

# CONCEPT PAPERS

For the

## Belize SAICM Initiative

Mainstreaming into Development Plans the Sound  
Management of Chemicals (SMC) Priorities for Key  
Development Sectors in Belize and Associated SMC  
Governance  
Project

Development of the National Chemical Management  
Situation Report

Submitted to the

Project Coordinator  
Belize SAICM Initiative  
Department of the Environment

By

Errol Vanzie MD and Humberto Paredes

November 13, 2010  
Belmopan, Belize

<b>TABLE OF CONTENTS</b>	
<b>Content</b>	<b>Page</b>
<b>1 Introduction</b>	<b>3</b>
<b>2 Prevention and Control of Chemical Pollution and Waste with Emphasis on Persistent Organic Pollutants</b>	<b>4</b>
<b>3 Enhancing Industry Sector Risk Reduction Through the Implementation of the Globally Harmonized Chemical Classification and Labeling</b>	<b>8</b>
<b>4 Safe Handling and Use of Chemicals, with Emphasis on Pesticides, to Address Poisoning, Good Agricultural Practices, and Unnecessary Threats to Biodiversity</b>	<b>10</b>
<b>5 Chemical Accidents Preparedness. Expand National Emergency Plans to Include Industrial Accidents, Including In Ports and Shipping Channels, To Defend Coastal Zone Integrity/Biodiversity and Safeguard Human Health.</b>	<b>16</b>

## **CONCEPT PAPERS**

### **Introduction**

#### **Introduction**

In September of 2009, Belize launched its SAICM project aimed at identifying and prioritizing chemical management issues (CMI) of concern, with the purpose of having an integrated approach to the sound management of chemicals in the country, and at the same time to identify the chemical issues of highest priority for mainstreaming into the national planning process. With full participation of government ministries, industry and the NGO community, a prioritization exercise was conducted in June of 2010. In essence, the participants validated what stakeholders had previously identified as the priority and highest priority chemical management issues in Belize. These concept papers aim to undertake a qualitative analysis of the links between these identified CMI and human health, the consequences of inaction and the potential benefit of taking steps to address the issues. Opportunities and priorities are identified for national decision-making on sound chemicals management.

Concept papers are intended to be brief and self-explanatory i.e. self contained and written in non-technical language in order to address a broader audience that is not directly involved in the chemical or environmental field.

The concepts arose out of consultations with stakeholders and out of the material reviewed in preparing the Situation Report. The concepts are issues that have been identified as being important to address in the upcoming economic planning cycle. It does not mean that other issues identified in the Situation Report are not important, just that the other issues can be addressed further downstream or as the possibility of addressing them arises.

The concept papers are intended to draw attention to issues that should be mainstreamed by including them in the development strategies and plans of the Government of Belize. They are not intended to be final and complete for this phase of the SAICM Project. Further work to expand the concepts with economic analysis and options for policy instruments for inclusion in the development strategy will be carried out in the second phase.

It should be noted that the theme of chemical management, human and environmental health is consistent throughout the four papers. As such the information provided in any one of the papers could in a manner be repeated in the other three. In order to avoid repetition it is suggested that the four papers be taken as one unit even though they contain sufficient information to stand independently.

Nationals identified four Chemical Management Issues (CMI) as high priority for further analysis and mainstreaming.

## **1. Prevention and Control of Chemical Pollution and Waste with Emphasis on Persistent Organic Pollutants.**

The first CMI identified was the “Prevention and control of Chemical Pollution and Waste” and the related reasons given were inadequate medical waste disposal, poor waste control management and the unintentional release of POPs (U-POPs) into the atmosphere. Hence, the core issue here is the presence of POPs in the environment and the limited capacity in-country for their control.

Persistent Organic Pollutants (POPs) are chemicals that persist in the environment for long periods, are extremely toxic to humans and wildlife, accumulate in fatty tissues, are volatile, and contaminate not only areas of direct exposure but also can travel long distances through water and air to contaminate environments and ecosystems far away from where they were originally used or released.

According to the World Health Organization, POPs may cause an array of adverse health effects, including deaths, disease, and birth defects among humans and animals. Specific effects can include cancer, allergies and hypersensitivity, damage to the central and peripheral nervous system, reproductive disorders and disruption of the immune system.

The Stockholm Convention identifies three categories of POPs: (i) POPs Pesticides, (ii) Industrial POPs Chemicals, and (iii) Unintentional by-products, which include dioxins and furans. In Belize, since 1985 importation and use of all POPs Pesticides were prohibited. The main potential source of PCBs, the Belize Electricity Limited, has an ongoing program of inventorying, monitoring, testing and removing PCBs from all transformers in the country. The third type of POPs nonetheless continues to be an unaddressed environmental and health problem. In the document “Belize National Profile and Assessment of the National Infrastructure for the Management of Chemicals” it is stated that “The dioxins, furans and hexachlorobenzene emissions are unintentionally released from combustion process like waste incineration, burning of garbage at landfills or municipal or urban dump sites, agricultural fields, firewood, and the production of lime”. The same document states that waste incineration accounts for most of the emissions, the main source being the KMH hospital which is located in the country’s most populated city.

At its fourth meeting held from 4 to 8 May 2009, the Conference of the Parties (COP), by decisions SC-4/10 to SC-4/18, adopted amendments to Annexes A (elimination), B (restriction) and C (unintentional production) of the Stockholm Convention to list nine additional chemicals as persistent organic pollutants (new POPs). Furthermore, by decision SC-4/19, the COP decided to undertake a work program to provide guidance to Parties on how best to restrict and eliminate these newly listed persistent organic pollutants.

The implication of the new listing for the implementation of the Stockholm Convention include:

- Implement control measures for each chemical
- Develop and implement action plans for unintentionally produced chemicals

- Develop inventories of the chemicals stockpiles
- Review and update the national implementation plan
- Include the new chemicals in the reporting
- Include the new chemicals in the programming for effective evaluation

The new POPs are Alpha hexachlorocyclohexane; Beta hexachlorocyclohexane; Hexabromodiphenyl ether and heptabromodiphenyl ether; Tetrabromodiphenyl ether and pentabromodiphenyl ether; Chlordecone; Hexabromobiphenyl; Lindane; Pentachlorobenzene; Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride.

Until now, the Stockholm Convention on Persistent Organic Pollutants (POPs) has targeted the so-called "dirty dozen": 12 hazardous pesticides and industrial chemicals that are linked with human health impacts ranging from damage to the nervous and immune systems, cancer and reproductive disorders and the disruption of infant and child development.

