Guyana Rice Supply Chain
Risk Assessment
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Acknowledgments

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Executive Summary

In 2008, the rice sector contributed 3 percent of GDP; 15 percent of total exports; and earned US$114 million in foreign exchange for Guyana. The industry made major productivity gains between 1992 and 1995, and since then, it has gone through several rounds of consolidation. The rice supply chain has successfully faced internal and external shocks and is gradually becoming more competitive. Over the past 15 years, the rice industry has diversified from an almost exclusive reliance on European Union markets to a significant expansion into the Caribbean Community (CARICOM) markets. The rice industry is important to Guyana's economy, yet it continues to exhibit significant levels of annual volatility in acreage, production, and exports. There are limited market and other risks, and, to a large extent, the volatility could be attributed to production risks. Some of the major risks include:

1. *Flood risk:* Due to persistent flood problems, many of the rice farmers are unable to sow paddy, and significant acreage is rendered unfit for paddy cultivation. Furthermore, vast acreage of standing crops is frequently lost and farmers also regularly suffer yield loses. Flood risk emanates from three different sources:
   a. *Excessive rainfall:* The data analyzed as well as farmers' perceptions (based on rice-sector respondents) show that rainfall patterns have become more unpredictable. The rainfall period has shortened considerably, while rainfall intensity has increased. Excessive rainfall within very short time periods frequently generates flooding in many rice-growing areas.
   b. *Inadequate drainage infrastructure:* Existing drainage and irrigation (D&I) infrastructure was built more than 150 years ago and was designed to accommodate 38.1 mm (1.5 inches) of rainfall over a 24-hour period. In the past and in normal conditions, these structures functioned adequately; however, with an increase in severe rainfall events and a slight rise in the sea level, the physical infrastructure is unable to cope with the increased water-drainage requirement, resulting in more frequent and severe flooding.
   c. *Water management:* At present, flood control is managed on an emergency basis, and control efforts are focused on responding to immediate needs rather than the development of long-term control strategies. This ad-hoc system of flood control is no longer effective, and there are limitations on the ability to manage water levels in the coastal plain and prevent flooding. Furthermore, in many areas the D&I system is poorly managed, and the drainage system is clogged, blocking the flow of water and contributing to flooding.

2. *Weed, pest, and disease:* Guyana has a well-functioning rice-extension system, provided through the Guyana Rice Development Board (GRDB), which has effectively managed large infestations of weed, pest, and disease in the past. However, these issues continue to persist and the country loses a sizeable amount of rice production every year due to it. In addition, it has a negative impact on the quality of rice milled and exported. The two major issues are:
   a. *Red rice:* This is essentially a weed that causes significant yield losses and price deductions made by the millers for poor quality. Poor seed quality, inadequate water and drainage availability, and on-farm management practices are the major causes for red rice.
   b. *Paddy bug:* This pest infests rice grains and reduces quality and yield of the paddy crop. Pesticides are widely available, yet every year a large volume of paddy is lost.

3. *Scarcity of water for irrigation:* There is acute water scarcity in Guyana this year (2010) due to what many describes as the El Niño phenomenon. This has been a recurring problem in many areas, and due to limited irrigation availability, many farmers have been unable to sow or are seeing major declines in paddy yield. Lack of rainfall definitely contributes to water availability; however, suboptimal management of the irrigation system is also a major contributor to this risk.

4. *Risk of delayed payment:* Delayed payment and, in many cases, nonpayment to the farmers by the millers are other risks being confronted by the rice supply chain. Cash payment on delivery of paddy is very limited and payment three to eight weeks after paddy delivery is the norm in the industry. The situation has worsened in the past two to three years and this creates significant cash-flow problems for the farmers, leading to a breakdown of trust between farmers and millers. In addition, millers also face this risk, which often limits their ability to pay farmers in a timely manner.

