department; National Solid Waste Management Authority (NSWMA); and Water Resources Authority (WRA). A review of their expenditure gives a broad indication of government spending on environmental protection initiatives (see Table 61).

Table 61: Estimates of Expenditure for Key MDAs 2007-2010, J$'000

MDA	2007/2008	2008/2009	2009/2010
NEPA	609,359	658,196	537,533
Forestry Dept.	180,023	400,609	268,675
WRA	146,869	177,713	167,731
NSWMA	1,090,498	2,227,680	965,168
TOTAL	**2,026,749**	**3,464,198**	**1,939,107**

Source: NEPA, Forestry Department, WRA, and the Ministry of Finance's Estimates of Expenditure (various years)

Permits, Licences and Planning Approvals

NEPA continues to receive a steady increase of applications for environment and planning activities. The FY 2008/2009 however saw a significant increase of about 39% in the number of applications received and processed, while the FY 2009/2010 showed a corresponding fall by 43% (see Table 62).

Table 62: Number of Applications received by NEPA

Financial Year	No. of Applications	% Annual Change
2004/2005	1,819	-
2005/2006	2,182	20
2006/2007	2,381	9
2007/2008	2,700	13
2008/2009	3,764	39
2009/2010	2,157	-43

Source: NEPA

Table 63 shows the types of applications processed between 2007 and 2010 and their corresponding numbers. Overall, Subdivisions (9 Lots & Under) accounted for 36% of the applications processed; Planning Applications - 21%, and Environmental Permit Applications –16%.

Table 63: Applications Processed by Types of Applications for 2007-2010

Applications	2009-2010	2008-2009	2007-2008
Approved	1,544	2,347	2,090
Refused	92	298	199
Rejected	147	461	119
Withdrawn	48	77	67
Delisted	40	193	56
Other	286	388	1,690
TOTAL	**2,157**	**3,764**	**4,221**

Source: NEPA

Table 64: Applications Status for 2007-2010

Types of Applications	2009-2010 Processed	2008/2009 Processed	2007/2008 Processed	TOTAL
Air Quality Discharge Licence	22	0	0	22
Beach Licence Applications	75	128	43	246
Compliance Monitoring	5	0	0	5
Enquiries	174	170	92	436
Environmental Impact Assessment	3	9	15	27

Types of Applications	2009-2010 Processed	2008/2009 Processed	2007/2008 Processed	TOTAL
Environmental Licence Applications	92	191	106	389
Environmental Permit Applications	325	658	418	1401
Parish Council Subdivision 9 Lots & Over	3	0	0	3
Planning - TCPA	168	17	0	185
Planning Applications	193	901	732	1826
Subdivision 10 Lots & Over	191	295	150	636
Subdivision 9 Lots & Under	752	1101	1132	2985
Tier 1 Residential Single Family	2	4	3	9
Tier 1 Subdivision 9 Lots & Under	152	290	9	451
TOTAL	**2157**	**3764**	**2700**	**8621**

Source: NEPA

Of the 5,981 approvals granted (Table 64) during the period April 2007 to March 2010, Subdivisions (9 Lots & Under) accounted for 42.8%, while Planning Applications and Environmental Permits Applications accounted for 21.5% and 14.45% respectively. As an indication of the level of developmental activities, the parishes that had the most approvals were St. Andrew with 18.4%, Manchester with 13.2% and St. Elizabeth with 9.9%.

Enforcement and Compliance

Several agencies are involved in the enforcement of laws established to protect the country's natural resources. The lead agency is the NEPA who carries out this mandate as a regulatory entity under four main pieces of legislation: the NRCA Act, Beach Control Act, Wild Life Protection Act and the TCP Act. As a part of its enforcement operations NEPA also carries out compliance monitoring mainly targeting "potential polluters".

During the period 2004 to 2010, the total number of enforcement actions taken by NEPA was 1,707 (see Table 65).

Table 65: Enforcement Actions taken by NEPA

FY	Enforcement Notices	Cessation Orders	Stop Notices	Notice of Intention to Suspend	Notice of Intention to Revoke	On-site Breach Notices	Warning Letters	Court Cases	Verbal Warnings	TOTAL
04/05	24	9	21	0	1	0	187	5	95	342
05/06	58	5	26	0	0	0	147	3	118	357
06/07	4	7	4	0	0	0	117	5	172	309
07/08	11	0	0	0	0	0	80	0	0	91
08/09	23	21	20	3	1	93	84	11	0	256
09/10	33	13	6	1	0	256	30	13	0	352
TOTAL	153	55	77	4	2	349	645	37	385	1,707

Source: NEPA

A Kingston Harbour Environmental Compliance Programme implemented during 2009-2010, saw significant compliance levels among companies that contributed to the pollution of the Kingston Harbour. Twenty seven (27) enforcement actions were served on entities in the Kingston and St. Catherine areas. In Kingston, five (5) Enforcement Notices and eight (8) Warning Notices were served on eleven (11) facilities; while in St. Catherine, one (1) Enforcement Notice and thirteen (13) Warning Notices were served on nine (9) facilities

90% of the entities served with Notices in Kingston, are complying with the requirements of the Notice(s). For St. Catherine however, only 72% of the entities are complying. This has necessitated additional enforcement action by NEPA.

RESPONSES GEARED TO IMPROVING JAMAICA'S ENVIRONMENTAL POLICIES AND LEGISLATION

A number of actions have been taken with respect to a revised and a more robust policy and legislative framework for environmental management and planning in Jamaica. Work towards the promulgation of an Environment and Planning Act and the creation of an Environmental Regulatory Authority were the two main areas of focus.

Preliminary drafting instructions for the National Environment and Planning Agency Act were prepared in 2005. However, concerns were raised, particularly by the Local Planning Authorities, directed at the proposed repeal of the Town and Country Planning Act, as there was a perception that this would leave a major gap in the planning process. As a result, the Government is implementing a proposal to repeal the Land Development and Utilization Commission Act and establish three Acts: a National Environment and Planning Agency (NEPA) Act, a revised Town and Country and Planning Act, and an Environment Act.

The recent Green Paper (#2/2010) recommends three key steps to be taken in relation to the underlying long-running failures of Jamaica's planning and environmental regulatory framework:

- Establishment of an Environmental Regulatory Authority (ERA) to which NEPA's responsibilities for environmental monitoring and enforcement will be transferred
- Preparation of a National Spatial Plan (NSP) which will include 'no build zones". NEPA will have the primary responsibility for developing, maintaining and updating this NSP
- Enhance NEPA to have the lead role in solving environmental problems through education, outreach, advisory assistance and training workshops.

Actions taken to improve the planning and legislative framework include:

- Preparation of a concept paper on the Environmental Regulatory Authority in July 2008
- Revision of a Draft Bill for the development of a New Town and Country Planning Act
- Development of the National Spatial Strategy (NSS) by the Office of the Prime Minister, to be executed by NEPA. The NSS will provide the framework for the effective use and management of the nation's land and land resources. On completion, it will *inter-alia* support the achievement of balanced regional development; strengthen inter-sectoral coordination of the country's development; promote environmental sustainability; and establish a national context for spatial planning at the national and local levels.

