



BELIZE

RAPID ASSESSMENT OF AGRICULTURAL RISKS

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BELIZE
RAPID AGRICULTURAL SUPPLY CHAINS RISK ASSESSMENT

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I. INTRODUCTION

At the request of the Belizean Ministry of Agriculture, Fisheries and Cooperatives (MAFC), this report is the initial step by the World Bank to identify the options for providing specialized technical assistance in the area of agricultural risk management. This report is intended as an advisory note to the Government of Belize to identify a policy framework for addressing agricultural risks and for identifying public investments to improve current risk management practices in the agricultural sector. Whereas the report is primarily intended to identify the options for the World Bank in assisting Belize in agricultural risk management, this initiative has been planned in close coordination with the Inter American Development Bank (IADB), the Inter-American Institute for Cooperation on Agriculture (IICA), the Regional Coordination for Technical Assistance in Agriculture (RUTA), and the European Union.¹

After fielding a technical mission with various experts in agricultural risk management, the World Bank has prepared this report to identify the major risks facing agriculture, to rank those risks in terms of their possible impact and frequency, and to offer a framework for improving current risk management practices. Insights and recommendations may provide a basis for follow-up planning work by the GOB, the World Bank, and other development partners.

Section II below briefly lays out the methodology used for this assessment and denotes the intended scope of the work. Section III provides a snap-shot of Belize's agricultural sector and its role in the national economy. Section IV summarizes the team's agricultural risk assessment findings. Section V denotes apparent 'vulnerabilities' in Belizean agriculture and provides a framework for future risk management efforts. Concluding remarks then follow.

This non-lending technical assistance is provided by the World Bank under the project "Market Based Agriculture Risk Management in the Caribbean" largely financed by the European Union AAACP initiative for the Caribbean Region. The World Bank wishes to acknowledge the contribution of IICA and RUTA in this analysis through the provision of specialized experts, in sanitary and phytosanitary management and rural finance, respectively.

II. METHODOLOGY

The findings and analysis of this initial assessment is based on an adaptation of a methodology designed by the Commodity Risk Management Group (CRMG) of the World Bank for assessing risks in agricultural supply chains. Whereas that methodology-- called "Rapid Agricultural Supply Chain Risk Assessment" (RapAgRisk)-- is meant to examine and quantify major risks along specific agricultural supply chains, the team adapted certain concepts for identifying risks for the agricultural sector as a whole. This is done in order to have a wider sector risk approach for identifying the options for the

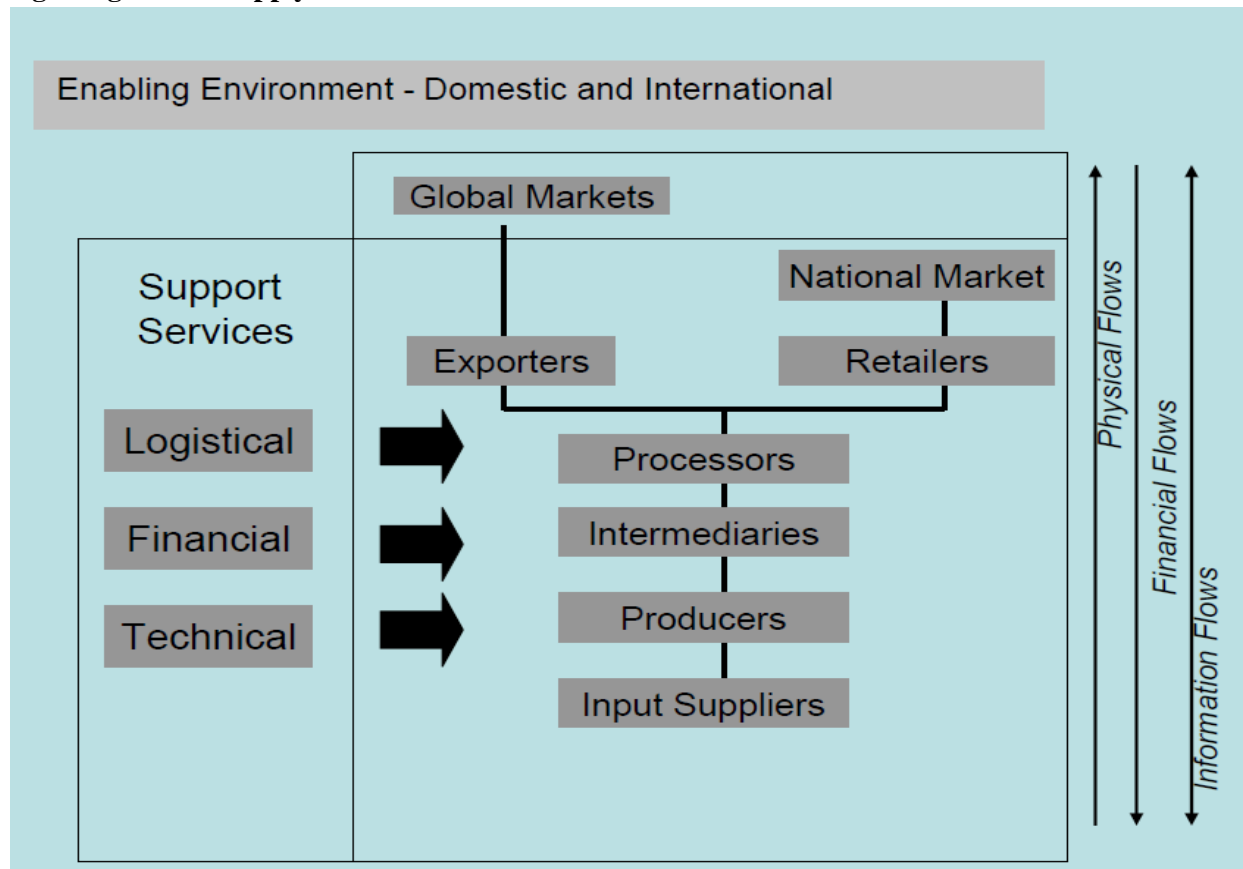
¹ The content of this report does not necessarily represent the views or objectives of the World Bank or the participating and sponsoring institutions.

World Bank and other agencies in eventually assisting Belize in specific interventions aimed at improving risk management practices in agriculture.

The RapAgRisk provides a conceptual framework and set of detailed guidelines for conducting a more system-wide assessment of risk, risk management, and vulnerability within agricultural (commodity) supply chains. Such assessments collect and compare risk factors and response opportunities involving the broad range of supply chain participants, including private and public sector support service providers, and the broader enabling environment (e.g., macroeconomic, trade and regulatory policies). The assessment is devised as a consultative and time-bound process geared toward providing a ‘first approximation’ of key vulnerabilities and areas requiring priority attention in investment and capacity building. The broad categories of risks to be investigated would usually include weather, price, logistics, infrastructure, sanitary/phytosanitary, environment, labor, and policy.

The essence of the assessment is to understand the wide range of ‘bottlenecks’ and ‘choke points’ that affect different participants and functions related to a given agricultural commodity system as summarized in Fig.1. This includes direct supply chain participants, as well as private and public sector support service providers, and the broader enabling environment (e.g., macroeconomic, trade and regulatory policies).