As a signatory to the Stockholm Convention, while pursuing efforts to continue the implementation of control measures aimed at the dirty dozen, Belize also has to initiate actions directed at complying with the additional responsibilities. These actions will not only protect the environment and population, but also facilitate access of Belizean products to international markets.

No epidemiological study has been conducted in Belize to link the unintentional release of dioxins and furans to the health of people living in polluted areas, but the world literature abounds with well designed studies that have established that there is a correlation between POPs, UPOPs and health. Ecological studies also corroborate those findings.

During the year 2000, a study was conducted in the republic of Congo in the communities of Nkayi and Ouessou to assess the use of POPs and their impact on the inhabitants' health. It was found that large amounts of dioxins and furans were being released in those two communities as a result of cane bagasse burning (613.23 TEQ per year), waste incineration (147 tons), and hospital waste burning (45 tons). The morbidity data related to lung diseases from Nkayi was compared with that of Makelekele, which has a better chemical management profile. The ratio of lung diseases among Nkayi inhabitants was 1 to 29 as compared to 1 to 92 for Makelekele's people. De La Salle University of Dasmarias conducted a study 2005 in the City of Trece Martires, Province of Cavite in the Philippines, with the purpose of measuring the presence of dioxins in free-range chicken eggs. The study found levels of dioxins 10 times higher than the limit for eggs set by the E.U. The level of PCBs also exceeded allowed E.U. levels. It was also found that the most obvious potential source of POPs to the community was the incineration plant that burned medical waste. Based on the findings, the authorities declared and enforced an incineration ban to prevent formation and release of UPOPs from waste burners and the replacement of the medical waste incinerators with a non-combustion alternative that did not generate POPs.

The WHO information paper on Public Health Management of POPs in Relation to the Stockholm Convention, annex 1, states “The convention requires the minimization and elimination of POPs which have no commercial use but which are produced as byproducts of combustion or industrial production”. Belize as a signatory to the Stockholm Convention is committed not only to the elimination of type i and ii POPs, where much has already been done, but also those unintentionally released into the atmosphere as a result of human activities such as improper incineration of medical waste among others.

At a time when some countries are taking steps to improve on the incineration of medical waste for the purpose of minimizing the production of dioxins and furans, specialized agencies in chemical management of the United Nations system are advocating the use of non-polluting methods for the elimination of medical waste. They are promoting the replacement of existing medical waste incinerators by other methods and technologies that are safer, less polluting and do not form U-POPs.

WHO, UNDP, GEF and Health Care without Harm are partners in a project developed in the framework of the Stockholm Convention that aims to demonstrate and promote “Best Practices” in reducing medical waste to avoid environmental release of dioxins and mercury from health care practice. This project offers an opportunity for countries that are interested in the reduction of U-POPs through alternative methods.

#### Summary of the costs of inaction in a qualitative manner

The effects on human health of POPs and other toxic chemicals in our environment are well known and include the incidence of cancer, leukemia, asthma, skin diseases as well as the lesser understood impacts on conceiving and holding a pregnancy in women. Other impacts can include birth defects. The costs of inaction include the continuation or increase in these diseases which can affect the entire population but are more concentrated in those who live near waste-burning sites and burning cane fields, and are exposed to other chemicals such as DDT and PCBs in electrical transformers, among others. Children and young mothers are especially at risk due to the developing stage of their smaller bodies and the consumption of breast milk. Other sections of the population can be affected many miles from the source sites due to the persistence of these chemicals in the air and their concentration in the food supply. The worst case scenario would be no action taken, in which case the health impacts, while difficult to quantify in dollar terms, would continue to impact our Belizean population.

#### Summary of the benefits and options for actions

Belize is actively implementing the Stockholm Convention.

DDT has been eliminated from use in controlling the incidence of malaria and a small store is kept for emergency use only under the control of the Government of Belize (GOB). PCBs are virtually eliminated as the Belize Electricity Limited has phased out the use of older transformers and actively ensures that its transformers are free of PCBs.

Belize has also taken positive action in reducing unintentional POPs through the recently approved Solid Waste Management Project with a sanitary landfill to be located at Mile 24 on the Western Highway. This project is now under implementation, with the construction of managed cells for solid waste outside Belize City being the first step. The new Solid Waste Management Project is being undertaken by the Government of Belize in partnership with IDB and OFID. The benefit of this positive action is undermined to a minor extent by solid waste that enters our national territory from other nations. Some regional coordination may be necessary with our neighbors as the incidents of solid waste being washed unto our cayes and beaches in Southern Belize and our Southernmost Town Punta Gorda is an almost annual occurrence during the rainy season. Belize's efforts are good but need support in neighboring Guatemala and Honduras. At a minimum, Punta Gorda is heavily impacted and needs some consultation for an improved system to handle the collection and sanitary disposal of large volumes of solid waste washed ashore and originating in nearby countries having millions of inhabitants. This is also seen to a much lesser extent whenever it rains in Melchor de Mencos Guatemala and the river carries solid waste downstream to Benque Viejo del Carmen Town and Succotz Village where the traditional washing of clothes and bathing takes place despite the availability of potable water in that village due to years of local customs or habit. This makes the point for increased public awareness and education.

While the solid waste project is a major step, there may still be a need to look at the incineration of medical waste for its proper treatment. The practice of burning sugar cane fields also adds to the chemical burden and can be looked at in order to find alternatives such as the green harvesting of sugar cane.

The actions that need to be undertaken involve the GOB in a regulatory and monitoring capacity. It also involves the private sector in their active participation in ensuring that POPs are not imported and that other known harmful chemicals are subject to improved awareness through better information being available and possible safer alternatives made available. As Belize does not manufacture chemicals this task is made simpler as a larger problem exists in countries that actively manufacture chemicals.

Public awareness and education at all levels is important to the success of any campaign to reduce the levels of POPs and harmful chemicals. This involves by necessity the coordination and integration of the efforts of the Department of the Environment with other Ministries and Department such as the Ministry of Health, which has a Policy Coordination and Planning Unit that can assist with this broader human health effort.

The private sector has participated in the POPs and Chemicals awareness projects over recent years and is involved in the present SAICM project. As such, it is an active participant in eliminating POPs and in ensuring the safety of the Belizean population. Even though Belize does not manufacture chemicals, we do import and use pesticides, fungicides, and other chemicals. As such, the adoption of what is used by the Chemical Manufacturers Association under its Responsible Care program may still be useful. Responsible Care establishes six codes of management practice to protect humans and the environment from the improper use of chemicals. These are: community awareness and emergency response; pollution prevention; process safety; distribution safety; employee safety and health; and product stewardship. This

would be an additional indication of the concern of private industry for pollution reduction through the Sound Management of Chemicals.