While risk-transfer and risk-coping solutions might be useful for managing some risk, risk-mitigation strategies to reduce the likelihood of the risk occurring and to reduce the loss from adverse events are more relevant and important for risk management in the country. Risk-mitigation measures such as upgrade and repair of existing D&I infrastructure, improvement in conservancy capacity, investment in drainage equipments (e.g., dredging equipments and pumps), improvement in water-management systems and processes, improvement in drainage-maintenance strategy, investment in capacity building of D&I staff, and investment in weather forecasting and dissemination mechanism might be more effective in managing flood risk. Strengthening agriculture extension services, improving farm-management practices, and having access to quality and disease-tolerant seed varieties are some risk-mitigation measures to manage the risks of weed, pest, and disease.

The Government of Guyana (GoG) has already implemented a number of initiatives to mitigate some of the above-mentioned risks. Many of the existing initiatives need to be strengthened and some new activities added to ensure comprehensive management of all the key risks facing the rice supply chain. In-depth evaluation of the individual solutions was beyond the scope of this exercise; however, exhaustive listing of potential risk-management solutions and a cost-benefit assessment of different options to manage these risks need to be undertaken by the GRDB and the Ministry of Agriculture (MoA).

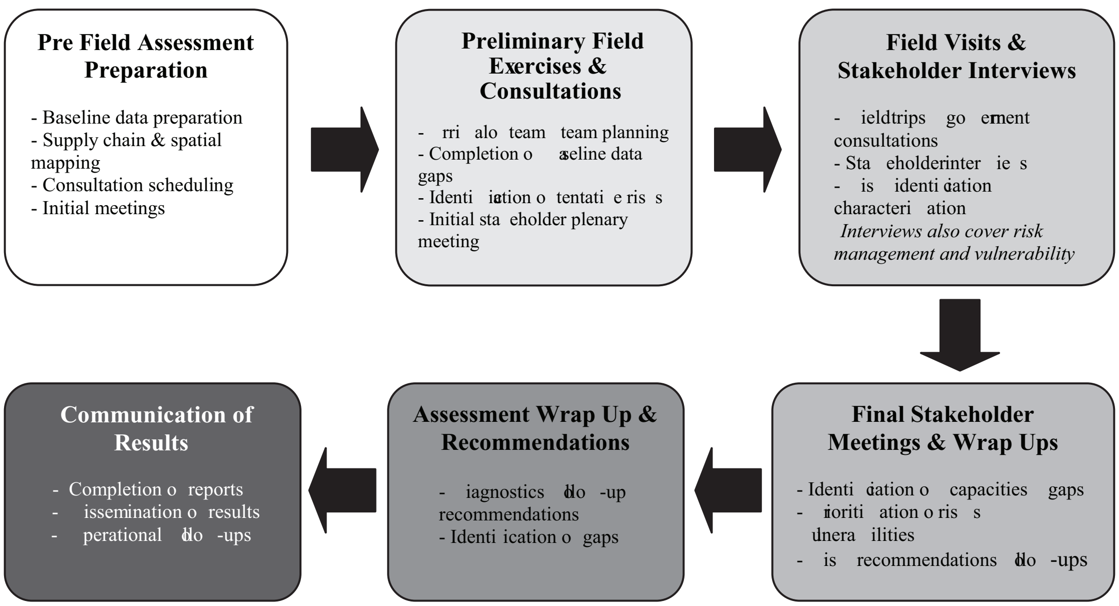
1. Background

At the request of the MoA, the GoG, and the GRDB, the World Bank conducted a rice supply chain risk assessment in Guyana. This report is the outcome of that assessment and is intended as an advisory note to the MoA and GRDB to enable them to identify a strategy and potential public investments to improve current risk-management practices in the rice supply chain.

This report identifies the major risks facing the rice supply chain, ranks them in terms of their potential impact and frequency, and offers a framework for improving current risk-management practices. The recommendations and findings will provide a basis for follow-up planning work by the GoG, the World Bank, and other development partners.

The findings and analysis of this initial assessment are based on a methodology designed by the Agricultural Risk Management Team (ARMT) for assessing risks in agricultural supply chains. The assessment team followed the following sequences of activities (figure 1) while conducting the assessment.