Fig.1: Agri Food Supply Chain Framework²



The agri-food system includes farmers and a diverse range of firms, including backward-linked input suppliers and forward-linked intermediaries, processors, traders, wholesalers and retailers.

In order to make the risk assessment for the agricultural sector for Belize manageable, the following factors were taken into account:

- The initial time and resources availability for developing a rapid assessment of the sector, basically relying on secondary documentation and a one-week field visit with various experts.³
- Conducting interviews with stakeholders of key supply chains, whose risks are largely representative of the risks facing the agricultural sector as a whole. These supply chains were: (i) banana and sugar as traditional export commodities currently facing the loss of significant, long-standing external trade and price preferences; (ii) horticultural products for export, including citrus concentrate and papaya; (iii) crops used in animal feed production, including yellow maize and sorghum; and (iv) staple food crops, including cassava, beans, and rice.
- Adaptation of the RapAgRisk methodology for a broader sector-wide approach scope, rather than focusing on a particular supply chain, resulting in a wider set of risk issues.⁴

² It should be noted that the framework is necessarily simplified. In reality, supply chains are more complex, with many participants, with product, finance and information flows often traversing large geographical / international areas and with distinct intra- and inter seasonal dimensions.

³ The field visit took place in June 8-12, 2009. The CRMG were supported by experts from IICA and RUTA.

III. THE AGRICULTURAL SECTOR IN PERSPECTIVE

Agriculture is the most important economic sector in Belize in terms of income generation, employment, food security and poverty alleviation. Belize has a population of just over 300,000 persons, GDP of some US\$1.5 bn., and a per capita income level of approximately US\$4,000. Agriculture's (inclusive of forestry) contribution to GDP exceeds 12 percent. Agriculture accounts for 66 percent of foreign exchange earnings (including tourism and financial transfers), and employs over 25 percent of the formal labor force. Income from primary agricultural production exceeds BZ\$417 million.

The Belizean economy has achieved relatively high rates of economic growth, with an average GDP growth rate of 6.2 percent over the period 1987-2007. In 2008, however, GDP grew at only 1.6 percent due to a contraction of exports (especially for sugar, bananas and shrimp). The economy has been stable, with an inflation rate on average of 2.7 percent, and an unemployment rate of about 10 percent (Table 1).

Tale 1: Overall Economic Performance

	2000	2001	2002	2003	2004	2005	2006	2007
Real GDP Growth (%)	13	5	5.1	9.3	4.6	3	5.3	1.6
Merchandise Exports (US\$mn)	281.8	269.1	309.7	315.5	307.5	325.3	427.2	428.5
Unemployment Rate (%)	11.1	9.1	10	12.9	11.6	11	9.4	8.5
Inflation Rate (%)	0.6	1.1	2.2	2.6	3.1	3.7	4.2	2.3
Debt to GDP ratio (%)	64.1	56.8	70.1	83.3	86.5	87	81.2	76.7

Source: FAO (2009)

Historically, Belizean agriculture has been heavily export-oriented, with long-standing industries for sugar, bananas, and citrus products. These industries continue to dominate Belize's agricultural (and overall) exports, although the country's sugar exports have begun to decline off their peak in 2006 due to the phasing out of ACP country price premiums offered by the European Union. Only modest gains have been achieved in export diversification, with a small but competitive papaya export sector and a still small but growing level of trade in beans, peas, and various condiments. A once vibrant trade in shrimp and other fish products (exceeding US\$ 50 million per annum in the early 2000s) has substantially contracted in recent years (with 2008 exports of US\$ 22 million) due to price competition from East Asian countries in the main destination markets. Overall, the value of Belize's agricultural exports have been more or less stagnant over the past six years (Table 2). However, official statistics reflect formal trade only. There is a significant movement of animals and food items across Belize's borders with Mexico and Guatemala.

Table 2: Agricultural Exports 2003-2008 (US\$'000)

⁴ A more in-depth assessment of agricultural risks in Belizean agriculture should ideally involve several local task forces, organized according to industry and thematic topics.

	2003	2004	2005	2006	2007	2008
Sugar/molasses	37,726	42,639	37,223	53,372	47,935	37,983
Bananas	26,914	27,125	26,147	25,896	21,224	33,603
Citrus Products	42,439	45,398	61,209	60,228	63,022	60,856
Fish Products	56,386	54,941	42,931	44,029	21,592	22,668
Papaya	8,575	11,680	13,702	15,875	13,346	11,487
Beans and peas	2,595	1,684	4,365	2,705	3,315	3,838
Other	11,540	13,848	18,657	19,403	17,526	16,160
Total	186,174	197,314	204,233	221,508	187,960	186,595

Source: Central Statistics office

Belizean imports of food and agricultural imports have grown at a fastest pace than have its agricultural exports in recent years. As illustrated in Table 3 below, the bulk of Belize's food imports are accounted for by dairy products, meat products, other processed foods, and cereals (especially wheat). Relatively significant agricultural input imports are for animal feed and fertilizer. The costs of those imports (and as those of cereals) increased considerably in 2008 as a result of international price spikes, yet the scale of these imports is still quite small in relation to Belize's overall imports.

Table 3: Agriculture Imports 2002-2008 (US\$'000)

	2003	2004	2005	2006	2007	2008
Meat	4,875.0	4,668.4	4,133.4	3,964.1	5,399.3	5,637.7
Dairy and eggs	12,412.0	12,521.2	12,870.5	12,752.3	14,580.6	14,626.9
Rice	151.8	69.7	67.6	89.7	107.2	315.4
Flour and cereals	9,628.6	9,766.5	9,673.8	9,791.5	9,788.6	16,750.0
Fruits and veget.	5,716.4	6,323.0	4,652.4	4,518.1	5,599.8	6,377.4
Rk. Beans	254.7	23.1	66.0	82.7	182.2	13.0
Seeds	683.8	651.4	772.9	941.6	2,177.6	1,384.2
Fertilizers	4,823.1	4,317.7	3,481.7	5,917.3	5,627.2	7,911.5
Herb, Fert. and Fungi.	6,027.6	5,894.3	6,437.3	7,233.8	7,783.4	9,124.9
Animal feed	10,596.7	8,377.1	6,197.7	6,830.1	7,036.7	11,938.2
Total Ag. Imports	55,169.8	52,612.3	48,353.3	52,121.3	58,282.7	74,079.0

Source: Central Statistical office

Most farms in Belize are quite small and only 32 percent is owned. Nationally, 24% of the farms have less than five acres, rising to 35% in the Toledo District region. Overall, 57% of farms have less than 20 acres. The distribution of landholding is very uneven, with the 24% of farms that are smallest (those under 5 acres) holding only 2.6% of the utilized farmland. Only 32% of the farmland is owned with a title that can be transferred or used as collateral, 31 percent is leased under long term arrangements with the government by paying an annual lease fee, 7 percent is crown land, 7 percent is squatted, and another 7 percent is rented.