The Town and Country Planning Act stipulates that in areas for which a Development Order has been prepared, planning permission is required from the Local Planning Authority before "development" as defined by the Act, can be undertaken. In those areas for which no development orders have been prepared no planning permission is required to undertake development. Therefore, it is critical for all

areas to be covered by up-to-date Development Orders in order to control development and land use in Jamaica. Some existing Orders date back to the 1960s, for example St. Mary and Portland (1963) and Kingston (1966).

Since 2005, seven (7) draft Development Orders have been completed and are at various stages of promulgation. These are for the parishes of Portland, Trelawny, Manchester, Kingston and St. Andrew, St. Catherine, St. James and Negril. The St. Ann Development Order is fairly recent (promulgated in 2000) and a development order for St. Thomas is slated to be completed in 2011.

In 2009 and 2010, the following key pieces of legislation and policies were drafted:

- The Wildlife and Protected Areas Act
- Wastewater and Sludge Regulations
- National Policy and Guidelines for Overwater Structures
- Coastal Resources Policy
- Wildlife Trade Policy
- Biosafety Policy

The critical step is to ensure that these regulations and policies are moved through the process from the draft stage to final promulgation.

PARTICIPATION BY NON-STATE ACTORS IN SUSTAINABLE USE OF NATURAL RESOURCES AND CONSERVATION EFFORTS

It is important for national government institutions charged with the environmental stewardship mandate to facilitate collaboration amongst other government institutions, private sector organizations, non-governmental organizations (NGOs), community-based organizations (CBOs) and other stakeholder groups. Non-state actors have an important role to play in natural resources conservation and environmental management. Local government authorities and other local governance organizations have an important part to play, often as the liaison between the national government bodies and the local communities.

PARTICIPATION BY THE PRIVATE SECTOR

The private sector has demonstrated increased appreciation of the link between business performance, conservation and the need to protect the natural resources of the country. As well as the major industries related to energy generation and bauxite, Jamaica's manufacturing sector produces

beverages, processed foods, chemicals, plastics, cosmetics, pharmaceuticals, nutraceuticals and apparel. Several companies have undertaken initiatives in the areas of waste minimization, energy conservation and alternative energy usage, and water conservation. There is increasingly the recognition that these areas of operation affect the company's bottom line and also provide a basis for promoting corporate social responsibility. However, it is acknowledged that these initiatives need to be supported through an established environmental stewardship programme across all sectors.

Some evidence of Jamaican businesses practicing corporate social responsibility (CSR) and implementing environmental activities include the following:

- There are 14 hotels which are Green Globe certified
- Major hotel chains are leaders in CSR
- New annual CSR and environmental awards programmes recognize increasing numbers of companies which practice CSR
- There is an increasing number of companies receiving training in CSR
- There is an increasing number of companies participating in ISO 9000 and ISO 14000 certification schemes
- A number of financial institutions implement CSR programmes, which often include grants to NGOs and communities for environmental projects
- 19 Jamaican organizations have achieved ISO 14001 certification (see Table 66), while 28 hold ISO 9001 certification. In most cases these are manufacturing companies that export their products.

Table 66: Jamaican Organizations which have achieved ISO 14001 Certification

Name of Certified Company	Date First Certified
West Indies Alumina Company (WINDALCO) - formerly Alcan	August 2000
St. Mary Banana Estates Ltd. Farms – Jamaica Producers Group Ltd.	2001
Eastern Banana Estates Ltd. – Jamaica Producers Group Ltd.	2001
JAMALCO	November 2002
Berger Paints Ltd.	April 2006
Red Stripe (Diageo)	September 2006
Central Food Packers Ltd.	January 2007
CANCO Food Processors Ltd.	January 2007
Jamaica Broilers Best Dressed Chicken Processing Plant	January 2007
Tijule Company Ltd.	January 2007
Southern Fruits and Food Processors Ltd.	January 2007
Maroon Pride Ltd.	January 2007
Walkerswood Caribbean Foods Ltd.	January 2007
Caribbean Cement Company Ltd.	February 2007
Trinjam Food Processors	March 2007
Alumina Partners of Jamaica (ALPART)	October 2008
Federated Pharmaceutical	December 2008
Jamaica Social Investment Fund (JSIF)	January 2009
J. Wray & Nephew Ltd.	January 2009

Source: International Organisation for Standardisation ISO Focus, 2010

Additionally, based on a modest survey conducted, there is an indication that several private sector entities also have taken the initiative to implement environmental good practices within their

organizations. Some of these initiatives can be classified as environmental stewardship actions as these organizations are demonstrating their commitment to the conservation of the natural environment. Table 67 shows some of these environmental stewardship initiatives that are being undertaken.

Table 67: Environmental Stewardship Initiatives of some Private Sector Companies

Name of Entity	Description of Initiatives	Status
Mega Mart Wholesale Club	• Mega Mart's Eco-Bags that provides an alternative to plastic bags	ongoing
Jamaica National Building Society Group	• $30 million for the purchase and installation of a solar system • Energy efficient UWI JN Branch • Going Paperless • Energy conservation practices • "Green Loan Facilities"	ongoing
Scotia Bank Jamaica Ltd.	• Scotia "Goes Green" Programme	ongoing
Continental Baking Company (National Bakery)	• Biodegradable Bread Bags • Use of solar powered lamps in parking areas • Recylcing of plastic bread baskets • Recycling of frying oil into biodiesel	ongoing

Source: JNBS, CIBC and NEPA

Environmental Stewardship in Action

The Continental Baking Company (National Bakery)[50] commenced the use of solar powered parking lamps for their parking areas in 2006. Most of the lighting in the plants is provided through the use of fluorescent units to minimize the energy requirements for lighting, and they are aided by translucent panels in the roof which provides natural light during the day. The initiative to control the disposal of styrofoam began in early 2010 and is ongoing with new initiative soon to come on stream to address the recycling of plastic bottles. The broken plastic bread baskets that are used in the delivery process have been collected for recycling dating back to some 9 years, and the organization also started producing biodiesel in 2008 after learning about biodiesel production in Costa Rica earlier that year. Additional initiative includes the changing over from diesel oil ovens to propane ovens. This has reduced emission levels tremendously.