Figure 1: Overall Sequence of Analysis and Consultative Steps



Sources: Rapid Agriculture Supply Chain Risk Assessment, World Bank 2010

In-depth interviews were conducted with key rice-supply-chain stakeholders in regions 2, 3, 5, 6, and Georgetown (i.e., farmers, input suppliers, traders, financial intermediaries, millers, exporters, service providers, government officials, research institutes, etc.). A full list of stakeholders interviewed is provided in annex 3.

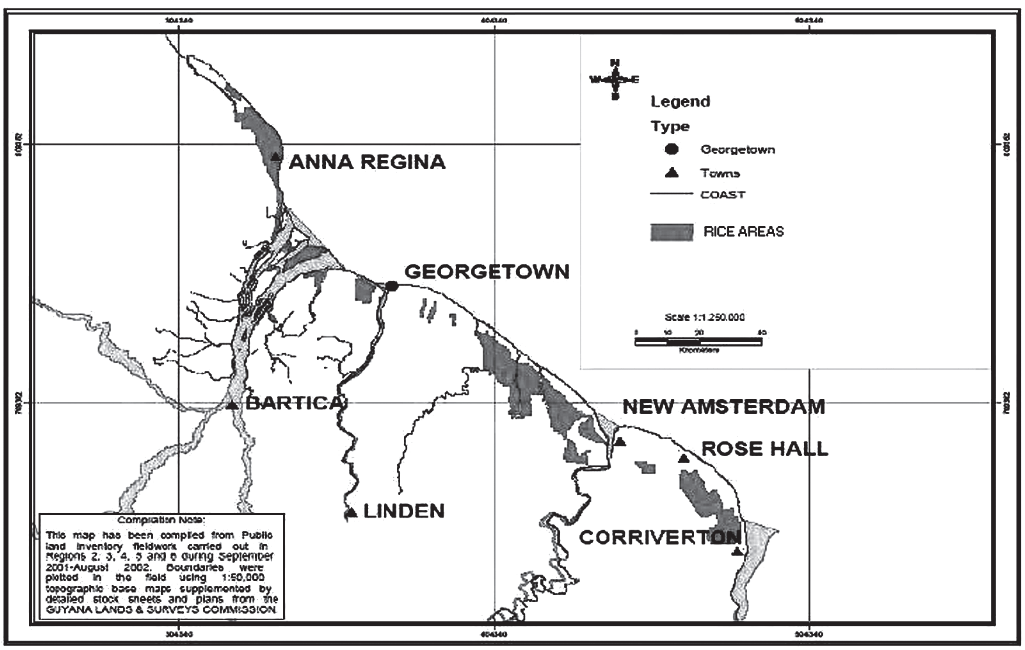
This nonlending technical assistance (NLTA) is provided by the World Bank to Caribbean countries looking to develop market-based agriculture risk-management mechanisms. This NLTA was financed in part by the European Union All ACP Agricultural Commodities Program for the Caribbean region. The World Bank team wishes to acknowledge the invaluable support provided by MOA and GRDB as partners in this activity.

2. Overview of the Rice Sector in Guyana

Agriculture is an important sector of Guyana's economy, accounting for approximately 28 percent of the total GDP,[1] 40 percent of the export earnings, and 30 percent of employment in the country.[2] About 400,000 acres of agricultural land is irrigated, of which about 200,000 acres is planted with rice, 130,000 acres with sugar cane, and 70,000 acres is allocated to other crops and livestock.[3] Sugar and rice are the most important crops in terms of area, value of production, employment creation, and contribution to export earnings. In 2008, the rice sector accounted for 12.5 percent of the agricultural GDP and 14.9 percent of the national export earnings.[4] Rice is the major source of employment in rural areas, and approximately 8,000 farmers are directly involved in rice cultivation.