For the traditional export industries, there is a varied structure of production. Banana production is concentrated on only 13 large farms. Citrus fruit (for processing and export) involves some 525 growers, although 35 only growers account for some 75% of production and an additional 30 growers account for 13% of total production. Sugarcane production involves some 6,200 producers, the great majority under 5 acres of land.

Just over 25,000 people are employed in primary agriculture, with about one-half of these employed in the traditional export-oriented sectors (Table 4). Thousands more are employed in agricultural processing operations. A significant proportion of farm workers in Belize are temporary (or longer-standing) migrants from Guatemala, Honduras, and elsewhere. For example, only 48% of farm workers in the banana sector are Belizean, and the estimated share of Belizeans working on citrus farms is considerably less.

Table 4: Employment in Agriculture

Category	2001	2002	2003	2004	2005	2006	2007
Agriculture/forestry/fisheries	24.5%	23.7%	22.5%	22.6%	22.3%	20.7%	22.2%
Sugar, Citrus, Bananas	10%	11%	11%	10%	10%	9%	10%
Other Agriculture	10%	10%	8%	9%	9%	9%	10%
Tourism	9%	11%	11%	12%	13%	14%	14%
Total Labor Force	87,188	84,404	89,222	95,911	98,590	102,234	111,837

Source: FAO (2009)

Poverty is predominantly rural with the lowest levels of human capital and development. The last Poverty Assessment Report 2002, shows that poverty rates are considerably higher in rural areas (44.2%) than urban areas (23.7%). Four districts have populations that are more than 60 percent rural. The indigent rate (extreme poverty) was estimated at 10.4 percent for the population and 7.5 percent for households (See Table 5). Small subsistence farmers continue to exhibit the highest poverty rates (at some 77%).

Table 5: Poverty profile

	Corozal	O/W	Belize	Cayo	S/C	Toledo	Total	Urban	Rural
Indigent Population	6.2	7.1	4.0	4.8	5.6	56.1	10.8	4.8	17.4
Poor population	26.1	34.9	24.8	27.4	34.8	79.0	33.5	23.7	44.2
Indigent households	5.0	4.3	3.7	3.1	4.9	45.0	7.5	3.3	12.7
poor households	19.9	23.2	18.4	20.5	25.9	67.3	24.5	17.2	33.7

Source: National Human development Advisory Committee, 2004

IV AGRICULTURAL SECTOR RISKS

There are a number of risks and constraints that are associated with the agricultural sector as a whole. These include the following:

Policy-based Risks and Distortions.

In pursue of the objective of food security, the GOB has applied various policies which potentially can potentially distort market (price) signals, restrict some market entry, and could provide a source of uncertainty for investors. High import tariff barriers of around 40 percent for sensitive food products, rather than meeting the objective of food security might be running the risks of constraining growth of these products given the narrowness of the domestic market. This cluster of policies includes food price controls (for certain food staples and non-staples), commercial/trade licensing arrangements, and relatively high import tariffs (upwards of 40%) for so-called ‘sensitive’ products. The effectiveness of these policies in addressing varied food security concerns is not clear. What is clear is that such policies are constraining domestic and regional food market development and integration. Belize has unrealized potential for exporting various food products to neighboring countries and the prevailing policy approaches are exacerbating some underlying competitiveness constraints, to deter investment. In the reform of these policies there would be some short-term ‘winners’ and ‘losers’, and thus, policy reform itself could pose a risk to certain stakeholders. Redefining the role of BMDC and reduce the use of price controls on food products will improve the incentives framework for exports. Likewise, reviewing the system of licensing requirements for exports and imports with an intention to simplify or eliminate them can go a long way to stimulating the dynamics of the sector.

Risks Posed by Porous Borders. Belize’s geographical position and its place in the cruise ship circuit present significant opportunities yet also risks that need to be managed. Belize’s borders with Mexico and Guatemala are rather porous, with considerable movements of people, animals, plants, and products taking place both at formal and informal crossing points. Such movements are associated with important economic activity yet can also bring with them the introduction of (new or formerly controlled) pests and diseases into Belizean agriculture. Large numbers of disembarking cruise ship passengers do spend money on goods and services in Belize, yet they too may create risks, by carrying certain pests or diseases on their clothes or when groups are congregated in areas with fragile eco-systems.

Risks to Competitiveness Posed by High Cost Services. Belizean primary producers and agro-processors face relatively high costs of electricity, telecommunications, and port services compared with their competitors in Central America, the Caribbean, and elsewhere. Statutory minimum wage rates in Belize are 30 to 50% higher than those in other Central American countries. With the loss of certain external trade preferences (e.g. for bananas and sugar) and with intensified competition in other markets, the higher cost structures in several Belizean agricultural sectors threatens near term viability for existing players and likely inhibits new investment.

Agriculture expansion and logging poses serious risks to the national biodiversity and environment.

The Central Statistical office reports that in 1992 approximately 79 percent of Belize's land area was under some type of forest canopy cover. By 1998, this share had declined to 69 percent. There is anecdotal evidence of accelerated deforestation since then. For example, timber production increased 86 percent between 2000 and 2002. Though there are some discrepancies in various deforestation estimates, this trend poses significant risks for Belize's agricultural tourism, water availability, and coral reefs. Still, there are encouraging measures to conserve natural resources with the creation of 2.6 million acres (22.3 percent of land) under some type of protected status, compared to 1.9 million in 1995.

Risks posed by a fragmentation of institutions, policy dialogue, and planning mechanisms. Although Belize is a relatively small country with a modest population, its agricultural sector is highly fragmented. An ample metaphor is that the sector is an archipelago, involving various distinct islands of economic interests and patterns of dialogue with government. Certain geographical areas are akin to 'mini-states' with there being 'sugar belt', a 'banana belt', and a 'citrus zone'. Many enterprises are themselves individual islands, having EPZ status and therefore being immune to certain shifting policies. Several individual sectors have their own service provisioning, pest/disease management approaches, and partial compensation schemes. Each interacts/negotiates with the GOB through distinct channels. Certain population communities are associated with certain industries. All in all, this pattern of 'institutional development' ensures that the agricultural sector 'whole' is less than the sum of the parts. In such a fragmented situation it is difficult to analyze potential efficiency and equity trade-offs from alternative policy and risk management measures. There are apparently few operational lines for concerted policy discussions or realizing scale and scope from interventions and programs.

Given the weight that sugar and banana production have played in agricultural GDP and employment, the impact of trade preference erosions could pose sector-wide risks. The adjustment processes may well involve some contraction in overall plantings, production, and employment. They will certainly involve the consolidation of production on fewer farms/land-holdings. The restructuring/consolidation process will be most significant for sugar as large numbers of existing growers will not be viable cane producers once prices move closer to competitive market levels. Their yields are only one-half or less what competitive sugarcane producers obtain elsewhere. It is expected that more than half of the 4000 active sugarcane growers will need to exit the sector. Many of these are older farmers with limited knowledge of other crops or access to bank finance. This and the small size of the domestic market for fresh fruits and vegetables may inhibit smooth diversification away from sugarcane. Yet, extended delay in the restructuring process could well threaten the viability of the remaining segments of that industry—and absorb larger amounts of GOB and donor resources that might be put to better use elsewhere. The adjustment process is expected to be less painful in the banana sector with a core of large independent growers likely to remain in operation and take over some other farms. Yield improvements are being achieved, although the sector will need to differentiate its products or customer services to retain a market position against lower cost producers. Any industry contraction would be most experienced by migrant farm workers and service supply industries (e.g. packaging; transport).