The benefits of a healthy population translates to greater economic productivity and lower health costs associated with treating exposed populations, especially since the most vulnerable poorer populations will generally turn to public health centers for treatment.

### Economic Analysis Framework

A review of any option for the development of policies and follow-up actions for the implementation of the selected policy requires the analysis of costs and benefits.

*Cost-benefit analysis* is a set of generally accepted methodological rules about how to identify, analyze and present economic information to decision-makers as one basis to make choices between options to address a problem or opportunity including, in this case, for the sound management of chemicals. For instance, if a problem has been identified as a potentially serious public policy concern, cost benefit analysis requires the practitioner to:

- a. Analyze that problem to determine how significant it is from an economic perspective; and
- b. Comparatively analyze practical options for responding to the problem in terms of which of these options will provide the greatest *benefits* to problem solving at the lowest *cost*.

A set of policies is presented for consideration by policy makers; these will require a detailed cost- benefit analysis to select the preferred choices.

The estimated cost to implement the actions addressing this sound management chemical issue is USD\$1,860,000.00

One new area that is outside the scope of the present concept yet is of such importance that it will require early international assistance is doing a review of the present situation with and the addressing of the newly listed POPs under the Stockholm Convention. Addressing the nine new POPs listed since May 2009 will require international assistance similar to that received for the previously listed ones in order to carry out inventories, management of any existing stocks, phasing out of the importation, action plans with financial mechanism, and other measures that are consistent with the COP work program. Costs were not provided for this new work program.

### Policy Options

In the document “Belize National Profile and Assessment of the National Infrastructure for the management of Chemicals” it is stated that “The dioxins, furans and hexachlorobenzene

emissions, are unintentionally released from combustion processes like waste incineration, burning of garbage at landfills or municipal or urban dump sites, agricultural fields, firewood, and the production of lime". The same document states that waste incineration accounts for most of the emissions, a main source being the KHHH hospital which is located in the country's most populated city.

To date, no action has been taken in-country to address the by-products of uncontrolled burning and the unintentional release of harmful chemicals into the environment.

With respect to waste disposal, an IDB-funded municipal garbage project is in its final stage of development but deals primarily with the establishment of a sanitary land fill and the disposal of domestic and commercial waste. It will not have the capacity to treat hazardous material; consequently the issues of field burning in agriculture and inadequate incineration of medical waste remains unaddressed. The unintentional release of dioxins and furans from burning of agricultural fields calls for a change in harvesting and land preparation practices.

The problem of improper disposal of medical and other hazardous waste requires the construction of an incinerator that meets international emission standards and is capable of handling up to 2,000 tons of waste per annum. This facility should be complemented by a medical and hazardous segregation, collection and transportation system.

Several work areas are available to begin addressing this high priority SMC issue:

1. Develop the enabling legal framework for the management of waste.
2. Review and update National Implementation Plan for POPs and UPOPs.
3. Identify and dispose of obsolete stocks of pesticides so that they are disposed of in an environmentally sound manner.
4. Develop a national waste management plan to begin phased improvements in how waste is collected, segregated and soundly recycled or disposed of.
5. Waste management awareness raising

Taking into consideration what is already in progress, the available timeframe and required resources, it is felt that these activities are feasible for mainstreaming into the next development planning cycle.

The implementation of policy options (2) and (3) implies updating of legislation, situational analysis of New POPs, final disposal abroad of legacy POPs and permanent solution to medical waste treatment, promotion of green cane harvesting and mechanized land preparation in agriculture. Policy options (1), (4) and (5) require the updating of legislation, waste management situational analysis, development of a waste management plan that addresses identified waste management gaps, and development and implementation of a waste management education and awareness program.

## **2. Enhancing Industry Sector Risk Reduction Through the Implementation of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) in Belize.**

The second CMI identified for further analysis was that of the role of industry in the reduction of chemicals-related risk. The SAICM Global Plan of Action (GPA) chemical management area “Globally Harmonized System for Classification and Labeling of Chemicals” (GHS) seeks to empower stakeholders, including industry, to contribute to the reduction of risk posed by chemicals throughout their life cycle.

The main objective of GHS is to ensure that employers, employees and the public are provided with adequate, practical, reliable and comprehensive information on the hazard of chemicals, so that they can take effective preventive and protective measures for their health and safety. The purpose is to enhance the protection of human health and the environment by providing an internationally-comprehensive system for hazard communication; to provide a recognized framework for countries without an existing system; to reduce the need for testing and evaluation of chemicals; and to facilitate international trade in chemicals whose hazards have been properly assessed and identified on an international basis.

In 1992 at the United Nation Conference on environment and development, in its Agenda 21, chapter 19 calls for “A globalized harmonized classification and compatible labelling system, including material safety data sheets and easily understood symbols, should be available, if feasible, by the year 2000”. The conference also calls on all countries to implement the system by 2008. Our review of relevant national documents and consultation with the Department of the Environment revealed that Belize has not yet initiated the implementation of GHS. It should be noted that the implementation of GHS by some manufacturing countries has partially benefited countries that import all of their chemicals, as is the case of Belize. Notwithstanding, the full benefit of the system can only be derived through national implementation of all its components. The United Nations Economic Commission for Europe (UNECE) has a listing of countries that are in the process of implementing GHS. Belize is not among them.

Even though GHS provides model legislation in support of countries’ efforts, it is not legislation in itself, but rather a mechanism to meet the basic requirements of any hazard communication system. It implies deciding if a given chemical product is hazardous and to prepare a label and Safety Data Sheet. This is done within the context of each country’s legislative system.

The sound management of chemicals should include systems through which chemical hazards are identified and communicated to all who are potentially exposed, such as workers, consumers, emergency responders and the public. When handling chemicals, it is important to know what chemical it is, its hazard risks to health and the environment, and means of controlling risk. At the prioritization workshop held in June of 2010, stakeholders such as the police, the medical response team and the Fire Department expressed their concern that in responding to cases of accidental or intentional chemical intoxication they were often unable to determine what was the chemical involved because of lack of or poor labelling.

