Biodiversity, Biosafety and Food Security of the Region as it looks to CSME.

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1. Let me begin by thanking the National Biosafety Project of the Ministry of Agriculture, Forestry and Fisheries and the Saint Lucia National Trust for the opportunity to present your 2006 World Food Day Lecture, which will also inaugurate the monthly Public Lecture Series to be hosted by the Trust.

I have been asked to talk to you on the topic: Biodiversity, Biosafety and Food Security of the Region as it looks towards CSME.

I will approach the topic as follows:

First I will provide and over review of biodiversity and establish its role in providing ecosystem services, many of which are also of value to mankind. I will then emphasize the value of the food services provided by biodiversity in wild and managed ecosystems. Following this I will review the biodiversity concerns impacting food security and the driving forces generating them. Finally I will review responses to these concerns and put forward proposals addressing a number of shortcomings in this regard.

2. **Definition of Biodiversity**

Biodiversity refers to variability in the many living things and living sections of plant earth. With the help of the non-living environment such as light, temperature and moisture, biodiversity is responsible for creating and maintaining all living sections of the earth. These living sections are generally referred to ecosystems and they may include forests, grassland, deserts, etc.

An ecosystem is therefore built and maintained by living species interacting with each other and the environment. The nature or type of species and their

variability, abundance, distribution, function and relationship with each other and the environment determine the type of ecosystem.

3. Relationship Between Biodiversity and Primary Food Production

Within the ecosystem there are several ongoing processes which generate outputs. These outputs and processes sustain or maintain ecosystems. Many also sustain mankind. Examples of common ecosystem outputs which benefit mankind are food, fibre and oxygen. Ecosystems also provide services of a non-material nature to humans and these include aesthetic, spiritual and/or recreational elements. All of these outputs and the ecosytem maintenance functions of biodiversity are interdependent.

This talk will focus on biodiversity and the food service it provides to mankind. For the purpose of the talk ecosystems containing biodiversity of relevance to food can be divided into two broad categories. One category includes naturally occurring ecosystems and the other contains artificially created ones.

Naturally occurring ecosystems can be important sources of food. A good example is the marine ecosystems which currently supplies over 100 million tons of sea food annually. This amount translates to about 6 percent of all protein consumed by humans.

Other naturally occurring ecosystems can be wild food sources. These ecosystems will be the source of a wide range of edible plant and animal

species. Ecosystems of this type and the food sources are important to people whose livelihoods are set in these environments.

It is worth noting that almost all plant and animal products used by humans are derived from wild species. Over 7,000 species of plants and several hundreds species of animals have been used as human food at one time or another. These species would have had their origin in wild or naturally occurring ecosystems. Currently, almost all plant and animal products used by humans are derived from these wild stocks.

Artificially created ecosystems are means for domesticating biodiversity. These types of ecosystem are the backbone of modern agriculture. In these ecosystems the biodiversity is deliberately selected and in the case of plants, it is cultivated as crops or reared as livestock in the case of animals. Domesticated ecosystems occupy over one third of the earth's surface and provide about 94 percent of the proteins and 99 percent of the calories in the human diet. Together with wild species, the domesticated stock make up the genetic resources for food and agriculture.

4. **Primary Food Production and Biodiversity Concerns.**

There are concerns about biodiversity with implications for the food service it provides. The main concerns arise from practices associated with domesticating ecosystems mainly for food production and from the emergence of modern biotechnology.

Domesticated ecosystems or cultivated systems, which they can be referred to, came about to meet the demand of a growing human population for food, feed and fibre. As the demand increased, mankind responded by increasing the cultivated area of land, intensifying production or both. Over the last 40 -50 years, intensification of cultivation globally has been the main method of increasing food production. However, in developing countries, particularly those with high population growth rates and low levels of economic productivity, expansion of the cultivated land area has been the response to increasing demand for food. In the global context, it is claimed that nearly all land suitable for intensive agriculture is currently in use.