The domestic effects of the global financial downturn pose a potential credit crunch risk to agriculture. The impact will be expressed by the presence of a liquidity crunch and through increases in interest rates. The agricultural sector has, over the last two years, accounted for 7.7 percent of the value of

loans from banks. However, if the global financial crisis continues to impact Belize, government will face a more difficult fiscal situation, drawing down on foreign reserves, which may lead to banks to reduce access to financial resources. This could result in a decrease of agriculture credit approvals and disbursements. Given the economic perspectives of the Central Bank for 2009, this scenario is very likely, affecting mostly large agribusiness firms which are the largest producers of agricultural goods. Approaches to manage the risk go beyond the agriculture sector (and the country), because it has to do with the global financial crisis and economic downturn. A non-existent culture towards saving, past economic policy management that put the country into high levels of debt, conservatism of financial sector to provide credit to the agricultural sector, and crowding out of private sector by public sector, are also domestic factors that exacerbate the situation.

More specific risks affecting particular agricultural supply chains can also be identified. Here, we consider (i) agricultural health risks, (ii) weather-related risks, (iii) price risks, and (iv) credit risks. We attempt to classified various risks according to their probability of occurrence and their potential severity of loss. Such an exercise can help the GOB to establish priorities for public policy and interventions.

3.1 Agricultural Health Risks

Agricultural health is affected by plant and animal pests and diseases. Human health can also be adversely impacted by contact with diseased animals (e.g. avian flu). During the discussions, few serious domestic food safety problems were identified. One possible exception relates to (informal) imports of fruits and vegetables from neighboring countries. There is concern about possible excessive levels of pesticide residues (and perhaps also microbiological contamination) which could be addressed through some form of product surveillance and testing program. No evidence was found to indicate food safety risks in relation to Belize’s tourism industry, although it is not evident that such risks are systemically monitored.

Table 6: Sanitary and Phytosanitary Risks. Expected Loss Ranking Matrix (Probability x Severity).

		Potential Severity of Impact				
		Negligible	Moderate	Considerable	Critical	Catastrophic
Probability of SPS Risks	Highly probable					
	Probable			Citrus greening. Potential loss of		

				citrus production		
	Occasional			Introduction of infectious animal diseases including brucellosis, tuberculosis, and Newcastle disease		
	Remote			Citrus Tristeza disease on the citrus industry. Red Palm Mite of coconuts Spinky mites , a pest of rice	Introduction/spread of plant pests or diseases through importation and distribution of seeds and plants	
	Improbable					

1. Loss of production due to Citrus Greening

Probability of event: Probable

Citrus greening, also known as huanglongbing (HLB) or yellow dragon disease is one of the most serious citrus diseases in the world. It is a bacterial disease that greatly reduces production, destroys the economic value of fruit and can kill trees. It has significantly reduced citrus production in Asia, Africa, the Arabian Peninsula and Brazil. The disease was identified in Florida in 2005 and has spread throughout the State and has been found in Louisiana and South Carolina. The entire state of Florida is now under quarantine. Once infected, there is no cure for a tree with citrus greening disease. In areas of the world where citrus greening is endemic, citrus trees decline and die within a few years.

The disease is primarily spread by two species of psyllid insects: the Asian citrus psyllid and the African citrus psyllid. The Asian citrus psyllid is the vector responsible for spreading the disease in Belize. The insect vector transports the citrus greening pathogen from infected trees to healthy trees as they feed on the plant. Citrus greening can also be transmitted by grafting diseased bud wood. The recommended management of disease is essentially removing infected trees.

Potential Severity of Impact: Considerable

Quoting the CEO of the Belize Citrus Growers Association (BCGA), “Approximately 69,000 persons benefit from citrus in Belize. It is the most citrus dependent country in the world.” The impact therefore

of any significant contraction of the industry due to the effects of citrus greening will have severe economic and social consequences. There are currently approximately 45,000 acres of citrus under production and the industry generates approximately \$60 million dollars per year. The Citrus Products of Belize Limited, the commercial arm of the BCGA, is the main processors of citrus in the country. Over 80% of citrus produced is processed by this company. The processing plants are currently operating at 60% of capacity and plans are in place to increase the throughput by increasing both the number of acres under production and by increasing the production per acre to 300 boxes. The company could therefore be severely impacted by this disease---depending upon its spread and the methods used to control it.

Controlling and managing the disease has proven to be very costly in countries that have had the disease. One Florida grower stated, “Fighting the disease has cost at least \$450 per acre per year for inspections, tree removal, new trees and psyllid control.” He estimates the company’s three-year loss due to citrus greening at \$18 million.⁵ The costs for Belize will depend upon how widely the disease has already spread and what methods and strategies are used to control it. Some mature and growing citrus trees will need to be removed and destroyed, yet the strategy and extent were still under consideration at the time of the Risk Assessment team’s visit. The destruction of existing nursery plants is being considered as one means of controlling the spread of the disease. Such a measure would entail a cost (to nursery holders or to a compensation scheme) of some US\$800,000.

2. The continuing effect of Citrus Tristeza Virus (CTV) and other potential disease threats

Probability of the Event: Remote

Citrus tristeza virus was discovered in Belize in 1984 in the Stann Creek Valley. Since the discovery of CTV growers were advised to use CTV-tolerant rootstocks. A certification program was initiated in 1994 the same year that the Citrus Brown Aphid, a CTV vector was identified in Belize.⁶ The impact of this disease on the industry has been fluctuating over the years and the disease remains a threat which must be constantly monitored.

Other pests and diseases of concern include:

- Spiny mite (*Steneotarsonemus spinki*) – an emerging problem in rice. The pest has been detected in the country and it has the potential to wipe out the rice industry.
- Citrus Canker – a serious bacterial disease of citrus found in Florida but not yet detected in Belize.
- Frosty Pod rot (*Moniliophthora roreri*) – a fungal disease affecting cocoa is one of the most devastating diseases of this crop. It has been detected in the country and is suspected to have been brought in from Guatemala.
- Foot and Mouth Disease – is a highly contagious viral disease that affects domestic cattle, sheep, pigs and goats. It is not reported in Belize. It is currently reported in Colombia.

⁵ Citrus + Vegetable, May 2009 Issue

<http://www.citrusandvegetable.com/PastIssues/ArticleLanding/tabid/70/Default.aspx?tid=1&cid=366585&issueid=730>.

⁶ <<http://www.promedmail.org>>

- Thrips palmi – this is an insect that feeds on a wide range of plants including red kidney beans and hot pepper, two important crops grown in Belize. The pest has been identified in Belize and is causing some concern especially among hot pepper growers.
- The Red Palm Mite (*Raoiella indica*)- is a pest of coconut which has been spreading throughout the Caribbean but has not yet been detected in Belize.
- Avian Influenza and *Bovine spongiform encephalopathy* (BSE) – These diseases are not known to be present in the country but remain high risks and require constant surveillance.