Prior to the Agenda 21 conference, industrialized countries had their own requirements as it related to chemical classification and labelling. Different requirements for classification and

labelling of chemicals in different countries, or even within a country as determined by different regulatory authorities, leads to inconsistent protection for those potentially exposed to chemicals. It also puts additional burden on companies producing chemicals and by extension discourages compliance. Once countries have consistent and appropriate information on the chemicals they import or produce locally, the infrastructure to control chemical exposure (Risk) and protect people and the environment can be established in a comprehensive manner.

#### Summary of the costs of inaction in a qualitative manner

The improper labeling and lack of knowledge of the hazards involved in the improper use of chemicals is compounded by the nature of Belize as a multilingual and developing country. Due to its multilingual nature (in which some sections of the population have Spanish as the primary language), there exists in Belize a language barrier; due to the considerable lower education levels among the farming and rural populations there exists an education barrier; due to lack of funding for sustained awareness-raising campaigns there is also an awareness barrier among the general target populations such as farmers and customs officers. All these barriers must be addressed in a sustainable manner. The improper labeling and lack of knowledge of the hazards involved and lack of proper use of chemicals including pesticides leads to unnecessary exposure by rural populations and the families of farmers, with the associated health and economic costs.

#### Summary of the benefits and options for actions

The suggested course of action is for Belize to implement GHS. This will assist industry and the stakeholders involved in chemicals in Belize in using internationally accepted standards for the classification and labeling of chemicals. In this way the possible hazards due to the lack of proper information can begin to be mitigated.

#### Economic Analysis Framework

A review of any option for the development of policies and follow-up actions for the implementation of the selected policy requires the analysis of costs and benefits.

*Cost-benefit analysis* is a set of generally accepted methodological rules about how to identify, analyze and present economic information to decision-makers as one basis to make choices between options to address a problem or opportunity including, in this case, for the sound management of chemicals. For instance, if a problem has been identified as a potentially serious public policy concern, cost benefit analysis requires the practitioner to:

- c. Analyze that problem to determine how significant it is from an economic perspective; and
- d. Comparatively analyze practical options for responding to the problem in terms of which of these options will provide the greatest *benefits* to problem solving at the lowest *cost*.

A set of policies is presented for consideration by policy makers; these will require a detailed cost- benefit analysis to select the preferred choices.

These include seeing what benefits can be derived by Belize under this GHS arrangement, i.e. funding and technical assistance from international donors where possible. Options include doing labeling and hazard identification according to country capacity should funding not arise from international partners. Costs for project development, implementation and coordination by government and the private sector will need to be explored in order to show the feasibility. The desirability of such a program for risk reduction in terms of benefits to the local population and the environment will need to be quantified. Where local data does not exist, as may be the case in adopting and implementing international standards and practices, the experience of other nations that have implemented GHS will be studied to draw conclusions appropriate for the Belizean context.

The estimated cost to implement the actions addressing this sound management chemical issue is USD\$225,000.00

### Policy Options

GHS enhances the protection of human health and the environment by providing an internationally comprehensive system of hazard communication; reducing the need for testing and evaluation of chemicals at the national level; and providing information to users on hazards and the safe handling of chemicals, thus reducing risk. Guidance documents exist on GHS implementation strategies, legislation, situation analysis, chemical hazards, labelling and safety data sheets. Technical support is also available for capacity building from UNITAR, ILO and OECD.

Stakeholders participating in the prioritization exercise to select high priority chemical management issues agreed that this issue was of great concern due to the unnecessary exposure to which workers were subjected because of limited knowledge on the hazards of chemicals they work with on a daily basis. Currently there is no legislation requiring employers to inform workers about chemical hazards and as such the ICM and other stakeholders were unanimous in recommending the implementation of the GHS in Belize.

The following steps will be taken to begin addressing this priority issue:

1. Review applicable national legislation and begin aligning with GHS requirements.
2. Establish roles and responsibilities of employees, chemical suppliers and government in the implementation of GHS.
3. Establish an information clearing house for hazard information.
4. Prepare safety data sheets and labels applicable to Belize building on the GHS source material.
5. Develop and implement GHS awareness-raising and capacity-building program.

Policy option (1) creates the enabling legal environment to implement GHS. It establishes the roles and responsibilities of key players as it relates to information dissemination and awareness.

Option (2) is partially addressed in the legal instrument, and is complemented by the GHS awareness-raising and capacity-building program. Option (3) deals with the issue of hazardous data collection, processing and availability for public use. Policy option (4) calls for the development of national safety data sheets and labels using the UN guidance document. In addition to the international standard for information to be included, the national safety data sheet should take into consideration culture, language, and literacy rate of target population in order to ensure effective transfer of information. Policy option (5) requires the development of public awareness plan to promote GHS implementation along the entire spectrum of chemical use.

### **3. Safe Handling and Use of Chemicals, with an Emphasis on Pesticides, to Address Poisoning, Good Agricultural Practices and Unnecessary Threats to Biodiversity.**

Pesticides are chemicals that are used in agriculture, aquaculture, forestry and the livestock industry. They help to increase production through the control of pests such as nematodes, fungi, insects, viruses and bacteria, as well as the elimination of competing weed plants, to mention a few. On the other hand, they pose a health risk to those who use them, as well as millions who are exposed to pesticide residues in agricultural and livestock produce, drinking water and seafood. In Belize, Agriculture, Forestry and Fishing continue to form the foundation of the productive sector and the rural economy of Belize. 11.65% of GDP and 26.2% of total employment is directly dependent on agriculture, fisheries & forestry. What is the key to understanding the importance of this sector is its direct contribution of 65% of our entire nation's exports earnings. It follows that large amounts of pesticides are imported and used in this sector. Data from the United Nations Commodity Trade Statistics shows that during the year 2006, Belize imported 8, 872 tons of pesticides and fertilizers combined.

The review of statistical information from the Ministry of Health points to some of the problems related to pesticide use. An acute pesticide intoxication study conducted in 2002 found that between the years 1999 and 2001 there was a steady increase in the number of preventable intoxications. The study highlights the fact that there were discrepancies between cases found in medical records and those reported by the surveillance system. This study also showed that as much as 36.7% of papaya workers suffer from contact dermatitis due to workplace pesticide exposure. The need therefore exists to develop and implement programs that could minimize the negative impact of pesticides on people and the environment. No one activity or program will suffice to control the problem. An integrated approach needs to be adopted whereby different time-tested strategies are implemented in order to have a productive, safe and sustainable agricultural industry.