The Jamaica National Building Society Group (JNBS)[51] has within the reporting period set out to continue several years of conducting its operations in a manner that reduces its impact on the environment. As such, it has maintained environmental protection and preservation as key components of its operational business strategies. The objective has been to focus on direct and indirect cost savings

[50] Source: Sykes, Stephen - The Continental Baking Company (National Bakery)

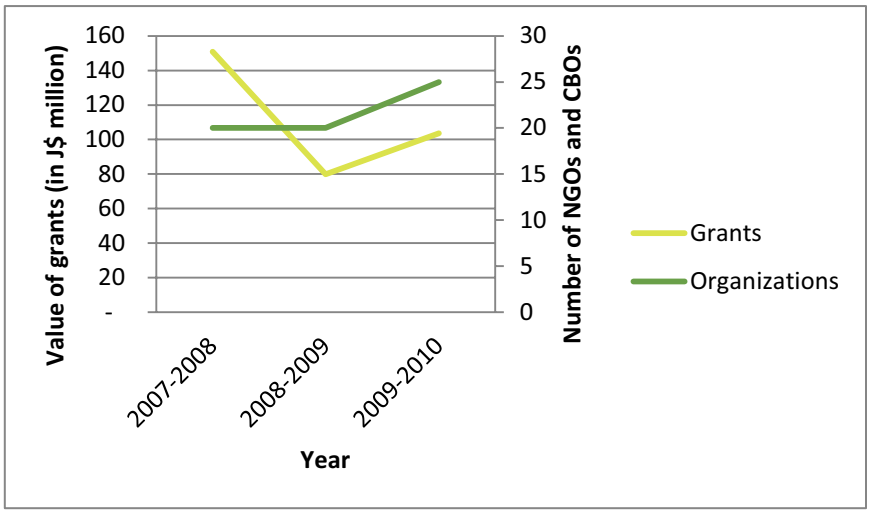
[51] JNBS. Environmental Initiatives

which can accrue to the organization through improved efficiency in its service delivery to customers and members; a reduction in energy consumption; and limiting avoidable waste. The organization has implemented several initiatives classified under three broad headings namely, Products with Environmental Impact; Internal Operational Efficiency; and External Operational Efficiency.

PARTICIPATION BY NGOS AND CBOS

CBOs, NGOs and professional organizations are playing a lead role in building public awareness, environmental advocacy and resource management. However, many of these organizations lack the necessary human and financial resources on a continuous basis for long-term programme implementation. They continue to rely on international and local donors for project and organization support.

Figure 31: EFJ Grant Activity 2007-2010



Source: Environmental Foundation of Jamaica

The Environmental Foundation of Jamaica (EFJ) is the country's leading source of grant funding for environmental and conservation initiatives undertaken by NGOs and CBOs. Between 2007 and 2010, the EFJ disbursed a total of J$334,358,089 towards protection and conservation initiatives implemented by local organizations. Funded projects were in the areas of Watershed and Coastal Zone Management; Biological Diversity; Waste and Water Management; Community Green Spaces; Alternative Energy; Eco-Systems Management; Water Harvesting; Hurricane Disaster Mitigation; Climate Change; Community Environmental Management; and Capacity Building. Figure 31 shows the total value of grants issued by EFJ and the number of NGOs and CBOs that received funding during this period. This can be used as an indicator of the level of environmental activities undertaken by these organizations.

A number of professional organizations are also involved in environmental activities. These include the Jamaica Manufacturers' Association, Jamaica Hotel & Tourist Association and the Small Business Association. Increasingly, they are promoting environmental stewardship among their members. Additionally, the Jamaica Institute of Environmental Professionals was formed in 2000 specifically to improve environmental management capacity and practices in Jamaica and is engaged in encouraging dialogue about environmental issues among different sectors of Jamaican society.

PARTICIPATION BY LOCAL GOVERNMENT ORGANIZATIONS

Local government authorities have traditionally depended on state agencies to implement environmental programmes and to intervene to address environmental concerns at the local level.

Through the ongoing reform process, local authorities are being strengthened to address these issues themselves.

The work of the Parish Development Committees (PDCs) complement the work of the local authorities as they partner with other stakeholders across the public and private sphere. The National Association of Parish Development Committees, formed in 2007, serves to represent and promote the interests of all 13 PDCs as well as the Portmore Citizens Advisory Council. It also provides on-going focused advocacy and policy direction. PDCs are involved in projects and programmes focused on local sustainable development planning, disaster risk assessment and management planning, reforestation efforts, recycling efforts, and waste reduction and management initiatives (see Table 68).

Table 68: Projects and Programmes Implemented by PDCs

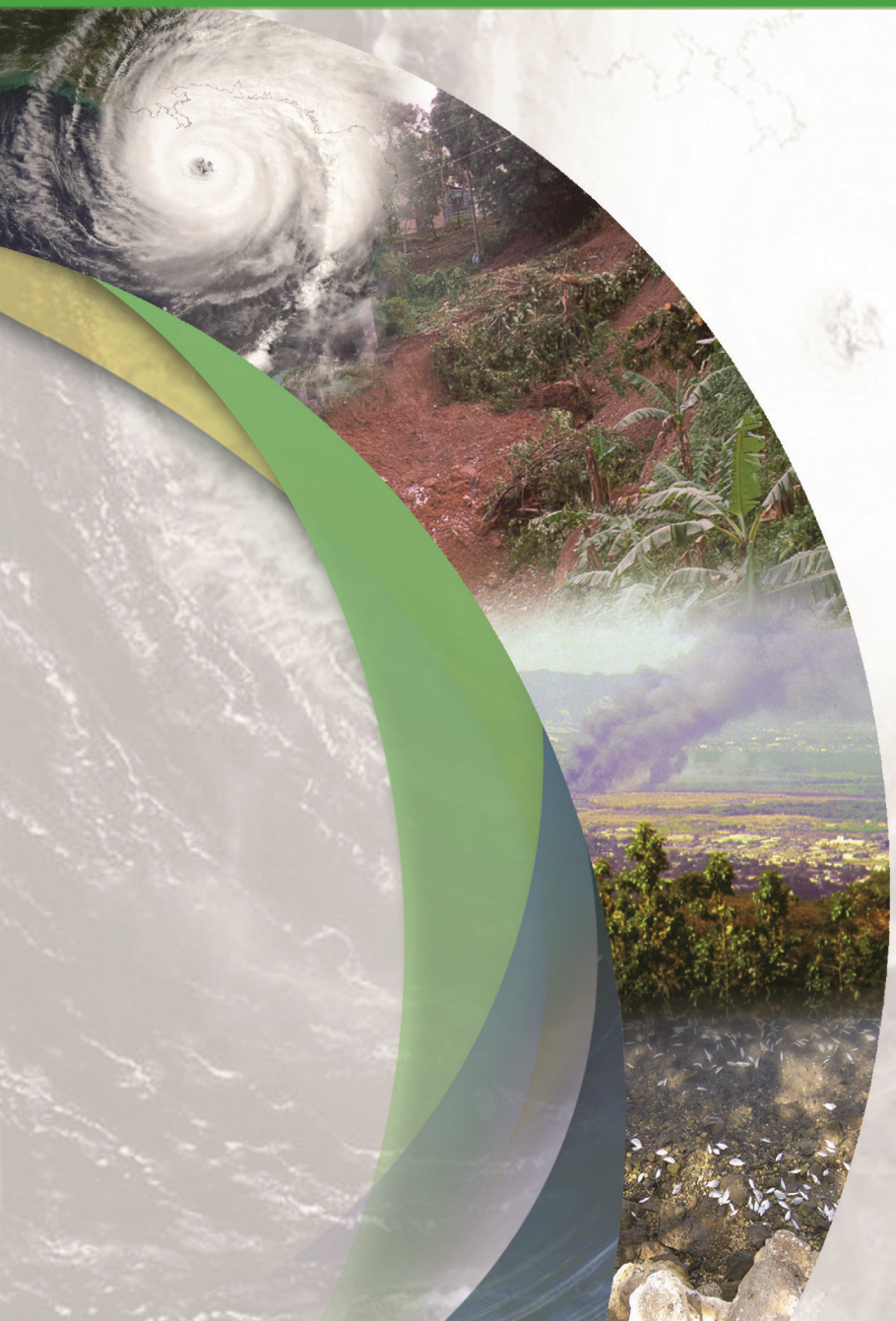
Parish Development Committee	Project	Comments
St. Elizabeth PDC	**Greater Treasure Beach Area Sustainable Development Plan:** – Currently preparing a sustainable development plan for the Greater Treasure Beach Area	By focusing on this region, the parish aims to capitalize on its potential for economic growth in key sectors such as community-based tourism and agri-business, while protecting the region's sensitive ecosystem.
Manchester PDC	**Local Sustainable Development Plan (LSDP):** – Developed the first Local Sustainable Development Plan in the English-speaking Caribbean using the participatory model.	Under the programmes being implemented through the LSDP, Alligator Pond along with Canoe Valley have been proposed and gazetted as protected areas, awaiting the actual declaration.
St. Ann PDC	**Disaster Risk management and Assessment Project:** – Currently implementing a Runaway Bay Disaster Risk Mapping and Assessment project which involves seven flood-prone communities.	The aim of the project is to ascertain the causes for the area being prone to floods and to find suitable solutions.
Clarendon PDC	**Reforestation Project:** – Over 4500 timber and fruit trees replanted – 75 men, women and children trained in better land and environmental management practices	The overall goal of the project is the restoration of mined-out lands in the Pleasant Valley Area through the empowerment of the residents and the implementation of an agro-forestry programme.
St. Mary PDC	**Plastic Bottle Recovery Project:** – Targets 33 schools in the parish	Through this project the PDC will be collecting data aimed at improving the disaster preparedness strategies of the parish.
Hanover PDC	**Environmental Programme:** – Partnering with Community Development Committees, private sector groups, businesses and government agencies	The PDC has a specific focus on building environmental awareness in schools.