Potential severity of impact: Considerable

The above-mentioned pests and diseases of plants and animals have the potential to be significantly detrimental to agricultural production and productivity in the country. In some cases entire industries could be affected and the social and economic impact could potentially be devastating if these diseases are not managed, controlled or prevented from entering the country.

3.2 Weather Risks

Table 5. Expected Loss/Gain Ranking Matrix (probability x severity)

		Potential Severity of Impact				
		Negligible	Moderate	Considerable	Critical	Catastrophic
Probability of Event	Highly probable			River floods damaging crops in adjacent valleys Flash floods in lowland areas (grains and tubers)		
	Probable					High winds and rains associated with hurricanes and tropical storms (Extensive agricultural areas affected and crops such as bananas and papaya destroyed)
	Occasional		Drought for rain fed rice in the south (Toledo)	Chill temperatures at some periods during growing season (cocoa and banana)	Drought for livestock (prolonged dry season) No planting material in store after a hurricane	

	Remote					
	Improbable					

Priority 1 = High Expected Loss: Damages caused to agriculture from **hurricane events** and associated rainfall of tropical storms causing **flash floods** in high land areas, are the two main weather risks identified that have been identified. Flash floods in low lands, associated with heavy rains from tropical storms, cause considerable damages to all crops. Particularly vulnerable are small producers of grains and tubers, reported from 40-60 percent of damages in flooded areas.

Priority 2 = Medium Expected Loss/Gain: Rivers flood out of their banks, affecting crops located in agricultural valleys along the main rivers. **Chill temperatures** for banana and cocoa in the south, damages cause business interruptions to export plans by these supply chain commodities. Similarly, **prolonged dry seasons** cause excessive weakening of livestock, and mortality in more extreme events.

Priority 3 = Low Expected Loss/Gain: Droughts for rain fed agriculture, particularly evident in rice production in the Toledo region.

1. Hurricane and tropical storms

Probability of event: Probable

Hurricane and tropical storms reported at 100 miles from Belize during last 30 years show the following return periods:⁷

- Hurricanes Category 5: (2 events)
 - Hurricane Mitch (1998)/155miles/h;
 - Hurricane Dean (2007)/165miles/h.
- Hurricanes Category 4: (1 event)
 - Hurricane Iris (2001)/145 miles/h.
- Hurricanes Category 3: (1 event)
 - Hurricane Keith (2000)/120miles/h.
- Tropical storms: (5 events)
 - Hermine (1980)/60 miles/h
 - Gert (1993)35 miles/h
 - Kyle (1996) 45 miles/h
 - Chantal (2001) 145 miles/h
 - Arthur (2008) 40 miles/h

⁷ Categories= Categories on Saffir-Simpson Scale. Wind speeds at landfall.

Severity of impact: Catastrophic

During the last 75 years, 19 tropical storms have been recorded in Belize. One out of every three storms have been hurricanes of category 3 severity. The most recent one to make landfall in the country was Iris in 2001 with maximum sustained winds of 145mph. Damage assessment for hurricane Iris has been estimated at Bz\$199 million. Damages to agriculture alone exceeded Bz\$102 million. The most affected industry was banana where losses were in excess of Bz\$50 million.

In 2000, hurricane Keith with maximum sustained winds of 120mph produced estimated total damages of Bz\$560 million, where agricultural damages were accounted for Bz124 million.

The Ministry of Agriculture estimates that direct damages jointly caused by hurricane Keith (2000/Cat3), tropical storm Chantal (2001/TS), and hurricane Iris (2001/Cat4), are estimated at around US\$200 million to the agricultural sector alone. For example, Hurricane iris (2001) reduced total production of cocoa from 65,000 lbs to 16,000lbs in the Toledo region.

Similarly, heavy rainfall levels cause flash floods in low lands, particularly in the southern areas of Stann Creek, Cayo, and Toledo. Though flash floods are reported nearly all over the country. Belizean agriculture is vulnerable to flash floods due to the low sea levels in large areas of the country.

Growth potential of agriculture is severely restrained or abruptly interrupted for some crops. Hurricane Dean caused severe disruptive damages to the northern regions of Belize, particularly affecting the papaya and sugar industries. However, most crops suffer from this type of event depending on the hurricane/tropical storm paths.

2. Prolonged dry season (drought)**Probability of event: Occasional**

Belize has 2 main weather seasons for agricultural purposes. A rainy season that starts in May and ends in November during which various types of annual crops are grown. There is also a dry period that runs from January to April, with no rain fed agriculture, and annual crops under irrigation are grown. When the dry season extends beyond their normal expected period, there are two types of damages: (i) lost of seeds or delays in sowing period for rain fed annual crops; and (ii) livestock weight losses.

Severity of impact: Critical

Positive and critical (defining) impact on rain-fed agriculture and livestock. This is particularly critical for small farmers producing food crops without irrigation, and for livestock growers with limited resources for securing animal feeding over extended summer periods. For agricultural producers these events means not only losing seeds, but re-seeding and pushing the crop phenological cycle further along

the normal rainfall distribution patterns with higher risks of experiencing unwanted rainfall events (excess/deficit).

3. Chilly temperatures

Probability of event: Probable

Banana and cocoa growers face risks of low temperatures during the months of November and December, though sometimes it occurs in January. The latex of the banana blackens and the fruit becomes unsalable due to the appearance of the fruit and despite the flesh remaining perfectly edible. This is due to the latitude where bananas are grown in Belize, just at the northern edge of the tropical zone. This weather risk is not shared by Ecuador or Costa Rica. This risk seems to affect the industry once every five years and results in losses of 25 percent (the industry loses 13 weeks of inventory). The return period for chill events is of every 4 years, though at times it seems to be random. In 2007, for example, there were 2 chills that reduced yields by over 30 percent.

Cocoa producers are affected by chill periods during the months of November and December affecting flowering and damaging young pods.

Severity of impact: Moderate

The amount of damage that cold snaps can cause varies depending on topography or the ways the banana plantations are managed. Damage can potentially affect all plants currently growing. As such, losses are up to 25 percent of 13 weeks worth of production, although total damage may vary.

In January 2009, there was a cold front that reduced cocoa yields by 35 percent. However the relatively small scale of cocoa production in Belize, and the relatively small number of producers involved in cocoa production ensures that the impact of chilly temperatures on cocoa production remains low.

4. Drought for rain fed crops

Probability of event: Occasional

This is a particular risk for annual rain fed crops, like rice. Around 60 percent of total production is rain fed. Droughts at certain key periods lead to damage to crops and reduction in yields. In the same region, there could be floods and droughts in the same year for the same crop.

Severity of impact: Moderate

The scarcity of detailed reporting on droughts events and damages lead to the preliminary conclusion that droughts are of a moderate nature in their severity for the agricultural sector.