Paddy production takes place along the coastal plain in Guyana. This is a fertile, flat strip, 5 to 7 km wide that runs along the sea shore. The coastal plain lies about 1.4 m below sea level at high tide; thus, in order to avoid sea ingress it is protected by a sea wall. The coastal plain enjoys an equatorial climate that is characterized by seasonal rainfall, high humidity, and small variations in temperature. Annual rainfall averages about 2,300 mm and is distributed over two rainy seasons, which occur from May to July and from November to January. Temperatures rarely rise above 31^{0}C or fall below 22^{0}C, and relative humidity is high, reaching 80 percent or more in the coastal zone. Map 1 shows the main rice-production areas in Guyana.

Map 1: Main Rice Production Areas in Guyana



Source: Authors, adapted from Guyana Lands and Surveys Commission (2008)

Historically, region 5 (Mahaica/Abary and West Berbice), region 6 (Black Bush Polder and Frontlands), and region 2 (Essequibo) have been the most important paddy-producing regions, with the greatest acreage of cultivated area

1 Source: World Bank, World Development Indicators.
2 http://www.caricom.org/jsp/community/donor_conference_agriculture/agri_profile_guyana.jsp.
3 Source: GRDB and Ministry of Agriculture.
4 Source: GRDB Annual Report, 2009.

and largest production volume in both the crop seasons. Table 1 summarizes the distribution of paddy farmers as well as the paddy sown area and paddy production per crop season among the different regions in Guyana.

Table 1: Distribution of paddy farmers, paddy sown area, and production per region (2008)

Region	Farmers #	First Crop Season		Second Crop Season		Aggregate	
		Sown Area (acres)	Production (tons)	Sown Area (acres)	Production (tons)	Sown Area (acres)	Production (tons)
Region 2	3,255	31,477	56,446	31,975	59,800	63,452	116,246
Region 3	2,279	19,863	29,189	21,068	34,434	40,931	63,623
Region 4	625	5,949	10,194	6,252	10,812	12,201	21,006
Region 5	1,021	63,481	95,791	56,297	83,218	119,778	179,010
Region 6	733	39,002	63,115	37,175	56,860	76,177	119,975
Grand Total	**7,913**	**159,772**	**254,735**	**152,767**	**245,125**	**312,539**	**499,860**

Source: GRDB, 2008

The fact that the vast majority of agricultural activities takes place in the coastal plain that lies below sea level at high tide means that agricultural production has to rely heavily on drainage systems. A comprehensive drainage and irrigation (D&I) system, currently managed by National Drainage and Irrigation Authority (NDIA), was constructed more than 150 years ago by the Dutch. Currently, drainage throughout most of Guyana is poor and river flow sluggish because the average gradient of the main rivers is only 1 m in every 5 km. Drainage by gravity is possible only when the tide is low, and drainage is affected by the ever-changing levels of the foreshore outside the sea defenses. The total length of the main drainage infrastructure is about 500 km, while the length of the secondary drainage system is 1,500 km.[5] Besides drainage, the same system is used to irrigate the paddy fields, which receive most of its water supply through pumping from four big water conservancies (East Demerara, Mahaica-Mahicony, Boerasirie, and Itirbisi) and the rivers.

Paddy is cultivated in Guyana during two crop seasons, namely the spring and autumn. The spring crop is generally cultivated during November and December and harvested from March to April. The autumn crop is usually cultivated during June and July and harvested during September and October. Paddy cropping calendars are synchronized with the rainy seasons.

Rice cultivation is largely mechanized, and large-wheeled tractors are used for land preparation, which includes plowing, harrowing, and puddling. The crop is directly seeded using pre-germinated seeds sown into flooded fields. The seeds are, however, usually sown manually. Harvesting is done by combine-harvesters and the paddy transported in bags or in bulk to the mills.