Notwithstanding the success of cultivated systems in food production, they often operate at the expense of naturally occurring biodiversity. This happens mainly through the conversion of naturally occurring ecosystems to cultivated systems. Urban expansion is also a growing cause of displacement of ecosystem and biodiversity. There is abundant evidence that major losses in biodiversity have come about with the destruction of natural habitats. For example it has been reported that of 10,000 wheat species present in China in 1949, only 10 percent were available in 1970. There are similar reports that 80 - 85 percent of the varieties of maize present in Mexico in 1930 and apple, cabbage, pea and tomato identified in 1904 in the United States of America, have become extinct through the loss of natural habitats.

Cultivated systems can also impact negatively on crop biodiversity by generally focusing on the use of relatively few species, often in response to market forces. Because of this focus, biodiversity not selected for cultivation

can be lost if it is not targeted for conservation. For example, of the 10,000 - 15,000 edible plants only 7,000 have been used in agriculture and less than 2 percent are considered economically important. Moreover, only 30 crops provide an estimated 90 percent of total energy needs of humans with rice, wheat and maize supplying about 50% of calories consumed. Furthermore, only economically important crops are conserved in the international seed banks.

Compared to the natural habitats they replace, cultivated ecosystems tend to support less biodiversity because of environmental damage often associated with poor farming practices such as excessive use of agricultural chemicals. Environmental damage resulting in loss of biodiversity can appear as increased surface water run-off, water pollution and loss of soil structure and fertility.

How relevant is this discussion on food and biodiversity to the Caribbean? There is relevance for several reasons. First, given the scale of conversion of natural habitats to cultivated systems and urban developments, the historical and widespread dependence on monoculture agriculture, erosion of biodiversity in the Caribbean has and continues to be a matter for serious concern. In the Windward Islands in particular, the rate of deforestation has caused consternation. In Haiti, deforestation has been catastrophic. I will return to deforestation.

The biodiversity damage referred to is exacerbated by small-island nature of most Caribbean countries. Island systems are unique with respect to their biodiversity and the fragility of their ecosytems.

Their biodiversity is unique because islands are physically isolated from each other and from continents by water. This water functions as a barrier to plant and animal dispersal. Because of their isolation, islands often produce highly adaptive species. Isolation also means that there is little or no dispersal of species. For this reason island ecosystems tend to contain species of narrow genetic diversity. This usually means that island species have reduced competitive ability, small populations and narrow distribution range relative to continental systems.

Island species tend to become concentrated in small areas on account of the generally limited size of islands. For this reason islands make a contribution to biodiversity in disproportion to their land area. It is also for this reason that island ecosystems are regarded as biodiversity hot spots. As hot spots, islands concentrate most of the world's biodiversity. Even though islands are only three percent of the land surface of the earth, 1 in 6 of the known plant species are endemic to islands. Islands therefore represent a vast pool of genetic information. It is for this reason and the high adaptive nature of their biodiversity that island ecosystems are unique.

As indicated earlier, island ecosystems are fragile. There are two main reasons for this. First, the entire land mass and the marine ecosystems are in close proximity to each other. Because of this, the effect of natural or man-made disturbances on land can impact coastal marine biodiversity quickly. Another reason for the fragility is that small islands possess limited capacity to buffer natural hazards or man-made disturbances. The unique features of island

biodiversity, previously characterized by the narrow genetic base, reduced competitive ability, small populations and narrow distribution ranges also make island ecosystems vulnerable in the face of threats to biodiversity.

5. Primary Food Production and Response to Biodiversity Concerns

Two main strategies have emerged to minimize the adverse impacts of cultivated systems on biodiversity. In one strategy the rate of converting natural habitats to farms can be reduced by intensifying production. With this strategy damage to the environment and hence biodiversity caused by the intensification process itself can be limited by efficient handling and use of agricultural inputs such as fertilizers, and chemical plant protectants and herbicides.