Compared with SPS and weather-related risks, Belizean agriculture is less exposed to price-related risks. The most significant 'price risks' faced are certainties rather than risks. Changes in the EU's trade regime for sugar and bananas are now resulting in substantially lower prices for Belizean exports of these

products to the U.K. and other EU markets. This can be construed as a near-term (but long expected) ‘price shock’ where the carry-over risk is that Belizean growers (and exporters) will no longer be financially viable when facing more market-based product prices. Measures to respond to those price shocks could include crop/product diversification, productivity-enhancing/cost-reducing measures, and exit. Some other price risk exposures are evident in Belizean agriculture although these can or are being managed.

5. No Planting Material in store for recovery after hurricane

Probability of Event: Occasional

During the last 10 years the country has been affected directly by hurricanes and devastating floods. The sector is essentially without insurance coverage and therefore after events such as these the farmers look to the government for assistance especially for replanting. There is not enough planting material in store locally to speed up recovery after a hurricane. Farmers have to depend on donated seeds from overseas which in many instances arrive well after the event has passed and the seeds, in some cases are not the right varieties, are not viable and generally are not suitable for local conditions (or food taste preferences). The imported emergency supply of seeds may also bring pest and disease risks, especially when usual quarantine arrangements are by-passed to enable quick planting. It is therefore important to ensure that there is a local supply of seeds available for quick recovery after a hurricane. Some type of small seed and germplasm bank could address this risk.

Potential Severity of impact: Critical

The rate of recovery after hurricanes or floods is directly related to the ready availability of planting material. This is critical to ensure that food is available in the shortest possible time and to minimize the impact on the economy and livelihood of the farmers and the farming communities.

3.3 Price Risks

Table 6. Price Risk Assessment for Key Agricultural Sectors

		Potential Severity of Impact				
		Negligible	Moderate	Considerable	Critical	Catastrophic
Probability of Price Shock or Price Volatility Events	Highly probable			Bananas	Sugar Cane	
	Probable		Reduction of import tariff	Citrus Products		

			protection for food crops			
			IV.			
	Occasional			Fertilizers		
	Remote					
	Improbable	Cocoa price volatility				

1. Cocoa

Probability of event: Improbable

International cocoa prices are highly volatile and cocoa producers in many countries often find their incomes varying substantially between and during seasons. However, the Belizean cocoa industry is sheltered from price volatility as the cocoa producers cooperative has secured a long term relationship with a large international buyer. This relationship provides the producers with a guaranteed minimum price for as much of their cocoa as they are able to produce. The minimum price formula provides cocoa producers with protection against falling prices while similarly enabling them to benefit from any rises in price. As such, price risk is improbable for the Belizean cocoa producers. Probability is classified as “remote” rather than “improbable” in case future collapses in world prices coincide with a renegotiation of the terms and conditions by their key buyer (a very unlikely event).

Potential Severity of Impact: Negligible

The Belizean cocoa industry is very small with less than 250 active farmers earning less than \$1,000 per annum from cocoa sales. Although the number is growing and the cooperative is aiming to have a total of 800 active farmers producing cocoa for export within the next four years. A cocoa crisis where the industry collapsed (from price or any other disaster) would not cause the economy any significant harm.

2. Reduction of Import tariff protection for food crops – examples: poultry and rice

Probability of event: Probable

Certain agricultural products have their retail prices set by the Belize government to both ensure affordability to consumers and to protect local production. This is the case for both rice and chicken. Prices are set by the government in negotiation with producers (chicken producers and rice millers) based upon a cost-plus formula. Set prices based upon a cost-plus formula should offer protection from price risk and secure the profitability of producers. However, price risk does exist based upon either political interference in the price setting process or possible reductions in import tariffs enabling the entry of lower

cost produce from nearby countries including Mexico and the USA. The rice sector is also at additional price risk from rice smuggling from neighboring countries should the Belizean price of rice be significantly above that of neighboring countries., As such, even when retail prices are set by government at a level above the cost of rice production, retail prices may be driven below this government set price level.

An additional price risk is that relating to input prices. The poultry sector is at risk from rises in the price of animal feed which is a key determinant in the cost of production. Chicken feed is comprised of grains and cereals which are highly volatile in price (both locally produced and imported grains and cereals). The rice sector is also at risk from rises in key inputs, especially fertilizer which is a key element in the cost of rice production. For both the chicken and rice sectors input prices create price risk for producers, especially when retail prices are “sticky” and do not speedily change to reflect changes in the cost of production due to increases in input costs.

Potential Severity of Impact: Moderate

Price risk is ever present in the rice and poultry industries and adverse price movements might result in losses for producers in these sectors, especially if tariffs are reduced or removed. The potential impact is classified as moderate based upon the scale of the industry in terms of employment and production, as even significant losses would not cause major reductions in employment or significant / major damage to the overall Belizean agricultural sector.

3. Bananas

Probability of event: Highly Probable

Belize has benefited for many years from preferential access to the EU, providing Belize’s banana producers with higher prices than they would otherwise have received in a freely competitive international marketplace. These preferential access arrangements are now being removed and the prices that Belize’s producers will receive for their bananas (negotiated between the BGA and the banana buyers/importers) will fall as the tariffs charged to other countries supplying into the EU fall.

There are two sides to consider in price risk for the banana industry – the reduction in sales prices for their bananas and the potential rise in unit costs due to either higher input costs or reduced volumes (through reduced use of inputs), both of these factors have the potential to reduce incomes and move the industry from a position of profitability to a position of loss.

Potential Severity of Impact: Considerable

The impact of price declines for bananas will be influenced by the speed and effectiveness of the industry’s restructuring and its ability to increase productivity, maintain/improve quality, and realize any differentiation in customer service. Should the industry contract somewhat, then so will tax revenue to the GOB and will employment (of a combination of migrant and local workers).

4. Sugar Cane

Probability of event: Highly Probable

The Belize sugar industry has been heavily reliant on exports to the EU and has historically avoided significant negative price volatility by benefitting from the guaranteed minimum prices provided by the

EU's preferential market access for ACP countries (the EU Sugar Protocol). However guaranteed minimum prices are being reduced – specifically between 2006 and 2010 a 36% reduction in the price paid for sugar. While preferential access to the EU will still remain post 2010, sharp price reductions are expected and perhaps a higher level of price volatility relatively small share of Belize's sugar production (approximately 10%) is somewhat protected from price volatility via Fairtrade contracts which guarantee a minimum price irrespective of movements in the international price for sugar.

Potential Severity of Impact: Critical

The potential impact of price volatility in the sugar industry is critical as there are 4,000 active sugar cane growers whose livelihoods will be damaged should losses occur. Sugar cane production is the main income source for the majority of these farmers and significant reductions in income could cause significant hardship (to such households and to small businesses in the north of Belize that provide services to such households). In addition sugar is a key export market for Belize and the loss of the sugar exporting industry would be significant in terms of reduced export earnings. Ultimately the impact on the industry will be determined by the efforts of the sugar industry to professionalize production and reduce unit costs to a level below the sales price received.

5. Citrus

Probability of event: Highly Probable

The international price paid for citrus juice concentrates is highly volatile (driven by production in Brazil and Florida) and citrus traders are exposed to volatile prices both year-on-year and within a season. Belizean citrus product exports are priced based on the world frozen orange juice prices (futures markets) and as such are similarly exposed to volatile prices. Incomes and the profitability of citrus farmers have varied significantly from year to year. Currently, world inventories of citrus fruit concentrates are very high and market prices are depressed (at or below the break-even level for some Belizean growers). While Citrus Products Ltd. does attempt to manage price risks externally, much of the industry's price risk exposure is passed back to growers (the largest of which are also major shareholders in CPL).