Parish Development Committee	Project	Comments
	– Distributing garbage receptacles to enable the sorting of the plastics and paper, as well as the introduction of composting	

Source: The National Association of Parish Development Committees

Section 4:

Natural and Man-Made Hazards



NATURAL HAZARDS



Natural hazards are rare or extreme event in the natural environment such as earthquakes, droughts or tropical cyclones that adversely affects human life, property or activity to the extent of causing a disaster. Their occurrence and scale of impact are often influenced by human-induced activities as a result of inappropriate land use, poor building codes and environmental degradation.

Jamaica, by virtue of its location, topography and geology, is prone to several natural hazards. These natural hazards can be placed into two categories: hydro-meteorological (tropical cyclones or hurricanes, floods, drought and fires) and geological (earthquakes, landslides and tsunamis) (UNEP, 2010).

PRESSURES EXACERBATING NATURAL HAZARDS

Anthropogenic Pressures

A natural hazard can become a disaster when combined with situations of high vulnerability, whether induced by nature or anthropogenic factors. These natural hazards affect both human and natural systems. Anthropogenic factors which increase vulnerability to natural hazards include the following:

- unsustainable land use such as farming and construction of homes and roads on hillsides, which contributes to deforestation and slope instability and increased vulnerability to flooding and landslides
- urbanization, which increases the amount of impervious surface which in turn increases storm water runoff
- development along river banks and within flood plains
- coastal development, which contributes to compromised health and reduction of effectiveness of protective ecosystem services of reefs, seagrass beds and mangroves.

Climate Change

Climate change is expected to cause an increase in the frequency and strength of climatological phenomena such as hurricanes and storms. The impact of these extreme weather events particularly in coastal areas includes loss of land for development, denudation of beaches and other coastal recreational areas and damage to coastal infrastructure including roads, bridges and sea defenses gives rise to concerns about the impact of climate change on small island developing states such as Jamaica.

Sea level rise, expected to increase due to climate change, is a threat to inundate coastal areas and also will increase the impact of storm events. Approximately 60% of Jamaica's population lives within 5 km of the coastline and therefore there is considerable risk to a large portion of the country's overall life and property.

CURRENT STATE

Environmental Vulnerability Index

The Environmental Vulnerability Index (EVI), developed by the South Pacific Applied Geoscience Commission, the United Nations Environment Programme (UNEP) and partners, is a measure for estimating the vulnerability of the environment of a country to future shocks. The index is based on 50 indicators which are combined and reported simultaneously as a single index, a range of policy-relevant thematic sub-indices and as a profile showing the results for each indicator. Furthermore, the index will enable the analysis of trends when compared with previous scores over time. Using this vulnerability index, Jamaica was ranked in 2005 as "Extremely vulnerable" with a score of 381.

It should be noted that while the country was evaluated to be least vulnerable or highly resilient to issues such as high winds, hot periods[52], earthquakes and landslides, activities such as deforestation, intensive farming, mining and soil degradation greatly increased the island's environmental vulnerability by increasing hazard risk. Many disasters can be reduced and in sometimes prevented by improving the capacity to resist and recover from the impacts of hazards. It is therefore imperative that the necessary programs and policies are developed implemented and maintained in order to build resilience and reduce hazard risk while the country works towards improvement in areas the EVI demonstrated highest environmental vulnerability.

[52] Defined as average annual excess heat over the past 5 years more than 5°C hotter than in the past 30 years.

Economic Impact of Natural Hazards

Jamaica has experienced an increase in the frequency of natural events related to inclement weather, tropical depressions, tropical storms, hurricanes – primarily floods, droughts and landslides - over the last 30 years, which have realized increasing economic and environmental cost. Table 69 shows the economic cost of selected major climatic events over the past twelve years, including estimated economic cost of Hurricane Gilbert.

Table 69: Economic Cost of Selected Major Climatic Events since 1998

Event	Year	Category	Cost ($JB)	Impact (%GDP)
Hurricane Gilbert	1988	5	~8.3	65.0
Hurricane Michelle	2001	4	2.52	0.8
May/June Flood Rains	2002	-	2.47	16.0
Hurricane Charley	2004	4	0.44	0.02
Hurricane Ivan	2004	3	36.9	8.0
Hurricanes Dennis & Emily	2005	4	5.98	1.2
Hurricane Wilma	2005	5	3.6	0.7
Hurricane Dean	2007	4	23.8	3.4
Tropical Storm Gustav	2008	-	0.15	2
Tropical Depression 16 & Tropical Storm Nicole	2010	-	20.6	1.9
Total Cost			**104.16**	

Source: Compiled by the PIOJ with data from various agencies

Rain and Wind Events

The 2010 Atlantic Hurricane Season was the third most active Atlantic hurricane season on record. The first storm formed in the region on June 25 and the last one on November 7. There were 21 tropical depressions and 19 storms, including 12 hurricanes, of which 5 were designated major hurricanes (Category 3 or higher with wind speeds of at least 178 km/h). Jamaica did not suffer any direct hits from hurricane-strength storms in 2010.