Since the Belize national development plan calls for the expansion of the agricultural sector, it is reasonable to expect increased use of pesticides and increases in the number of people handling these chemicals. FAO and other specialized agencies of the UN system have been promoting the use of Good Agricultural Practices (GAP) as a strategy to ensure safety on farms and processing plants, healthy food at the market place and sustainable farming.

Broadly defined, GAP applies available knowledge to addressing environmental, economic and social sustainability for on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products.

In Belize some farmers are already applying GAP through sustainable agricultural methods such as Integrated Pest Management (IPM), Integrated Nutrient Management, and Conservation Agriculture. IPM is a recommended practice in the Code of Conduct on Pesticide and in chapter 14 of Agenda 21. These methods are especially appropriate for smaller- or medium-scale farmers in developing countries and they contribute to increasing local food production, food security and conservation of natural resources.

Codex Alimentarius defines GAP as the use of pesticides under actual conditions necessary for effective and reliable pest control. The actual conditions includes any stage of the production, storage, transport, distribution and processing of food commodities and animal feed. GAP in this context is used to set maximum residue levels for pesticides and is also recognized in the International Code of Conduct on the Distribution and Use of Pesticides.

GAP allows for countries to improve food security, rural livelihood and income. It contributes to environmental, economic and social sustainability of on-farm production, resulting in safe and healthy food. While a GAP approach may respond to the growing demands of increasingly globalized and integrated agricultural sectors, it is also very important for local and national markets.

GAP is not a convention; it is an approach that integrates a number of new and existing codes, standards, guidelines and conventions. Two of the important existing conventions of relevance to this concept paper are:

#### Convention on Biological Diversity

The Convention on Biological Diversity was born out of the Earth Summit in 1992. More than 175 countries have ratified the agreement. The Convention has three main goals: The conservation of biodiversity; sustainable use of the components of biodiversity; and, sharing the benefits arising from the commercial and other utilisation of genetic resources in a fair and equitable way. Parties must establish rules governing access to biological resources, systems recognizing the rights of local communities, mechanisms ensuring the transfer of appropriate technologies, and procedures for the safe handling, use and transfer of living modified organisms.

#### Conventions on Pesticide and Pesticide Use

Two documents exist that describes the international commitments related to the use of pesticides.

- The International Code of Conduct on the Distribution and Use of Pesticides, the revised version of which was adopted by the FAO Council in November 2001.

- The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. FAO/UNEP, Rome/Geneva. 1998. Under the PIC procedure, the secretariat provides all participating countries with detailed information on the risks the chemicals pose, allowing them to decide whether to accept future imports. If any country does choose to ban or restrict substances on the PIC list, which contains presently 31 chemicals, exporting countries are advised and must immediately inform their exporters, industry and customs departments.

### Benefits of GAP implementation

Appropriate adoption and monitoring of GAP helps improve the safety and quality of food and other agricultural products.

It may help reduce the risk of non-compliance with national and international regulations, standards and guidelines (in particular of the Codex Alimentarius Commission, World Organisation for Animal Health (OIE) and the International Plant Protection Convention IPPC regarding permitted pesticides, maximum levels of contaminants (including pesticides, veterinary drugs, radionuclide and mycotoxins) in food and non-food agricultural products, as well as other chemical, microbiological and physical contamination hazards.

Adoption of GAP helps promote sustainable agriculture and contributes to meeting national and international environment and social development objectives.

The four pillars of GAP are:

- Economic viability
- Environmental sustainability
- Social acceptability and
- Food safety and quality

The adoption and implementation of GAP in Belize will contribute to safeguarding the health of people handling pesticides by introducing practices that reduce exposure, intoxications and poisoning by these chemicals. It will also minimize the impact on the environment and threat to biodiversity.

Some of the key issues related to the risks of pesticide intoxication are: the use of alternative chemicals of low toxicity, personal protection, -packaging of the product, labeling, storage and disposal. Experts in the field advise that pesticide poisoning could be greatly reduced if packaging, labeling and storage practices meet specific requirements.

**Packaging:** The packaging of pesticides must withstand transport, handling, and the climatic and storage conditions to which they will be exposed. Specifications for packaging are therefore not limited to the transport period and the associated handling, but must ensure the integrity of the container for the whole period from packing by the manufacturer to the application of the pesticide in the field.

**Labelling:** Proper labelling is essential to the safe use of pesticides. Careful attention should be paid to the design, content, and quality of labels to ensure that users will easily understand them. As a rule, appropriate labelling is mandatory and part of national registration requirements. As an absolute minimum, a label must give information on the product itself, i.e. approved name and content of active ingredient, proprietary name, net weight of contents, batch or reference number, date of manufacture, name of manufacturer, and a reference to WHO or FAO specifications.

**Storage:** As pesticides are valuable but hazardous commodities, facilities should be made available for their safe and secure storage. Proper facilities should be constructed for central as well as regional storage of full pesticide containers and of empty containers awaiting disposal. The containers should not be in direct contact with the ground, and should be stored at a level that is high enough to avoid flooding. They should be protected from the sun and rain by a roof or other impervious covering

**Disposal:** Relevant authorities should make available information on established methods for disposal and their effectiveness, and should develop systems for the disposal of unwanted pesticides, if necessary in collaboration with international agencies.

The safe handling and use of pesticides by those who come in contact with these chemicals at different stages of their life cycle can only be achieved by raising public awareness on the risks involved through effective educational programs. When directed to communities, professionals, and policy-makers, health education for prevention of pesticide poisoning is concerned with raising awareness of problems, influencing priorities for action, and persuading about the potential effectiveness of preventive measures. Without these activities, prevention strategies such as regulation and legislation will have little impact. A lack of resources need not be a barrier to community education if safety messages are integrated into existing health care and other sector programmes, particularly those concerned with the health of children, the elderly and specific vulnerable groups.

Another issue related to pesticides use is the threat to bio-diversity. Numerous studies around the world have clearly established the link between pesticides and decreased biodiversity in the ecosystems where they are used. Carbamate insecticides affect birds, fish, bees and mammals. They can be a direct threat to non-target insect species including pollinators. Some pesticides are known as endocrine disruptors because of the subtle biochemical and physiological changes during the embryonic and early neonatal stages of amphibians and reptiles. Colburn and Clement 1992, studied and described the effect of endocrine disruptors:

- Decreased fertility: Birds, fish and mammals
- Thyroid dysfunction: Birds and fish
- Decreased hatching success: Birds, fish and turtles
- Birth deformities: Birds, fish and turtles
- Feminization of males: Birds, fish and mammal

- Masculinisation of females: Birds, fish and mammals

Food chain magnification is another issue related to pesticides and biodiversity. It is the process by which pollutants become concentrated as they reach higher levels of the food chain. Fish absorb and ingest large amounts of chemical contaminants from runoffs into aquatic systems and are a major pathway of exposure to fish-eating birds and mammals (Calburn and Clement, 1992). The extensive use of herbicides reduces the abundance of many plants, which subsequently decreases the diversity of insects and pollinators that depend on them. Since thousands of wild plants depends on insect pollinators in order to reproduce seeds and fruits, this leads to a further decrease in plant diversity. This cycle is intensified by the use of broad-spectrum insecticides (Kearns and Inowye, 1997).