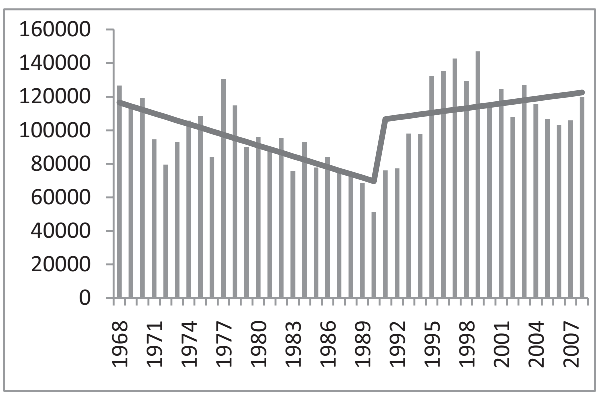
The rice sector's historic performance in Guyana since its independence can be clearly divided into two periods, the period of state control of the economy (1966–89) and the period of liberalization of the economy (1990 to the present). During the former, MoA used to set the prices of paddy and there were restrictions on the internal trade of rice, with farmers being constrained to sell rice only within certain geographical areas. There were also further restrictions on the amount of paddy or rice which farmers could hold-a measure to combat

5 http://www.fao.org/nr/water/aquastat/countries/guyana/index.stm.

hoarding. During this period, the area planted with paddy fell from 120,000 hectares in 1968 to 60,000 hectares by 1989. Despite this area decline, however, production increased slightly due to an increase in productivity (1.7 MT/hectare in 1968 and 3 MT/hectare in 1989). The yield gains were largely due to the state investment in improved rice varieties, extension services, and provision of farm inputs.

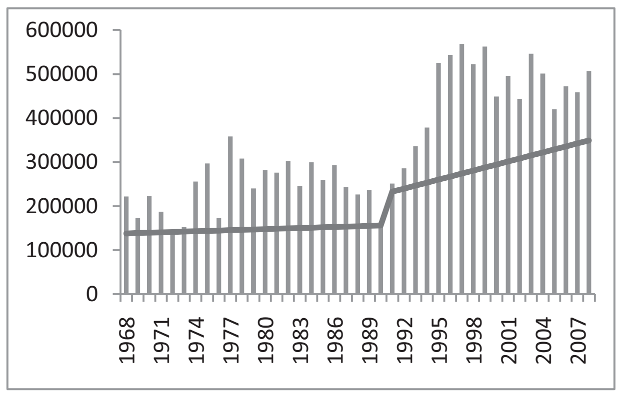
By the late 1980s, the government had begun to dismantle its pricing, and institutional structure and farmers were allowed to sell freely in their markets of choice. During that period, the devaluations of the exchange rate also had the effect of dramatically raising rice prices relative to prices of other agricultural commodities in the Guyanese economy. Also of significant importance was the government sell-off of almost all its rice mills (retaining only one complex under the Guyana Rice Milling and Marketing Authority (GRMMA), which sharply improved the competitiveness of the sector, raising prices for farmers and giving farmers the incentive to invest in paddy cultivation. This triggered a rapid response by farmers, and as a result, from 1990–91 the total area harvested increased by 46 percent and rice production increased by more than 60 percent. Between 1991 and 1998, the area harvested increased by 75 percent and production by 100 percent. The strong trend of increases in rice acreage was reversed from 1998. Figures 2, 3, and 4 show the historic evolution of paddy area harvested, paddy production, and paddy yields, respectively, during the period 1968–2008.

Figure 2: Paddy Area Harvested 1968–2008/(Ha)