However, during 2010, Jamaica was impacted significantly by rains produced by Tropical Depression No. 16 and Tropical Storm Nicole in September. These events occurred over 6 days and impacted 507,831 persons or approximately 18.7% of the island's population. While the entire island was impacted by rains, the most severe impacts were sustained by the southern parishes and the southern sections of northern parishes. There was considerable damage to the road network, drainage systems, farm roads, schools, beaches and NWC installations as well as loss of crops and livestock. Preliminary assessments estimated that the floods would cost the Government at least US$ 151 million.

Flooding and Landslides

Flooding and landslides remain a major problem in Jamaica. There are four types of flooding that affect Jamaica:

- Flash Floods –normally result from heavy rainfall or cloudburst over a relatively small drainage area. Flash floods carry highly destructive flood waves and are most common in mountainous areas or in steep terrain with streams flowing though narrow canyons.
- Riverine Floods – which occur when a large amount of rain falls in river systems with tributaries that drain large areas containing many independent river basins. They may last a few hours or many days depending on the intensity, amount and the distribution of the rainfall.
- Tidal Floods – which result when large bodies of water, like the sea or lakes, overflow onto bordering lands. They are mainly caused by high tides, the heavy rains that accompany hurricanes, waves created by high wind surges created by storms, and long waves produced by earthquakes out at sea.
- Ponding – a slow build up of water in depressions, sink holes, areas with clay base soil, and slow percolation rate, for example, flooding in New Market.

Table 70 shows the incidence of flooding and landslides throughout Jamaica during the period 2007-2010.

Table 70: Incidence of Flooding and Landslides 2007 - 2010

Parish	Year	Event	# of Floods	# of Landslides
St Catherine	2010	Tropical Depression 16 (TS Nicole)	21	1
St Thomas	2010	Tropical Depression 16 (TS Nicole)	7	0
Portland	2010	Tropical Depression 16 (TS Nicole)		
St Mary	2010	Tropical Depression 16 (TS Nicole)	4	2
St. Ann	2010	Tropical Depression 16 (TS Nicole)	3	2
Trelawny	2010	Tropical Depression 16 (TS Nicole)	6	1
St James	2010	Tropical Depression 16 (TS Nicole)	11	5
Hanover	2010	Tropical Depression 16 (TS Nicole)	18	6
Westmoreland	2010	Tropical Depression 16 (TS Nicole)	22	1
St Elizabeth	2010	Tropical Depression 16 (TS Nicole)	18	0
Manchester	2010	Tropical Depression 16 (TS Nicole)	6	0
KSA	2010	Tropical Depression 16 (TS Nicole)	17	8
Clarendon	2010	Tropical Depression 16 (TS Nicole)	36	4
St Catherine	2008	TS Gustav	19	6
St Thomas	2008	TS Gustav	2	2
Portland	2008	TS Gustav	1	
St Mary	2008	TS Gustav	4	1
St. Ann	2008	TS Gustav	3	0
St Elizabeth	2008	TS Gustav	1	0
KSA	2008	TS Gustav	16	1
Clarendon	2008	TS Gustav	6	1
Portland	2007	Trough	6	2

Parish	Year	Event	# of Floods	# of Landslides
St Mary	2007	Trough	5	0
St. Ann	2007	Trough	9	1
Trelawny	2007	Trough	1	0

Source: Office of Disaster Preparedness and Emergency Management

Earthquakes

The Earthquake unit at the University of the West Indies, Mona is the central repository of information on the occurrence of earthquakes throughout Jamaica. During 2010, a total of 327 earthquakes were recorded. Of these, approximately 88 or 27% were local (on land) and 120 or 37% were near (off the island). Of the local earthquakes which occurred, only four were felt and two registered greater than 4 on the Richter scale (ODPEM, 2010).

JAMAICA'S RESPONSE TO NATURAL HAZARDS

Natural hazards are a part of our everyday life and cannot be prevented. However, our response and management of hazards can prevent or minimize their becoming disasters which affect the nation's economic and social well-being. It is imperative that the risks associated with these hazards are managed or minimized through applied research and data gathering to inform the use of appropriate mitigation measures which are incorporated into the physical planning and policy development processes.

Scientific and technological advances have made it possible to identify natural hazard risks in real time and reduce their impact. Through mitigation it has been demonstrated that benefits of vulnerability reduction greatly outweigh the costs to recover from a disaster[53]. These mitigation measures such as improved warning evacuation systems and vulnerability mapping have cut the death toll of hurricanes and hydro-geologic hazard events dramatically while structural and non-structural mitigation measures have been shown to alleviate the effects of earthquakes, landslides, floods, and droughts worldwide.

National Legislation, Policies and Plans

The **Disaster Preparedness and Emergency Management Act (1993)** is the main piece of legislation governing disaster management in Jamaica. It governs the actions of national disaster officials and allows the declaration of disaster areas.

A **Draft National Hazard Mitigation Policy for Jamaica** is being developed which will promote an integrated approach to hazard risk management and development planning.

In the absence of a Natural Hazard Mitigation Policy for the country, the 1997 **National Disaster Action Plan for Jamaica** details arrangements to cope with the effects of natural and/or man-made disasters occurring in Jamaica. It is intended to provide the legal framework on which disaster preparedness, operations and training are predicated. Also it provides a framework supported by the Disaster

[53] risk management, vulnerability and natural Disasters in the Caribbean Report prepared for the international federation of Red cross Rafi Ahmad 2007

Preparedness and Emergency Management Act, under which Government officers can be held accountable for disaster responsibilities.

The Office of Disaster Preparedness and Emergency Management (ODPEM) is the Government agency charged with providing disaster management functions. Its operations are designed towards developing and implementing policies and programmes for the purpose of achieving and maintaining an appropriate state of national preparedness for natural disasters and other emergency events. The disaster response structure operates on three levels:

- national – led by the National Disaster Committee, chaired by the Prime Minister
- parish – lead by Parish Disaster Coordinators
- community – divided into zones which could manage internally for at least 72 hours until outside assistance can reach them following a disaster

To support implementation of the national plan, the ODPEM has developed or is developing plans that address specific aspects of disaster management, including the following:

- National Disaster Assessment Plan
- National Earthquake Response Plan
- National Fire Management Plan
- National Oil Spill Plan
- Disaster emergency plans for child care institutions

Approaches to Hazard Risk and Disaster Management

Several projects aimed at strengthening community and national capacity to identify, mitigate and respond to natural hazards have been implemented. These projects use a variety of approaches to reduce hazard risk and increase capacity for disaster management. Some examples of different approaches are described below.

Community Resilience for Hazard Risk Reduction

Communities are normally the first responders during hazard impacts and remain active throughout the recovery period. Repeated hazard impacts have fostered a wealth of experiences, resilience and coping mechanisms that have allowed these communities to rebound with minimal intervention from government and other external resources. As such, communities are critical resources for hazard risk reduction and therefore, community experiences, resilience and coping strategies should be identified, recognized, documented and integrated into the hazard risk reduction process.