#### Summary of the costs of inaction in a qualitative manner

Belize has a well-known wealth of biological diversity. In addition, the nation, while having a relatively small human population, is blessed with a rich cultural heritage arising out of the variety of races and cultures that call Belize home. This special combination has made Belize a popular tourist destination, and the tourism industry makes up a significant part of the nation's economy, providing jobs and foreign exchange earnings.

The rich biodiversity and abundant natural resources comprised of both marine and land-based beauty and abundant flora and fauna make Belize a special destination that goes beyond the traditional offering of sea-based recreation. Land-based tourism is important, with the forests, rivers, caves and wildlife being important attractions in their own right. It is beyond question that Belize's biodiversity is the source of wealth through its valuable resources. However, a question does arise as to how the natural resources and biodiversity should be developed or protected from development and how the protected areas should be managed so that they yield long term benefits to the nation and its people.

The potential impacts on biodiversity caused by more commonplace activities need to be further developed. The wealth of biodiversity can be impacted by agricultural runoffs of pesticides, fertilizers and other chemical inputs. The land, rivers and subsequently the sea and precious barrier reef can also be impacted by effluents produced by normal urban activities such as sewage and the use of household chemicals. While Belize does not have major industrial activities that create large discharges of industrial contaminants, the tendency in developing nations as well as in the more developed world is to use the sewage system for disposing of liquid industrial waste.

Impacts of the more commonplace agricultural and urban runoffs can lead to the contamination of drinking water and damage to the human population as well as to the species that either drink water from potentially contaminated rivers or are dependent on the rivers and sea for life. These would include fish and other creatures such as the manatees that live there as well as the aquatic life such as corals that comprise our barrier reef.

Belize also is impacted through having a high part of its rural and farming population speak other languages, Spanish being the chief one. As such messages through intended public awareness

need to be prepared either in at least two major languages (English and Spanish) or combined with easily understood signs. This of course is part of the labeling effort mentioned above.

### Summary of the benefits and options for actions

The most important benefit is the prevention of impacts on the Belizean population, which is not merely a casual visitor but instead lives here. The impacts are not always evenly spread across a nation's population. The heaviest impact falls on the rural poor and urban poor. These persons may either live near or use the natural resources for their direct livelihood such as for agriculture or for drinking water. Within urban areas the poor are also the ones likely to be affected due to their proximity to urban waste dumps which are likely to contain improperly disposed chemicals especially pesticides. The follow-up cost to the impacted population is that these are more likely to be children who are more prone to the effects of pollution due to the development stage of their smaller bodies. Babies may also be contaminated by their mothers directly such as from breast milk or indirectly through their economic and household activities, especially due to their higher incidence of living in closer proximity to contaminated sites. The marginalized segment of society is unfortunately the part of the population that can least afford medical care and that part which is most likely to depend on the public health system for their medical needs.

International public awareness of the role of chemicals in health and on the environment is relatively recent, starting with the publication of Rachel Carson's well-known book *Silent Spring* in the early 1960s. The effects of chemicals on the environment and the link to human health are significant and as a result the protection of the environment through safe drinking water and food supplies has been an international health practice since 1878. A point to be made is that while this is the case in the health and environment communities, this public awareness has not been properly disseminated to the sectors of the population that are most likely to be impacted. In Belize this includes farmers and their families, in particular children.

Following from the above background information, the indicated course of action is awareness-raising at a national level and especially targeted at the family unit where women are likely to play a key role, in primary schools where children are most likely to benefit, and the training of farmers in the safe handling and storage of chemicals with emphasis on pesticides.

The adoption and implementation of GAP has several benefits as stated in the earlier section above. The most significant in the Belizean context would arise through the combined implementation of GAP along with GHS. This would yield positive benefits to those who handle agricultural chemicals such as farm workers, their families and surrounding communities. The safety and health standards of the food consumed by our population will be enhanced. An additional and important economic benefit would accrue to the present and future exports of our agricultural produce as our trading partners such as the European Union and international health and agricultural organizations place importance on the implementation GAP.

### Economic Analysis Framework

A review of any option for the development of policies and follow actions for the implementation of the selected policy requires the analysis of costs and benefits.

*Cost-benefit analysis* is a set of generally accepted methodological rules about how to identify, analyze and present economic information to decision-makers as one basis to make choices between options to address a problem or opportunity including, in this case, for the sound management of chemicals. For instance, if a problem has been identified as a potentially serious public policy concern, cost benefit analysis requires the practitioner to:

- e. Analyze that problem to determine how significant it is from an economic perspective; and
- f. Comparatively analyze practical options for responding to the problem in terms of which of these options will provide the greatest *benefits* to problem solving at the lowest *cost*.

A set of policies is presented for consideration by policy makers; these will require a detailed cost-benefit analysis to select the preferred choices.

The estimated cost to implement the actions addressing this sound management chemical issue is USD\$670,000.00

The case for improved human health especially in children and vulnerable economic groups needs to be further developed through additional studies. The safe-guarding of our agricultural exports was shown in economic terms as a benefit through the implementation of GAP or as a cost through the possible erosion of our agricultural and agro-processing exports.

A Cost-benefit analysis using the above points was carried out on the Sugar Cane industry in Belize. The traditional method of farming used in Belize was examined, with the findings that most farmers in the case studied for sugar cane farming do not:

- Use chemical inputs according to the recommended best practices;
- Adopt a Cost Benefit Analysis in determining the required levels of use;
- Take into account the environmental, social and economic impacts of not following best practices with regards to timing and modern methods of applications.

The case study reveals that farm-based income in Belize can be improved and the above negatives mitigated through the application of Good Agricultural Practices (GAP). A related finding is that increased acreages should not be seen as a solution in and of itself without first implementing GAP to ensure that the environmental, social and economic aspects of economic development are taken into account with the Sound Management of Chemicals.