The other main strategy is to use more environmentally friendly cultivation practices. The practices of integrated crop management and organic agriculture are part of this strategy.

Cultivated systems can also be configured to conserve biodiversity. This can happen if these systems accommodate what is referred to as wildlife corridors. Wildlife corridors will be areas of naturally occurring habitats within and between cultivated systems. Appropriate policy support and education will be required to promote biodiversity conservation through the use of wildlife corridors.

Farmers could also be encouraged to conserve indigenous agrobiodiversity, which in most cases will be marginal crops. One way is to provide policy support to bring these marginal crops into mainstream agriculture. The use of fairs and festivals targeting these crops may be helpful in achieving the objective.

A higher strategic value must also be given to endemic agrobiodiversity. The small countries of the Caribbean are unable to be competitive in agriculture on the basis of high volumes of output because of the smallness of the land area available for farming. This constraint on high volume output can be compensated for to some extent by developing and exploiting the unique biodiversity. As I have pointed out, earlier island species are genetically unique and are highly adaptive to their environment. The Barbadian black belly sheep, the West Indian Sea Island Cotton varieties and the West Indies Red and Scotch Bonnet hot pepper types are expressions of this unique genetics and adaptability of Caribbean island biodiversity. The unique value of these commodities have already been recognized by others who have sought to exploit them commercially.

I can also share with you another strategy which I hope will be implemented in Saint Lucia to promote conservation of the island's forest in the face of encroachments by agriculture. The Government of Saint Lucia has sought to reduce dependence on monoculture agriculture by promoting agricultural diversification. It has also expressed consternation at the rates at which natural forests, some of which are privately owned, are cleared in response to the

diversification thrust. Indiscriminate deforestation is common cause of soil erosion, reduced fresh water reserves and loss of biological diversity.

Notwithstanding the rapid encroachment of agriculture into zones of forest, strategies were sought to make the encroachment of agriculture ecologically acceptable. One strategy proposed is to culture agronomically important endemic forest species in native forest. This strategy on the basis of selecting species depending on the native forest environment for culture will eliminate the need to clear forests, and may contribute to agricultural diversification, both of which are objectives of the Government, as described before. The strategy requires that changes arising from the encroachment of agriculture into native forest be detected and monitored for the purpose of conservation management of the vulnerable areas of biodiversity, water catchments and soil fertility and structure.

It is expected that commercial culture of species of interest will utilize little or no external inputs as a measure to minimize damage to the forest environment. This requirement for cultivating crops is likely to be met by resource-poor farmers, many of whom have been displaced by decline in banana profits.

6. Biotechnology: Basis and Role in Primary Food Production

I will now discuss the potential impact of modern biotechnology on biodiversity with links to food security. The potential benefits of modern biotechnology are mainly linked to gene transfer by genetic engineering. With genetic engineering, the hereditary material or DNA of one organism can be altered to contain genes from different organisms in precise ways without

regard for dissimilarity of the organisms involved. This ability to engineer hereditary material has given rise to life forms called GMOs, living modified organisms (LMOs) or transgenic organisms.

A foremost application of biotechnology based on genetic engineering is to crop improvement. In this use, desirable or agronomically important genes are sought and introduced into crops. These genes are frequently used for controlling insect pests and diseases caused by microbes. All of these infestations reduce crops yield if they are unchecked. Improving crop adaptability to drought or other growth-limiting situations such as saline soil in Guyana is desirable. Marginal and subsistence crops, both of which are often of critical importance to indigenous people, rural communities and resource-poor farmers, should also be among those targeted for improvement or upgrade by modern biotechnology.

7. Biodiversity Concerns about Biotechnology

I now turn to the biodiversity concerns about modern biotechnology. Genetic engineering eliminates all natural barriers to exchange of genetic information between all forms of life. Eliminating these barriers creates possibilities for unlimited combinations of genetic material in GMO development. However, inherent in the use of the technique in this way is a degree of unpredictability relative to intended outcomes. For this reason and in the absence of historical data on GMO use, there is consensus on the need for œaution to minimize potential adverse impacts. With trade in GMOs and products derived from them, risks of adverse nature may therefore be anticipated.