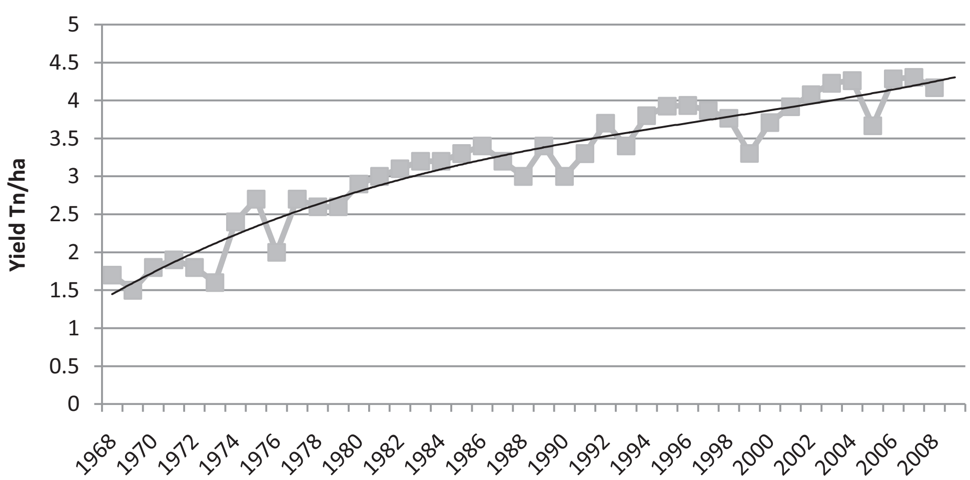
Source: GRDB, 2008

Figure 3: Paddy Production 1968–2008/(Metric tons)



Source: GRDB, 2008

Figure 4: Paddy Yield 1968–2008/(tons/Ha.)



Source: GRDB, 2008

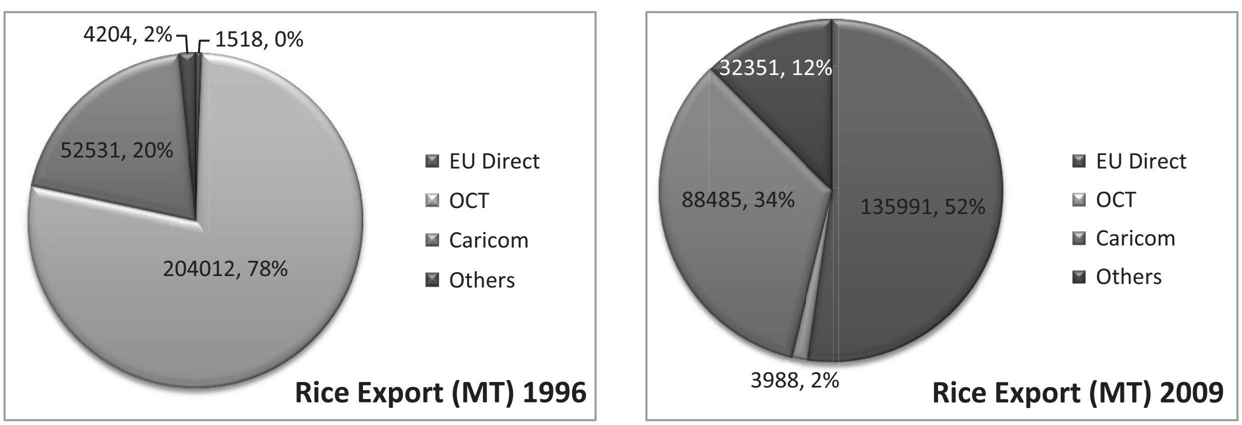
3. Structure of the Rice Supply Chain in Guyana

The rice supply chain (figure 6) is marked by direct interaction between farmers, millers, and exporters. The supply is primarily geared toward export markets, and approximately 70 percent of the total rice production is exported. The primary industry participants are farmers, millers (processors), and exporters, with support services provided by banks, microfinance institutions, input suppliers (seeds, fertilizers, and chemicals), and shipping companies. In addition, GRDB provides a series of critical services to the industry, including seed production and distribution, quality assurance, monitoring and auditing, extension services, and fumigation of exports. In addition to GRDB, the Rice Producers Association (RPA) also plays a role in providing extension services to farmers.

The number of participants in the supply chain has dropped sharply over the past 30 years due to consolidation. The total number of farmers and processors (millers) operating within the Guyanese rice supply chain has fallen consistently over time. While there were 12,600 rice farmers in 1978, currently only 7,993 farmers are engaged in rice cultivation. The number of millers has declined from 96 in 2000 to 69 to 2009.