Implementing GAP over a five year period would allow for the net benefit of BZ\$324.5 per acre per year and BZ\$119,071,604.37 NPV over a five year period. The benefit/cost ratio of 3.15 shows that GAP is economically beneficial as well as being able to foster environmental and social development objectives.

While GAP is not an international obligation under any treaty, it is a good measure to use as a standard to implement in order to adapt to increasing international requirements for food safety

as well as related social and other obligations as seen by our major trading partners. It should be seen as an incentive and opportunity in itself while having the potential to ward off some potential threats.

### Policy Options

In Belize, Agriculture, Forestry and Fishing continue to form the foundation of the productive sector and the rural economy of Belize. 11.65% of GDP and 26.2% of total employment is directly dependent on agriculture, fisheries & forestry. What is the key to understanding the importance of this sector is its direct contribution of 65% of our entire nation's exports earnings. It follows that large amounts of pesticides are imported and used in this sector.

An acute pesticide intoxication study conducted in 2003 found that a large number of preventable intoxications occur annually. This study also showed that as much as 36.7% of papaya workers in one year suffered from contact dermatitis due to workplace pesticide exposure. The improper use of pesticides releases high quantities of these chemicals in the environment with negative impact on local ecosystems and biodiversity. The application of good agricultural practices in farming and food processing around the world have demonstrated its contribution to safeguard the health of people handling pesticides by introducing practices that reduce exposure, intoxications and poisoning. It also minimizes the impact on the environment from runoff and threats to biodiversity. Required initiatives are:

1. Develop and promote the implementation of GAP including Integrated Pest Management.
2. Promote access to lower risk or safer pesticides.
3. Promote the use of pest and disease-resistant crop varieties
4. Provide training in alternative and ecological agricultural practices, including non-chemical alternatives.
5. Regulation on safety gear availability at the workplace and awareness program on personal protection while handling pesticides.

The required actions to implement policy option (1) are to develop the scope and strategies for the national GAP program, to develop crop specific IPM manuals and the development of a national awareness IPM program. The implementation of policy option 2, 3 and 4 are components of national training and awareness program to be implemented through the existing agriculture extension services. This requires the development of GAP and IPM capacity-building program for agriculture extension officers, the development of an IPM training manual for farmers and the integration of GAP and IPM into the school of agriculture curricula.

#### **4. Chemical Accidents Preparedness. Expand National Emergency Plans to Include Industrial Accidents Including In Ports and Shipping Channels To Defend Coastal Zone Integrity/Biodiversity and Safeguard Human Health.**

Representatives of the fire department who were participating in the prioritization exercise commented that in a recent accident that occurred in the northern district of Orange Walk, emergency crews were unaware of what was the substance involved and proceeded to extinguish

a fire with water; to their surprise, the amount of flames increased and the fire was made worse with the water they were using. Members of the Police and the Belize Defense Force refer to events where they have been called as part of the disaster preparedness protocol to keep order at the site of an accident just to find that chemicals have been spilled yet they were unaware of the nature of the chemicals, their potential risk and what protective measures to take. The oil spill in the Gulf of Mexico and the ongoing national debate on the granting of offshore oil exploration rights to companies have served to raise the level of national awareness regarding the eventuality of a major accident where chemicals are involved.

Prior to 2006, Belize was a net importer of fuel and lubricants-related chemicals. As of that year, oil production was initiated with 29 million gallons. The annual production has been steadily increasing, reaching 48.04 million gallons in 2008 and 53.58 million gallons 2009. Approximately 7% of the production is transported to Guatemala by road, which is about 25 miles away. The remaining 93% is transported to the southern port of Mango Creek, which is approximately 125 miles away. Notwithstanding the fact that the Belize National Energy (BNE) Company has a good transport safety program in place, the risk exists for an accident to occur. It is not surprising therefore that those stakeholders identified chemical accidents as a high priority chemical issue requiring urgent attention at the highest level.

In a paper submitted to the second International Conference on Chemical Management (ICCM2), the WHO noted: “The health sector is faced with additional roles and responsibilities due to increased production and use of chemicals in developing countries and those in economic transition. This includes increased risk assessment needs and dealing with the impact of chemical incidents on human health.” It goes on to say that among recent chemical accidents, there is the case of a mass outbreak of sodium bromide poisoning in Angola in March of 2008, which affected 467 people.

The WHO document “Manual for the Public Health Management of Chemical Accidents” says that the most effective method for minimizing the negative outcomes of an incident is to respond to the emergency in a timely and appropriate way. Because chemical incidents are by nature complex and often acute, such a response can only be achieved through the coordination and proper preparation of the various agencies that may be involved in responding to an emergency. This requires both emergency planning and preparedness activities. Emergency planning is concerned with the design, set-up and maintenance of an effective emergency response infrastructure.

Emergency planning will result in plans, procedures, guidelines, and relevant information on accident management. While these are crucial for the response to the incident, the multidisciplinary process of drafting those plans itself is probably at least equally important. It offers an opportunity to build trust and understanding among those agencies and individuals who will be charged with the response if and when an incident occurs. Even though the document outlines different scenarios where the national chemical accident prevention and control plan could be housed, it recommends its integration into the broader national disaster preparedness plan in order to capitalize on the existing infrastructure and resources.

Summary of the costs of inaction in a qualitative manner

A chemical accident can have a detrimental effect on both human health and upon our biodiversity. The clearest effect is upon human health, including not only the accident victims but also the emergency responders and populations living in the immediate area as well as within the wider impact area due to the flow of water or air currents. As tourism is so important to Belize any degrading of our biodiversity would lead to an immediate impact in the value of our natural resources which are important for their diversity and beauty. While it is possible to describe the impacts on the reefs and coastal zone in and of itself this can also be achieved in a more realistic and real life manner through the use of two international incidents whose effects were long-term and led to the development of better information systems, and improved the understanding of the effects of chemical impacts on coastal areas and inland waterways located at great distances from the site of the accident. The effects on human health were slow to be recognized and in one case are not yet completely assessed. The point that needs to be emphasized is that in the final analysis an impact on biodiversity does lead to an impact on human health as well as on other life forms. There is a direct link between a healthy environment and a healthy life for all inhabitants of a country.