In the context of agriculture several concerns feature frequently. There is concern that some GMOs if released in the environment may become invasive species and cause damage to ecosystems. There are also concerns about what is referred to as “gene flow”. Gene flow is the possibility of transferring transgene from a genetically modified (GM) crop to other species or unintended parts of the environment.

The following are the main gene flow concerns:

1. spreading of transgene through hybridization of GMOs with closely related domesticated or wild species or unintended.
2. spreading of transgenes through horizontal transfer from GMOs to unrelated species (eg. from plants to microbes).
3. development of herbicide resistant weeds (if a GM plant is resistant to herbicides and the resistance is transferred to weeds).
4. development of insecticide-resistant pests.
5. damage to non-target organisms interacting with GMOs intended for specific species.

In the case of the GMOs used for food or feed, there are also public and animal health concerns.

The following are the main concerns:

a) persistence and uptake of GMO-derived DNA and proteins in the mammalian gastro-intestinal tract.

b) presence of toxicants, allergens, antinutrients and potential carcinogens associated with transgenes.

c) presence of unwanted and potentially harmful substances in food and feed through hybridization of GMOs producing pharmaceuticals and closely related domesticated species or unintended mixture of these GMOs and conventional crops.

8. Relevance of Biotechnology Concerns to Biodiversity

What is the relevance of these potential threats to Saint Lucia and the rest of the Caribbean? The following observations are helpful in providing and answer: -

1. The small island states in the Caribbean possess fragile ecosytems that are highly vulnerable to natural disasters and external threats by invasive biological agents including plants, animal and microbes. These islands are also characterized by a tight cluster of small farms lacking significant physical barriers between them to isolate crops from invasive biological agents or "gene flow".
2. Several Caribbean countries notably Suriname, Belize and Guyana are mega-rich with respect to biodiversity, which they are bound by international conventions to conserve. They also possess indigenous human settlements whose livelihoods are set in an environment sustained by the rich biodiversity.
3. Most Caribbean countries are also heavily dependent on food imports and agricultural inputs including seeds and microbial biological agents, all of which have become targets for the application of modern biotechnology.

4. Another relevant observation on Caribbean countries is the importance of domestic agriculture to the corresponding economies as shown in the table below:

Table 1

Economic Contribution of Agriculture in Several Caribbean Countries

Country	Percent of Gross Domestic Product 2003	Percent of Foreign Exchange Earning 2001	Percent of Labour Force 2002
Anguilla	2.9	-	-
Antigua & Barbuda	3.8[1]	0.1	-
Bahamas	4.0	1.5	4.0
Barbados	4.0[1]	30.0	4.6
Belize	17.0	71.0	24.1
British Virgin Islands	1.7[1]	-	-
Cayman Islands	....	-	-
Dominica	17.6	44.0	30.0[2]
Grenada	10.0	48.7[1]	-
Guyana	35.0	35.0	17[2]
Jamaica	6.4	16	19.4
St. Kitts/Nevis	3.3[1]	19.0	-
St. Lucia	5.4	38.0	11.9
St. Vincent & The Grenadines	9.0	66.0	-
Surinam	9.0	16.0	19.0[2]
Trinidad & Tobago	1.1	4.0[1]	6.9
Turks & Caicos Islands	5.0[1]	-	-

Notes:
- Data not available
.... Less than one per cent
1 Data are for 2002

2 Data are for 2001

Source: Caribbean Development Bank; FAO STAT and World bank Development Indicators 2002

On the basis of the observations above, it can be concluded that GMOs could be considered great potential threat to biodiversity with implications for rural development and sustainable livelihoods in the Caribbean. There are also potential risks to human health through food consumption.