The two major export markets for rice are the European Union (EU) and the Caribbean, with 52 percent of total exports going to the EU and 34 percent heading for CARICOM countries in 2009. Historically, the market was primarily focused on the EU, which provided preferential market access through the Other Countries and Territories (OCT)[6] route. However, preferential market access has declined over time, and by the end of 2010, it is expected to disappear completely. Figure 5 represents the shift in the rice-export market for Guyana. Jamaica is currently the main Caribbean market for Guyanese rice, followed by Trinidad and Haiti, collectively accounting for over 90 percent of all Guyanese Caribbean rice exports.[7] Guyana rice exports benefit from a 25 percent CARICOM tariff on extraregional rice imports and also from lower shipping costs due to its geographic proximity to the Caribbean markets.

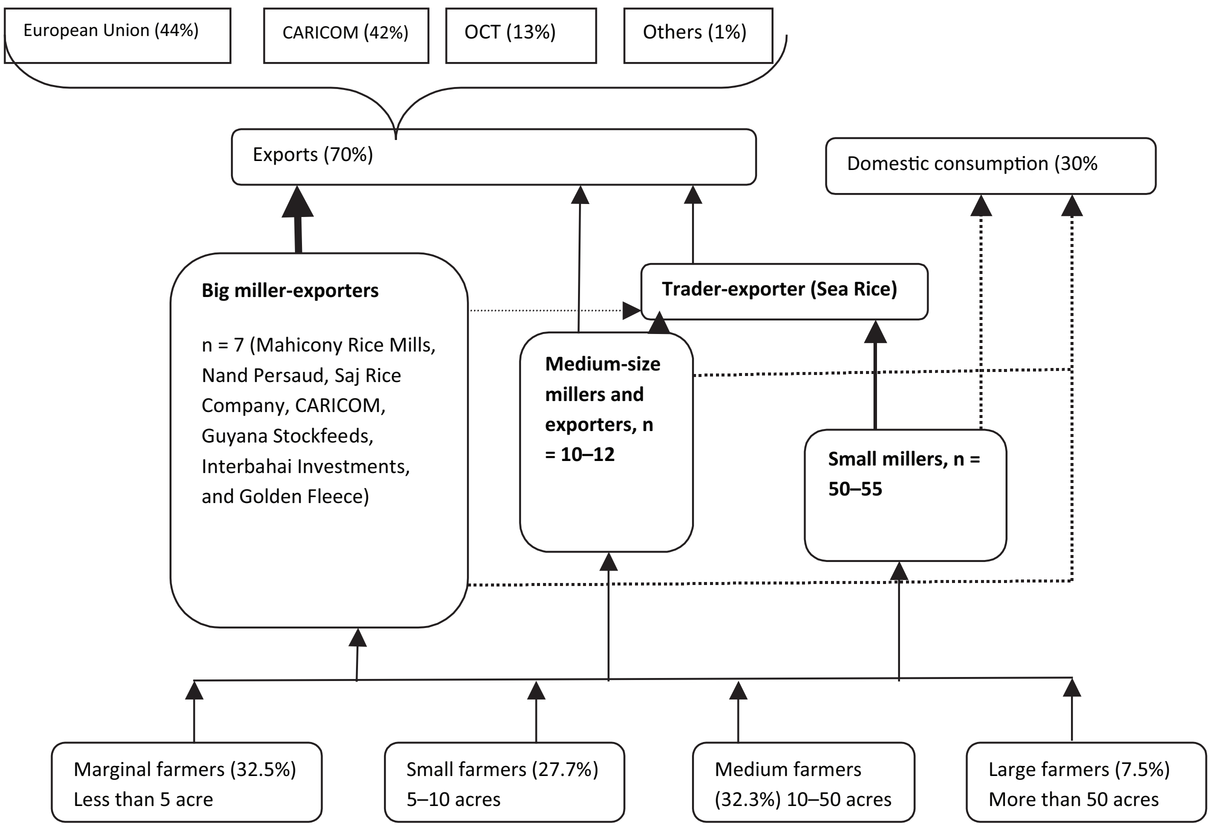
Figure 5: Shift in the Share of Rice Exports to Major Destinations (1996–2009)



Source: GRDB Annual Reports

6 There are 20 overseas countries and territories (OCTs) that are linked to Denmark, France, the Netherlands, and the United Kingdom, and they are associated with the European Union.
7 GRDB Annual Report 2008, page 58.