Flood Warning Systems

Flood Warning Systems are designed to forewarn end users of the likelihood of flooding in order to save lives and property. Presently, the country operates two categories of flood warning systems, community-operated and automated (real-time) systems. Currently the Rio Cobre and Rio Grande automated flood warning systems are the only automated flood early warning systems operating in the island. The Rio Cobre system consists of rain gauges, repeater sites and river gauges which transmit signals to the WRA, Met Office, and ODPEM base stations. Based on these reports, the Bogwalk Gorge is ordered closed to prevent loss of life and property. Community flood warning systems operate in the Rio Cobre (St. Catherine), Cave River (St. Ann), Rio Grande (Portland), Pedro River (St. Ann), North and South Gully (St James) and the Rio Minho, Aenon Town, and

A tsunami is a large ocean wave that is caused by sudden motion on the ocean floor. Tsunamis are generated when an earthquake occurs 100 km or less under the ocean floor or a huge landslide takes place near a coast and displaces a large body of sea water.

Tsunamis travel across the open ocean at great speeds and build into large waves in the shallow water of a shoreline.

Thompson Pen communities (Clarendon).

Tsunami Warning System

Following the December 26, 2004 Sumatran Tsunami, worldwide interest and concern about tsunamis increased. All islands in the Caribbean Sea are vulnerable to tsunamis that may be generated either in the Caribbean or the Atlantic Ocean.[54]

Since 2004, here has been scientific evidence in support of tsunami events throughout the Caribbean including the ABC islands[55], the Bahamas, Cayman Islands, and the southern and central Antillean island arc[56]. Evidence of tsunami events in Jamaica in 1692, 1780 has been supported.

The Caribbean Disaster Emergency Management Agency (CDEMA) currently is supporting regional efforts to establish a Tsunami & Coastal Hazards Warning System on behalf of the CARICOM Member States. The system will support the establishment of an effective end-to-end tsunami warning system at the regional and national levels, and to undertake public education and awareness campaigns to prepare coastal communities for actions to be taken when a warning is issued.

Hazard Risk Research and Mapping

In order to design appropriate responses to hazards an accurate understanding of how specific hazards can affect an area is critical. Much progress has been made to better understand the effects of tropical storms through the development of storm hazard models, which can assess the risk to coastal areas from surges, waves and high winds produced by such storms.

The ODPEM has improved and expanded their data collection and Geographical Information System (GIS) to facilitate mapping of multi-hazards. The technology has been utilized in the disaster management process particularly in advising on optimal land use, by identifying the areas of most vulnerability, also in mitigation activities and damage assessment. Several hazard maps have been developed by the University of the West Indies and the Mines and Geology Division. Discussions are being held to create a centralized clearinghouse that will house hazard risk and disaster management information which can be accessed by government and other entities to inform decision making.

A recent coastal multi-hazard mapping and vulnerability assessment study, funded by the Funded by the Global Facility for Disaster Reduction and Recovery and the World Bank, [57] analyzed hazard and vulnerability for the communities of Portland Cottage in Clarendon, Morant Bay in St. Thomas, and Manchioneal in Portland. The hazards under consideration for communities included: storm surge; river flooding; seismic activity; landslides; and storm winds. The vulnerability analysis examined the impact of those hazards on the housing stock and critical facilities in each of the towns. The project provides an example for other areas in the country. The results of this analysis will be used by Local Planning Authorities and the National Environment and Planning Agency and other entities to make appropriate decisions regarding land use and disaster management in the areas around these three towns.

---

[54] Reported by Aurelio Mercado-Irizarry (Department of Marine Sciences, University of Puerto Rico at Mayagüez) and Philip L.-F. Liu (Department of Civil and Environmental Engineering, Cornell University), at the NSF Caribbean Tsunami Workshop, March 30-31, 2004, San Juan Beach Hotel, San Juan, P.R.

[55] Aruba, Bonaire, Curacao

[56] Lander *et al*., 2002; Ahmad *et al*., 2005; Grindlay *et al.*, 2005; Scheffers *et al*., 2005; Robinson *et al*., 2006.

[57] Funded by the Global Facility for Disaster Reduction and Recovery and the World Bank. The final report is entitled *Coastal Multi-Hazard Mapping and Vulnerability Assessments Towards Integrated Planning and Reduction of Vulnerability for Portland Cottage, Morant Bay and Manchioneal - Jamaica*

The UNEP Risk and Vulnerability Assessment Methodology Development Project (RiVAMP) developed a methodology that takes into account environmental factors in the analysis of disaster risk and vulnerability. RiVAMP utilizes evidence-based, scientific and qualitative research to demonstrate the role of ecosystems in disaster risk reduction. Healthy, functioning ecosystems such as wetlands, forests and coral reefs provide a valuable ecosystem service in the reduction of disaster risk faced by coastal areas as they serve as natural protective barriers, stabilize slopes and provide coastal protection against storm surge. The RiVAMP methodology enables policymakers and planners to make better-informed decisions that facilitate sustainable development through ecosystems management. The pilot project is being implemented in Negril with the expectation of replicating the methodology throughout the island.

Financial Mitigation through Insurance

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a risk pooling facility that provides coverage to Caribbean governments for hurricane and earthquake losses. It is designed to limit the financial impact of catastrophic hurricanes and earthquakes to Caribbean governments by quickly providing short-term liquidity when a policy is triggered. Payouts are made within a month after an event to facilitate a government in "getting back to business" while the country makes other financial arrangements and before potential international aid arrives. Jamaica is one of sixteen member countries that have CCRIF policies. While Jamaica has not yet experienced a catastrophe which triggered payment from CCRIF, there have been several other Caribbean islands which have received payouts. Between 2007 and 2010, CCRIF made payments totaling over US$30 million to seven member countries after they were affected by hurricanes or earthquakes (CCRIF Annual Report 2010).

MAN-MADE HAZARDS AND ENVIRONMENTAL INCIDENTS

An environmental incident is an occurrence that has resulted in or has the potential to cause significant environmental harm. A pollution incident is the accidental or deliberate entry of a substance into the environment that may be a hazard to the environment and/or human health. The Office of Disaster Preparedness and Emergency (ODPEM) is the primary agency responsible for coordinating responses to oil and chemical spills emergencies and NEPA has the direct responsibility for receiving reports and responding to all pollution incidents.

CURRENT STATE

Reported Pollution Incidents

Pollution incidents may result from a malfunctioning wastewater treatment plant, a breach in storage container holding material which may pose a risk to the environment, an accident while transporting these materials or illegal disposal on land or in the sea. The risk of an oil spill in Jamaica, particularly in the marine environment, is high due to the fact that the country has an active transshipment terminal is located at the intersection of a number of sea-lanes.

In the time period, 2005 to 2010, the majority of pollution incidents that were reported were due to the release of untreated effluent into the environment resulting mainly from the malfunctioning of wastewater treatment plants (see Table 71). In the case of the fish kills, the root cause was rarely discovered.