9. Response to Biotechnology Concerns: the Cartagena Protocol on Biodeversity

Not withstanding the promise of modern biotechnology, biodiversity and agriculture also require the highest level of safeguard from potential adverse effects. The Cartagena Protocol on Biosafety (Biosafety Protocol) is relevant in this context.

The Cartagena Protocol on Biosafety has its origins in the Convention on Biological Diversity (CBD) which was concluded at the Conference on the Environment and Development, Rio de Janeiro, Brazil in 1992. A major objective of the CBD is developing systems which are to ensure, as far as possible, that developments of global significance are not pursued at the expense of damage to the environment and human well being. The drafters of the CBD were aware of the impending global commercialization of the products of modern biotechnology, notably GMOs and the potential threat this trade can pose to the environment and human welfare. In January 2000, agreement was reached on the Cartagena Protocol on Biosafety which came

into effect on September 11, 2003. All CARICOM countries have ratified it or are in the process of doing so.

The Biosafety Protocol, which is slanted towards agriculture, is regarded as an important legal instrument for two main reasons. First, it is intended to help countries to decide for themselves how they wish to develop agriculture, implement sustainable development programmes, protect genetic resources and ensure food security, all in the context of trade in GMOs and their products. To accomplish these, the Biosafety Protocol contains a number of enabling provisions for comprehensive risk assessment, risk management, public participation in discussions concerning GMOs and related products, their unintended and deliberate releases to the environment and capacity building for biotechnology, including biosafety.

Parties to the Biosafety Protocol are required to be proactive in the face of potential threats linked to GMOs in commercial use. Under the Biosafety Protocol proactive action, initially in the form of risk assessment, will be triggered by applications to a competent authority for permission to place GMOs on the market. The outcome of the risk assessment will be used to decide if permission should be granted and if so whether or not mandatory risk containment procedures are required. Compliance with the Biosafety Protocol therefore will reduce the potential for uncontrolled or erroneous introduction of GMOs on the market. This is especially important for Caribbean countries in light of their general small size, limited resource base and the overall relevance of threats highlighted earlier.

In conducting risk assessment on GMOs and their products, it should be recognized that the technologies giving rise to them are new. For this reason the effects of GMOs and their products on health and the environment are not yet well understood. In many instances the risks are not yet assessed. Moreover GMOs and their products are complex and a prudent approach is required in the assessment of risks posed by them. Furthermore, for each GMO in question, the possible risks are specific to the genetic modification involved and the environment in which it will be introduced.

10. **Implementing the Biosafety Protocol: Challenges and Solutions**

Capacity to comply with the Biosafety Protocol in the areas of risk assessment and risk management is seriously lacking in CARICOM. Because of the importance of biosafety and the acute lack of capacity in CARICOM in these areas, it is important that action be taken to adequately address biosafety concerns associated with modern biotechnology. This is because an effective biosafety capacity in each CARICOM country is required to give government, policy makers, the general public and international biotechnology industry confidence in each country's ability to deal effectively with the increasing number of confronting biotechnology related issues requiring biosafety response.

Not withstanding the fact that individual CARICOM countries lack effective biosafety capacity, harnessing the relevant regional skills in an institutional arrangement to establish a common resource and technical capacity for all participating countries could adequately address the biosafety capacity concerns. Given the multiplicity of stakeholders that will be involved in the

biosafety process, coordination and cohesion will be critically important points of any intention to bring regional cooperativity to biosafety enforcement. In this context, a proposal is being made here for the creation of a CARICOM or Regional Competent Authority (RCA) for the overall purpose of meeting the shortfall in skills by coordinating and enhancing the human and infrastructural capacity within the collective principal regulatory body to carry out comprehensive and efficient biosafety enforcements.

The RCA will accomplish the general aim above through the following specific objectives:-

1) Provide national biosafety regulatory agencies, which will otherwise lack indigenous capacity to carry out and oversee technical functions in biosafety operations, access to the appropriate technical and human resource capabilities.