The first example of the possible impacts on human health and on biodiversity includes the Minamata Bay incident involving mercury discharge in Japan. This occurred between 1932 and 1968 when a factory producing acetic acid discharged liquid waste into Minamata Bay in Japan. The discharge contained a high concentration of mercury which was converted to methyl mercury in the environment. The bay was rich in fish, which were the major source of employment and food for local fishermen and the population surrounding the bay. The awareness of the link between mercury contaminations through eating fish from the bay was not recognized for many years. When strange diseases in both humans and cats began to appear, peaking in the 1950s, the link between mercury and the fish was finally discovered. Diseases included severe cases of brain damage, paralysis, incoherent speech and delirium.

The second case, which shows the possible contamination of areas far removed from the site of the original accident site, is the Red Rhine Incident in 1986. This was an inland accident involving a chemical store in Basel, Switzerland near the borders of France and Germany. A fire destroyed the plant and the chemicals reached the water through the sewage system when huge amounts of water were used to extinguish the flames. The chemical stocks included 32 different chemicals, including insecticides and others. The presence in the river was discovered because of a red dye used in one of the chemical substances. The first effect was on eels, fish and small mammals living on the riverbanks. The total eel population, for example, was completely destroyed for a distance of 500 kilometers downstream from the fire. The contamination of drinking water and impacts on fish used as food was not clearly and immediately grasped. It took 3 months for the concentrations of chemicals to decrease to normal levels. As a result; the effects on human health have not yet been fully understood as some of the potential toxic effects are long-term.

These examples of incidents and accidents have led to the development of information systems with improved data on potential accidents relevant to those countries involved. The costs such as damage to our coastal waters, reef, fishing industry, tourism and human health through the lack

of knowledge of the possible impacts of accidents and a lack of a coordinated response is something that needs to be minimized and if possible avoided.

### Summary of the benefits and options for actions

The most practical option here is to ensure that steps are taken to prevent a major accident from occurring. The reason for this is that the cost of a cleanup, especially if an accident occurs at sea or within a watershed area for a river, can be enormous. This is illustrated by looking at the ongoing situation regarding the offshore oil well operated by British Petroleum in the Gulf of Mexico and a leak at the Swiss chemicals store in 1986. The cost of a cleanup in strictly financial terms could exceed many multiples of the gross domestic product of the country. The cost in terms of damage to our territorial waters, reefs, marine life, inland flora and fauna, drinking water, human health and tourism would also be very high for a small economy with a GDP of some US\$1.4 billion and with more than US\$200.0 million contributed in foreign exchange by the tourism industry each year.

The benefits in terms of human health are harder to quantify, as limited data exists as demonstrated in the examples above.

Both incidents and accidents mentioned above have led to the development of information systems with improved data on potential accidents relevant to those countries involved. The prevention of costs such as damage to our coastal waters, reef, fishing industry, tourism and human health through the lack of knowledge of the possible impacts of accidents and a lack of a coordinated response is something that needs to be minimized and if possible avoided.

National emergency management can be improved through the development of such information systems with a view to making data available on the possible types of incidents and likely chemicals involved that could occur in Belize. Once these are understood and the information is readily available the response to a possible chemical accident can be better informed and acted upon.

While the prevention of major accidents is important it is also necessary to develop our national capacity to respond to incidents that may arise. This includes the basic understanding of the issues involved with chemicals, the types of response levels possible, as well as training and equipping of personnel to be able to respond with some level of confidence.

### Economic Analysis Framework

A review of any option for the development of policies and follow-up actions for the implementation of the selected policy requires the analysis of costs and benefits.

*Cost-benefit analysis* is a set of generally accepted methodological rules about how to identify, analyze and present economic information to decision-makers as one basis to make choices between options to address a problem or opportunity including, in this case, for the sound management of chemicals. For instance, if a problem has been identified as a potentially serious public policy concern, cost benefit analysis requires the practitioner to:

- g. Analyze that problem to determine how significant it is from an economic perspective; and
- h. Comparatively analyze practical options for responding to the problem in terms of which of these options will provide the greatest *benefits* to problem solving at the lowest *cost*.

A set of policies is presented for consideration by policy makers; these will require a detailed cost-benefit analysis to select the preferred choices.

The costs involved in order to develop national emergency plan to expand the functions of the National Emergency Management Organization to manage industrial accidents is one area that requires further analysis. This would entail looking at training and capacity-building related to plan development and implementation. The benefits involved in having such plans and capacities will need to be further developed. Possible sources of information include international best practices in emergency organizations and local sources such as the Port of Belize, as well as local organizations that may be involved in the conservation of our marine resources. The development of an information system will also need to be looked at with its possible cost implications. The capacity to respond to incidents that may arise also needs to be addressed in some detail.

The estimated cost to implement the actions addressing this sound management chemical issue is USD\$265,000.00

### Policy Options

The oil spill in the Gulf of Mexico (2010) and the ongoing national debate on the granting of offshore oil exploration rights to companies has served to raise the level of national awareness regarding the eventuality of a major accident where chemicals are involved.

Prior to 2006, Belize was a net importer of fuel and lubricants-related chemicals. As of that year, oil production was initiated with 29 million gallons. The annual production has been steadily increasing reaching 48.04 million gallons in 2008 and 53.58 million gallons in 2009. Approximately 7% of the production is transported to Guatemala, which is about 25 miles away, by road. The remaining 93% is transported to the southern port of Mango Creek, which is approximately 125 miles away. Notwithstanding the fact that the Belize National Energy (BNE) Company has a good transport safety program in place, the risk exists for an accident to occur. It is not surprising, therefore, that stakeholders identified chemical accidents as a high priority chemical issue requiring urgent attention at the highest level. Recent accidents involving a natural gas explosion, highway oil spill and processing plant chemical spill in a nearby river has shown that agencies responding to these events were not prepared to adequately deal with the problem and level of coordination was poor.

Nationals have identified the lack of disaster preparedness to deal with industrial and chemical accidents as a major SMC issue confronting Belize; consequently, they see the need to formulate prevention and response measures to mitigate environmental and health impacts of emergencies evolving chemicals.

The single most important work area to address this SMC issue is to develop an integrated national system to prevent major industrial accidents and for emergency preparedness and response to accidents and disasters involving chemicals. It should be noted that the infrastructure required (NEMO, fire department, police, Health) for such systems already exist but capacities must be enhanced to respond in context of a chemical-related emergency.

Improvements in this area will require the following:

1. Review legislation dealing with accident prevention, preparedness and control.
2. Industry hazard identification and risk assessment.
3. Incorporate into national disaster preparedness plan, a chapter on industrial and chemical prevention and response, utilizing OECD, WHO and IPCS guidance documents.
4. Support industry to develop on-site accident prevention and response plans.