Table 71: Pollution Incidents Reported 2005-2010

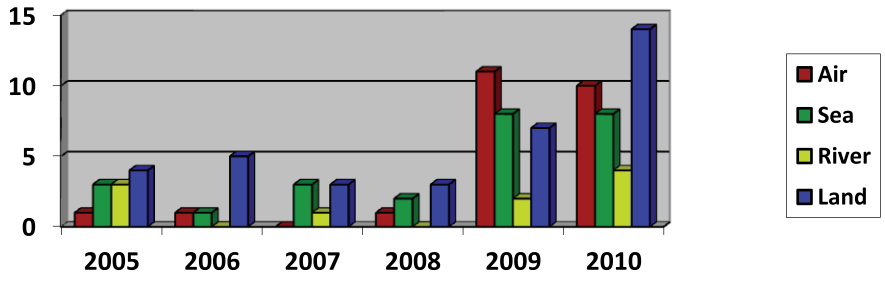
Type of Incident[a]	Number of incidents reported					
	2005	2006	2007	2008	2009	2010
Oil Spills	1	-	2	4	3	6
Chemical spills	-	2	3	2	2	4
Fish kill	1	-	5	-	3	5
Gas releases (Chlorine & Ammonia)	-	-	-	1	5	3
Dust Air Pollution	-	1	-	-	3	7
Other Air Pollution	1	-	-	1	3	-
Release of untreated effluent into the environment	5	3	2	3	4	12
Dunder/ Molasses spill	-	-	1	-	1	2
Other Marine Pollution	1	-	-	-	3	3

[a]Based on Officers' observations in the field and complaints by the public

Source: NEPA

Figure 32 shows the distribution of reported incidents with respect across receptors (air, sea, rivers, land). The highest rate of pollution incidents is the release of polluting matter on land, occurring in gullies, most of which are water ways which lead directly to rivers and eventually to the marine environment.

Figure 32: Chart Showing the Distribution of Pollution Incidents across Receptors - Air, Sea, River and Land (2005 - 2010)



Source: NEPA

Fires at NSWMA Disposal Sites

The Riverton Disposal Site and other dumpsites have been the scenes of numerous fires over the years. In some cases the fires have lasted for many days and have caused noxious emissions which have polluted neighbouring communities. There are a number of factors that contribute to this problem including suspected arson, illicit disposal of incendiary waste, the uncontrolled release of methane, a flammable gas, which is released as a by-product of the biodegradation of waste. However, as shown in

Table 72, during the period between 2004 and 2009, the number of fires at dumpsites across the island has decreased – from 13 in 2004 to 2 in 2009, with only one occurring – at Riverton – in 2008.

Table 72: Fires at Jamaica's Disposal Sites – 2004, 2005, 2008, 2009

Date	Disposal Site	Comments
2004		
April 2004	NEPM- Tobalski	Smoke hazard
May 2004	NEPM- Tobalski	Fire
June 27-28,2004	MPM- Church Corner	Major fire set by someone
June 19, 2004	NEPM- Doctors Wood	Fires
June 2004	WPM- Retirement	Spontaneous fires
July 2004	NEPM- Doctors Wood	Weekly fires
July 2004	SPM- Martin's Hill	Fire
August 2004	MPM- Riverton	Major fire
August 27, 2004	WPM- Retirement	Fire
September 2004	MPM- Riverton	Fire
October 10, 2004	WPM- Retirement	Major fire
November 2004	MPM- Riverton	Minor fires
December 2004	MPM- Riverton	Minor fires
2004 TOTAL	**14**	
2005		
January 2005	MPM- Church Corner	Minor fires
February 2005	MPM- Church Corner	Underground fire
March 2005	NEPM- Doctors Wood	Fire
March 2005	SPM- Martin's Hill	Fire
October 2005	MPM- Church Corner	Major fire - lack of cover material to contain fire
2005 TOTAL	**5**	
2008		
July 7 – 11, 2008	MPM- Riverton	Fire. Smoke continued from July 12-15; rehabilitation July 16-19
2008 TOTAL	**1**	
2009		
Feb 2- 6, 2009	MPM- Riverton	Fire
June 30 - July 3, 2009	MPM- Riverton	Fire
2009 TOTAL	**2**	

Source: Integrated Waste Management Strategy and Action Plan, March 2010

Enforcement Actions

Within the time period 2009 – 2010, forty-one enforcement actions (for example, enforcement notices or prosecutions) were taken and forty-three warning notices issued for pollution incidents by NEPA.

JAMAICA'S RESPONSE TO MAN-MADE HAZARDS AND ENVIRONMENTAL INCIDENTS

National Legislation, Policies and Plans

When a pollution incident occurs, an enforcement action is often taken, which may range from a warning letter to prosecution under the **Natural Resources Conservation Authority (NRCA) Act (1991)** or the **Wild Life Protection Act (1945)**. In addition, the offender is required to ensure that the affected areas are cleaned and where necessary, remediated. The reality is that most pollution incidents (especially those considered to be small) go unreported due to lack of awareness and education.

In an attempt to reduce dumping of oil and other hazardous materials, NEPA has developed guidelines for the storage of hazardous material which includes specific requirements for secondary containment. The storage of petroleum is regulated via the requirement of an Environmental Permit under **NRCA Regulations** for quantities exceeding a specific amount. Permittees are required to develop and institute Emergency Response and Spill Management Plans to ensure that any incident may be met with a prepared and coordinated response thereby minimizing the environmental impact. The Agency has plans to extend the requirement for a permit to entities storing hazardous liquids as well.

Jamaican policy requires the spiller to initiate necessary clean-up measures. However, it is recognized that in most ship-source spills, some of the responsibility would be assumed by the relevant government agencies. The **National Oil Spill Contingency Plan**, developed by the ODPEM, lays out the responsible parties and actions to be taken for dealing with oil spills. However, given the type of equipment available, response is likely to be limited to near shore areas and shoreline clean up.

In 2009, NEPA took steps to integrate the efforts of national players towards a systematic approach to chemical emergencies management for Jamaica by commencing the development of a **draft National Chemical Emergency Response Protocol.** The protocol will incorporate risk analysis into decision making process at the local and national level, build capacity for emergency response and facilitate an integrated, timely response to chemical incidents in the local terrestrial and/or marine environment.

Approaches for Management of Man-made Hazards and Environmental Incidents

Collection and Publishing of Pollutant Data

The establishment of a **Pollutant Release and Transfer Register** (PRTR) is a component of NEPA's strategy to encourage "Community Right to Know". The purpose of the Register is to make available to the public, information on sources of pollution and their releases to air, water and land; the resources that may be damaged or harmed by such pollution; the facilities' environmental management systems and environment related community activities; and the steps being taken by NEPA to protect the environment in respect of the sources of pollutants released. The anticipated benefits of the PRTR include making polluters more accountable for their releases to the environment and providing a tool for communication among industry, government and the community.