In addition citrus production relies on the use of inputs to ensure high yields and a major cost of production is therefore the cost of fertilizers. Highly volatile fertilizer prices therefore also expose citrus producers to price risk as a significant rise in input costs can reduce profitability or result in losses if citrus prices don't similarly rise.

Potential Severity of Impact: Critical

Impact is high based on the importance to the citrus industry on the Belizean economy, employing large numbers of workers and generating significant exports. A significant period of highly volatile prices could generate potential losses for the industry if the processor/exporter fails to hedge their price risk effectively. In addition low prices may result in losses for individual citrus farmers who may find incomes below their costs of production.

6. Fertilizer

Probability of event: Occasional

The past two years illustrates how prices for agricultural fertilizers can move sharply over short periods of time based on a variety of factors including the price of petroleum. Even though expectations are for calm to return to the marketplace there is still potential for some significant volatility in prices. World prices determine the price of fertilizer in Belize as all inputs are imported from overseas (there is no local production of the key inputs for fertilizers). In addition fertilizers are produced from petrochemicals and hence directly reflect the cost of oil, which itself has become increasingly price volatile.

Potential Severity of Impact: Considerable

The impact is classified as considerable. This doesn't relate to the fertilizer importer / retailer which has largely passed on the higher prices to farmers. Farmers have thus borne the impact of this price shock.

V. VULNERABILITY SITUATION AND RISK MANAGEMENT

5.1 Vulnerability

Based on the information that was gathered it is important to identify and characterize existing risk management strategies and measures undertaken by supply chain participants and third parties. The effectiveness and current capacity for managing pertinent risks has been reviewed and rated utilizing the 1-5 scale outlined in Table 8. At this stage, the analysis seeks to pinpoint clear gaps in the prevailing approaches to risk management and/or circumstances where prevailing practices are unlikely to be sufficient given the potential severity of loss.

In this table the risks with highest vulnerability in the terms already defined, are represented by the boxes shaded darkest (upper left corner), and the risks ranked as lower vulnerability are shown in the boxes with the clearer shades (toward the right side of the table), Even though the analysis is more qualitative than quantitative, the results shown here are useful and serve as the basis for placing the recommendations that are presented in the following section.

Table 8: Vulnerability to Risky Events Based on Expected Loss + Capacity to Manage Risk

	(-) -----Capacity to Manage Risk ----- (+)				
Expected losses	1	2	3	4	5
High	Hurricanes and tropical storms (banana)	Citrus greening Sugar price shock	Chill periods for banana		

		Hurricane/Tropical Storms (Papaya)			
Medium		<p>Hurricane/Tropical Storm (Citrus industry)</p> <p>No food crop planting material after major storm</p> <p>Food safety risk from informal cross border trade.</p>	<p>Animal disease threats</p> <p>Fertilizer price volatility</p> <p>Citrus product price volatility</p>	Drought for rain fed crops	Adverse impact of trade policy change for poultry
Low		<p>Banana price shock</p> <p>Prolonged dry season affecting livestock</p>		Pest/disease risks in papaya, sugar, and banana,	<p>Cocoa price volatility</p> <p>Adverse impact of trade policy change for rice</p>

5.2 Risk Management

This section presents a series of considerations to improve existing risks management measures and to facilitate the adoption of additional ones – either by individual supply chains participants, sets of participants (in collaboration), or by the public sector.

Sanitary and Phytosanitary (SPS) Risks

Sanitary and phytosanitary risks in a country’s agriculture are of such a nature that prevention is the most critical factor. Once a plant or animal pest or disease becomes established in a country, the costs of control, and/or eradication are very high. It means, in many cases sacrificing herds, or destroying entire plantations in order to control the pest or disease. Emphasis therefore should be placed mostly on prevention. The following measures have been therefore identified as priority.

The existing cadre of technical personnel in BAHA has been doing a good job notwithstanding considerable resource limitations. Activities such as pest and disease surveys and surveillance, pesticide use monitoring, pest and disease identification and diagnosis, pesticide residue testing, import and export inspection and certification, crop protection, animal health protection and general animal and plant quarantine require adequate trained personnel and adequate infrastructure and equipment.

There is need for technically trained personnel in BAHA in areas such as pathology and residue testing. The effects of the absence of disease diagnostic capabilities in BAHA was evident in the current situation with Citrus Greening where it took more than three months for samples sent to an overseas laboratory to be diagnosed and the results communicated to BAHA. Technical assistance has been offered for training Belizean veterinarians in the area of laboratory diagnosis for certain animal diseases as part of an agreement to export animals and animal products to a neighboring country. The offer also includes assisting with veterinary personnel to conduct the national survey to evaluate the status of bovine tuberculosis in Belize.

There is also need to acquire additional capacity to conduct surveys and surveillance activities for the many animal and plant pests and diseases that are of concern to the country. Inadequate capacity in these areas poses serious challenges for meeting the sanitary and phytosanitary (SPS) requirements of trading partners. Surveys for diseases such as tuberculosis and brucellosis in cattle must be conducted on a regular basis in order to scientifically establish freedom from these diseases. If such information is not readily available this will significantly impact the country's ability to trade.

There is scope to strengthen regional collaboration on SPS management measures, under programs facilitated by OHIRSA, IICA, and others. Investments in SPS management in Belize represent something of an 'insurance policy' for its neighbors, and vice versa. Additional collaborative programs in disease and pest surveillance as well as joint programs on pesticides regulation and pesticide safe use could be considered.

Weather Risks

Managing weather risks is one of the most urgent priorities for Belizean agriculture. The effects of hurricanes can be devastating for the sector as it has been demonstrated for the most recent events in 2007 and 2001, where some crops experienced 100 percent loss in yields and for some permanent crops over 60 percent of losses in trees with slow and costly recovery.

Whereas weather risks are typically dealt with crop insurance as a risk transfer mechanisms, there are however measures that can be an important part of the weather risk management strategy for the agriculture sector of Belize. Flash floods, as one of the identified risks in agriculture for instance, are very frequent events in Belize due to the large flat agricultural areas at near sea level. This type of events occur so randomly and so frequent that there is no affordable insurance against this risk. However, instead of every farmer trying to tackle the problem on its own, the suggestion is to undertake a watershed approach and undertake the hydraulic studies and analyses that will identify the drainage infrastructure needed to manage the risks in a more comprehensive manner. These measures could be incorporated into the National Integrated Water Resource Management Policy and Plan recommendations.