2) Provide complementary infrastructure to create greater capacity to detect and handle products of modern biotechnology and assist in establishing co-sharing arrangements of containment facilities.

3) Provide and enhance acquisition of technical information on biosafety of relevance to CARICOM.

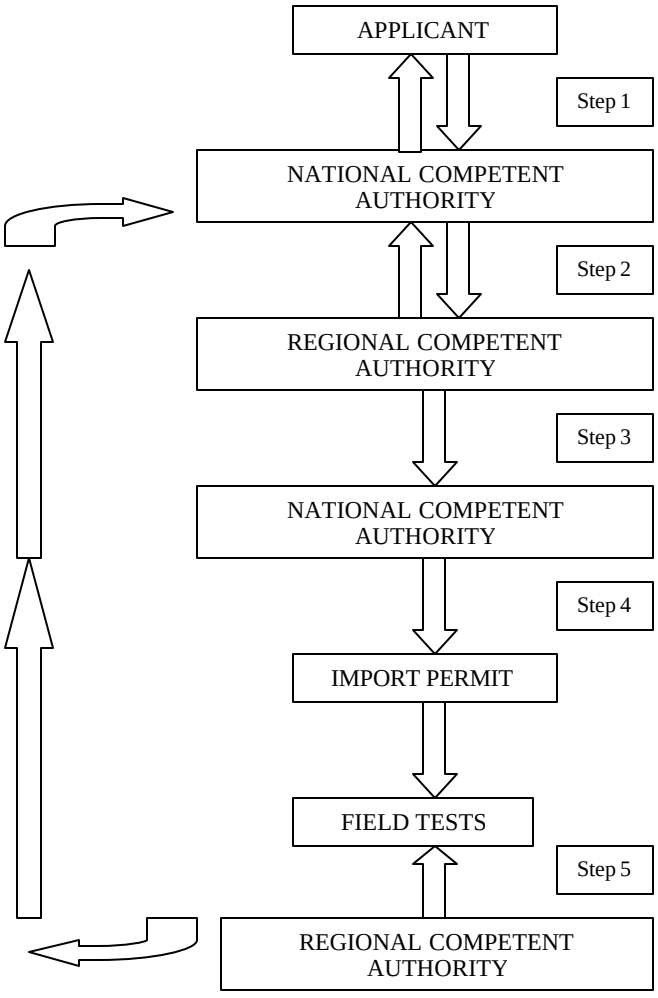
4) Provide partnerships and regional cooperation in capacity building through effective collaboration and linkages among national biosafety

regulatory agencies as well as with more advanced laboratories, donors and stakeholders in the area of biosafety.

5) Provide common pre-clearance of modern biotechnology products deemed safe for entry to the CARICOM market.

6) Provide the functions of a regional node for biosafety information for each participating country.

It is expected that the advent of the RCA will lead to the operation of standardized efficient biosafety regimes in each CARICOM country.



Notes to steps

1. Applicant seeks approval from the National Competent Authority (NCA) to place LMO on the market.
2. NCA screens application and initiates feed-back with applicant. Makes decision on application or passes it on to Regional Competent Authority (RCA) if additional risk assessment is required.
3. RCA conducts risk assessments and reports back to NCA.
4. NCA receives report from RCA which in turn reports back to applicant. In the case of approval NCA may issue an import permit and may require field tests for further risk assessment and risk management strategies if recommended by RCA.
5. RCA coordinates field tests and report results including risks management options back to the NCA.

Figure 1. Proposed role of a regional competent authority in risk assessment and risk management and its functional relationship with national regulatory bodies.

11. Biosafety Protocol: Limitations and Solutions

Proactive action through the case by case approach has limitations and represents minimal obligations under the Biosafety protocol. Countries are accordingly encouraged in their self-interest to elaborate more comprehensive levels of safeguards against the potential adverse effects of GMOs intended for the market.