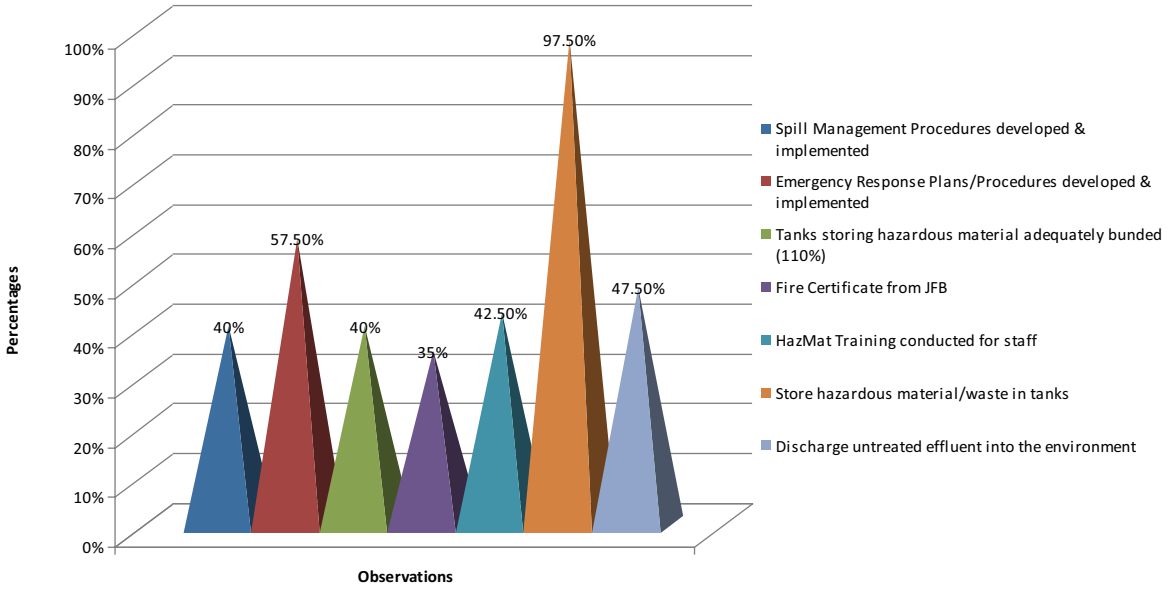
Area-specific Environmental Management Programmes

The **Kingston Harbour Environmental Management Programme** (KHEMP)[58] was conceptualized as a result of a major pollution incident which occurred in September 2009. This incident resulted from the spill of approximately 300,000 tons of sulphuric acid into the Kingston Harbour. The objective of the KHEMP is to ensure that all facilities (inclusive of public sector entities) which are potential polluters of the Kingston Harbour are in compliance with the requisite environmental regulations, standards and guidelines.

In 2010, assessments were completed of seventy four (74) industrial type facilities which impact the Kingston Harbour – thirty nine (39) facilities located along the rim of the Harbour in the Kingston and St. Andrew Region (KSA) and thirty five (35) facilities located in St. Catherine (within the Rio Cobre watershed). At December 2010, almost half (44%) of the facilities assessed under the Programme had exhibited a high level of compliance with the requirements of the NRCA/NEPA related to pollution prevention and remediation.

The findings of the assessments carried out in the KSA indicated that, of the entities assessed, the majority stored hazardous material (97%). However, of these entities, only 40% have adequate secondary containment; 57% had developed and implemented an Emergency Response Procedure or Plan; 42% had trained their staff to handle hazardous materials; 40% implemented spill management procedures/guidelines, and 35% had Fire Certificates from the Jamaica Fire Brigade. The findings for KSA are summarized in Figure 33.

Figure 33: Chart showing a Summary of the Observations for the 40 Facilities Assessed under the KHEMP on Kingston and St. Andrew

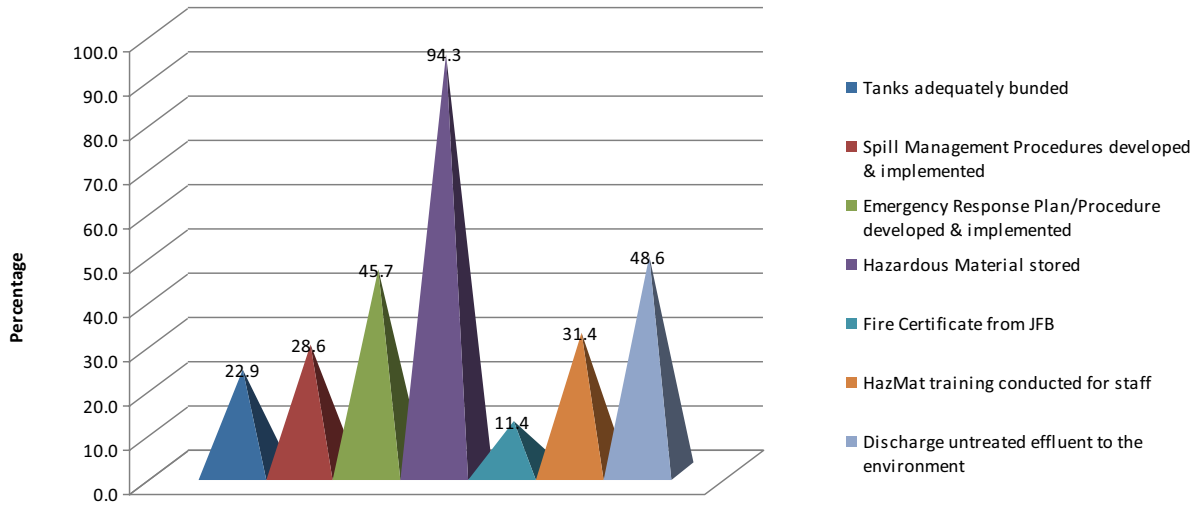


Source: NEPA

[58] Information extracted from *the Report on the Kingston Harbour Environmental Management Programme (KHEMP)* as at December 2010, Pollution Prevention Branch, NEPA

The trends in the findings of the assessments carried out in St Catherine were very similar to those seen for the KSA. Most entities stored hazardous material (94%), of which 23% had adequate secondary containment; 45% of the entities developed and implemented an Emergency Response Procedure or Plan; only 31% of the entities had trained their staff to handle hazardous materials; 28% had implemented spill management procedures/guidelines; and 11% had Fire Certificates from the Jamaica Fire Brigade. The findings for St. Catherine are summarized in Figure 34.

Figure 34: Chart showing a Summary of the Observations for the 35 Facilities Assessed under the KHEMP in St. Catherine



Source: NEPA

In an effort to decrease the response time in responding to pollution incidents on the Black River, the **Black River Water Quality Early Warning Response Programme** was developed by NEPA in 2009. The programme relies upon the initial observation by individuals living in proximity to the river thereby creating a cadre of individuals who would be designated as "First Responders" or "River Guardians" with responsibility for collecting water quality samples when pollution incidents occur prior to the arrival of representatives from NEPA. This initiative will serve to enhance the process of securing proper evidence when a prosecution is made.

Notes

Notes

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