Belize National Emergency Management Organization (NEMO) in close coordination with DANA manage a system that includes emergency preparedness, damage evaluation, and coping mechanisms, with the participation of 10 operational committees chaired at the highest level. Their main mandate is to preserve life and property. Regarding agriculture, the system relies on an ex-post evaluation of damages

using ECLA's methodology, and they coordinate all international assistance in the event of a disaster, and the Ministry of Agriculture is the main channel to assist farmers regarding agricultural damages.⁸

Belize needs to consider the possibility to identify and subscribe risk transfer insurance instruments appropriate to the agricultural sector that can complement the already existing CCRIF. Whereas CCRIF is designed for hedging public asset exposure against hurricanes with a return period of 15 years, the agricultural sector needs protection for private assets and for a shorter return period (around 5-7 year events). A risk mapping exercise of the agricultural sector risks could be very helpful tool in designing an agriculture weather risk strategy that identifies risk transfer mechanisms for vulnerable small farmers, as well as insurance for chills in banana and cocoa, droughts in rice, and wind damages for most crops.

Whatever weather risk transfer mechanism that can be identified and developed, it should be integrated with improved agricultural practices designed to adapt or manage weather risks in the sector. These practices include improved drought resistant seeds, farm drainage, natural wind breakers, short cycle crop varieties, varied plant density, and various other practices. Likewise, weather forecasting systems are incorporating models that are becoming useful for alerting farmers on sowing seasons and potential hazardous weather events.

Worth considering and providing a high priority is the expansion of the country's irrigated area, along with formation of water user groups, particularly important for export agriculture, replicating the recent experience with small scale irrigation projects.

Price Risks

Volatile fertilizer prices are arguably the greatest manageable price risk facing the Belizean agricultural sector. Rising input costs greatly impact upon all the major agricultural sectors of the economy, including export agricultural commodities (bananas, citrus, sugar) and domestic agricultural commodities (poultry, rice). Currently there is no input price mitigation and rising fertilizer costs are either absorbed by the producers, or managed by producers reducing the use of these inputs. Both scenarios result in higher unit production costs and a reduction in yields. Ex-ante risk management of volatile (rising) fertilizer prices could ensure that input price risk is hedged preventing a sharp drop in profitability. Such risk management would directly benefit the key Belizean agricultural commodities by preventing sharp spikes in the cost of fertilizers and other inputs.

The risk of rising input prices (fertilizer prices) could be managed through the use of derivative instruments (futures and options). Derivative instruments could be utilized to either "lock in" a current market price for fertilizer or to protect against extreme rises in prices. Hedging with financial instruments would be based on urea derivatives. Basis risk is unlikely to be a major concern as fertilizer inputs are imported into Belize and purchased from suppliers based on world fertilizer prices, local retail prices for fertilizer are based upon a cost-plus formula and currency rates are stable. As such a hedge on the international commodities exchange would likely provide a high level of the desired protection.

⁸ These activities are all conducted under the Belize National Hazard Mitigation Policy (2004).

Hedging could be undertaken by either the main Belizean fertilizer importer or the government. The main importer currently has no desire to incur the cost and effort of hedging as they are able to maintain high local fertilizer prices (even after world prices have fallen) to cover any rises in their purchase price. As such they are protected from losses from volatile prices due to the local market dynamics (transferring their risk of price volatility onto the fertilizer users). Government could hedge on behalf of the agricultural sector by purchasing Call Options on urea futures, effectively setting a ceiling price on fertilizers. If the option were exercised, the payout could be used to either provide direct subsidies to fertilizer buyers (agricultural producers) or to support the fertilizer retailers to reduce fertilizer prices.

There is limited scope for specific additional ex-ante price risk management in the agriculture sector. The CPL already hedges its transactions into the US market plus receives a price premium in the Japanese market. The company is also diversifying into finished product consumer lines for which price volatility is considered less than for frozen concentrate sold as a bulk commodity.

5.3 Approaches to Risk Management (Summary)

Approaches to risk management can be articulated as *ex ante* or *ex post* strategies. *Ex ante* actions are taken before a risky event occurs, and *ex post* management takes place after its realization, as summarized in Box 1 below.

Box 1: Approaches to Risk Management

Risk Prevention / Reduction (ex ante). Actions taken to eliminate or reduce risky events from occurring (e.g. elimination of pests, pest resistant varieties, water draining infrastructure, crop diversification, self insurance).

Risk Transfer (ex ante). Actions that will reduce the exposure of such risks. Financial transfer mechanisms will trigger compensation or reduce the losses in the case of a risk generated loss (e.g., purchasing insurance, financial hedging tools, contingent funds for disaster relief). Other examples of responses to expected losses are precautionary savings, access to communal savings, communal contracts, etc.).

Risk Coping (ex post). Actions that will mitigate the losses caused by a risk event (e.g. government assistance to farmers (seeds), selling assets, credit, seeking temporary employment, migration, rebuilding roads, etc.)

Table 9 summarizes the risk management measures identified in this exercise in terms of the approaches that can be taken.

Table 9: Identified Priority Measures for Risk Management in the Agricultural Sector

Identified Risks	Proposed Risk Prevention (ex ante)	Proposed Risk Transfer Tools (ex ante)	Proposed Risk Coping (ex post)
Sanitary and Phytosanitary	- Train personnel in BAHA. - Acquire capacity to conduct surveys.		- Destruction of infected plants and/or animals needs financial compensation for

	<ul style="list-style-type: none"> - Training Belizean veterinarians, laboratory diagnosis for certain animal diseases. - Local supply of seeds available for quick recovery after a hurricane. - Certification program in place. -Domestic food safety surveillance program 		measures to be effective.
Weather	<ul style="list-style-type: none"> - Weather risk mapping for agriculture. - Weather risk management strategy. - Drainage plan for agriculture at watershed level. - Efficient ex-ante mechanism in place for helping farmers after disasters. --Development of seed/planting material bank for major food crops. --Program to facilitate increased planting of natural windbreaks (bamboo; eucalyptus trees) - Expansion of country's irrigates area. 	<ul style="list-style-type: none"> - Setting up an emergency fund for agriculture with contingent lines of credit and other sources, including re-insurance. - Risk transfer insurance for small farmers. - Commercial insurance for specific crops risks (bananas, rice, cocoa, etc). 	<ul style="list-style-type: none"> - Efficient and transparent distribution mechanism for public sector assistance to farmers.
Price	<ul style="list-style-type: none"> - Higher competition in fertilizer import markets. 	<ul style="list-style-type: none"> - Price hedging instruments for fertilizer imports (futures and options). 	

VI. FINAL REMARKS

The purpose of the paper has been to assist the Ministry of Agriculture of Belize in the application of a methodological framework for identifying key risks facing the agricultural sector, the capacity of the country to manage those risks, and the vulnerability the sector is exposed to the identified risks. The methodology used focused on the application of this assessment for crop based supply chains in developing countries, known as RapAgRisk.

Though the methodology that was used is more suited for assessing risks at the value chain level, the adaptation of the methodology to identify broader sector issues resulted in losing some degree of details

that can be achieved at value chain analysis. However, the results presented in this paper allow for the identification of priority areas for investment and/or capacity building interventions. The target audiences for this final assessment are policy makers, development agencies, country level stakeholders, and other practitioners.

Based on the above analysis the assessment concludes with a set of considerations to improve existing risk management measures and to facilitate the adoption of additional measures—either by individual supply chain participants, sets of participants in collaboration, or third parties.

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