A strategy is therefore required to augment protection contemplated under the Biosafety Protocol. One strategy I wish to propose is one which maintains planting material of selected crops at all times and in quantities sufficient to replace predetermined acreage of these crops in event of GMO-related damage in the field or through trade. The proposed strategy is an industry-level response to prospective macro-level forces linked to modern biotechnology and which may impact adversely on agriculture and the environment.

Crops could be selected for maintenance based on their importance to export agriculture and/or food security and vulnerability to potential threats. Several Caribbean countries have already identified crops for export promotion and food security as shown in the table below:

Table 2

Main Crops Identified for Food Security and/or Export Agriculture in Selected Caribbean Countries

Country	Crops
Anguilla	-
Antigua & Barbuda	Fruits, vegetables, hot pepper
Bahamas	Citrus, avocado, vegetables
Barbados	Sugarcane, vegetables, root crops, fruits, hot pepper
Belize	Rice, sugarcane, banana, citrus, beans, papaya, vegetables, hot pepper
British Virgin Islands	-
Cayman Islands	-
Dominica	Banana, hot pepper, plantain, citrus, root crops, vegetables, avocado, coconut, papaya
Grenada	Nutmeg, cocoa, banana, fruits, hot pepper, root crops, vegetables, papaya
Guyana	Sugarcane, rice, spices, pineapple, coconut, plantain, vegetables
Jamaica	Sugarcane, banana, root crops, hot pepper, coffee, fruits, papaya
St. Kitts/Nevis	Sugarcane, root crops, vegetables
St. Lucia	Banana, hot pepper, fruits, spices, coconut, vegetables, papaya
St. Vincent & The Grenadines	Banana, root crops, fruits, spices, plantain, coconut, hot pepper, papaya
Surinam	Rice, banana, root crops, fruits, vegetables
Trinidad & Tobago	Sugarcane, fruits, vegetables, hot pepper
Turks & Caicos Islands	-

Main Source: FAO STAT and World Bank Development Indicators, 2002

Indices of vulnerability based on risk assessment will have to be derived to meet the crop selection requirement. Planting material should be bulked preferably as seeds or tissue culture plantlets for efficiency with respect to production, storage, maintenance, transport and overall control of the propagative material.

The proposed strategy will also form the basis for the previously mentioned programmes of crop improvement by genetic engineering, which is dependent on plant tissue culture for GM crop development. Plant tissue culture in its own right can also be used to improve crops. Marginal and subsistence crops can be promoted or upgraded, at least by making bulk quantities of high quality planting material available.

Planting material maintained as seeds or tissue culture plantlets has limited shelf life and must be replaced periodically. In this regard, the strategy proposed can be operated as a regular supply system of planting material to farmers also. A supply system organized in this way creates opportunities to develop and enforce quality standards for planting material, as would be required in any case but are generally lacking for indigenous crops. This supply system will also be a critical point of support by the proposed strategy for crops cultivated for export and food security. It can also be used to buffer potential dislocation of agriculture by GMO trade if it use is accompanied by promotion and incentives to make cultivation of affected crops viable.

Capacity, including physical facilities and technical, scientific and administrative competences will be required to match the scale and complexity of the proposed strategy. Programmes to build effective capacity in tissue culture and seed technologies in CARICOM countries have been previously undertaken by the Food and Agricultural Organization (FAO) of the United Nations. These programmes should be built upon.

The proposed strategy augments and consolidates another important initiative targeting the Caribbean. It extends the scope of the disaster preparedness plan by taking into account potential adverse impact of GMO on agriculture.

Implementing the proposed strategy will involve varied and complex considerations. Many of these including crop selection, the forms in which planting material will be maintained, scale of bulking of this material and corresponding institutional capacity required, have been mentioned earlier. Other relevant considerations relate to location and coordination of activities for bulking and storing planting material, transboundary movement of propagative material and overall feasibility of the proposed strategy.

Ladies and Gentlemen I thank you very much for listening.

Good night!