Figure 6: Guyana Rice Supply Chain Map



Source: Authors

3.1 Millers-Exporters

The Guyana Rice Development Board issues milling licenses, and millers need to renew it every year. In 2009, 69 milling licenses were issued by GRDB. Until a few years ago, a few big exporters were responsible for most of the exporting; most of the millers were engaged exclusively in milling, while a few large millers performed both milling and exporting functions.

Today, those who exclusively export rice no longer exist in Guyana. Vertical integration is common in the Guyana rice supply chain, with the larger millers starting to export directly and the exporters entering the milling business. The last remaining rice exporter that deal exclusively in rice is Sea Rice (earlier known as Nidera), which now also has part ownership of a Guyanese rice mill and long-term relationships with existing third-party mills.

Rice exports were more concentrated in 2006, with 5 exporters accounting for more than 90 percent of the export market share and just two exporters (Mahaicony and Sea Rice) accounting for more than 70 percent of total export market share (table 2). In 2009, 8 exporters exported just under 90 percent of rice from Guyana, and the share of the largest two exporters fell to 45 percent. The change in export market share concentration reflects new dynamism in the industry and is partially attributable to the younger generation taking over the operations of many mills.

Table 2: Export market share of millers/exporters

Exporters	2006	2007	2008	2009
Mahaicony Rice Mills	38.7	30.9	29.9	18.98
Nidera	22.8	30.6	23.8	-
Nand Persaud	9.8	8.7	9.8	10.83
Saj Rice Co.	8.7	7.9	6.5	7.15
CARICOM Rice Mills	9.9	7.3	5.6	4.55
Others		14.6	7.7	12.6
Guyana Stockfeeds			3.2	2.9
Interbahai Investment			8.7	10.24
Sea Rice (earlier known as Nidera)				27.04
Golden Fleece			4.8	5.71

Source: GRDB Annual Report, 2009

In addition to the consolidation of the milling industry, millers have been attempting to increase their value-added figure by raising the proportion of parboiled and white rice as a share of total exports. Between 2005 and 2007 the share of total exports accounted for by white rice rose from 30.4 to 32.3 percent, with parboiled rice rising from 10.6 to 11.4 percent.[8] Selected millers have also begun to package their rice in branded retail-sized packages, which they are exporting to Caribbean markets through recently established distribution channels. Their aim has been to raise the price for their rice while also establishing a market presence to protect them against imports from other rice-producing countries. The move from cargo to white rice is financially significant, given that in 2008 white rice sold to Caribbean markets generated an additional US$65/MT over cargo rice, while white packaged rice generated an additional $140/MT (the differential is even greater when global rice prices are lower; for example, the differential between packaged white rice and bulk cargo rice exported to Caribbean markets was US$311/MT in 2007).

Apart from the 17–19 large- and medium-sized millers that cater to the export market and sell a sizeable amount of milled rice to the domestic market, there are 50–55 smaller mills that procure a sizeable amount of rice from the farmers. The bulk of the production of medium- and small-sized millers is exported by Sea Rice. These smaller millers also sell in the domestic market and some of them provide a fee-based service to farmers for processing their rice.

3.2 Farmers

Over the years, rice farming has witnessed a decline in the number of farmers but an increase in the average farm size. Currently, out of the approximately 7,900 households cultivating paddy in Guyana, 60.2 percent of the households, which are cultivate under 10 acres each, account for 13.5 percent of total paddy acreage; conversely, the remaining 39.8 percent of the households, which cultivate above 10 acres each, account for 86.5 percent of the total paddy acreage in the country. Table 3 shows the distribution of the total paddy acreage according to farm size. A number of reasons have been suggested anecdotally for the decline in farmer numbers, the primary

8 GRDB Annual Report, 2008.

one being the migration of rice-producing individuals and families to Georgetown or overseas and cessation of production following financial losses.

Table 3: Guyana paddy acreage distribution per size of farms

Farm size	Number of Households		Area	
	# Farms	Percentage	Acreage	Percentage
< = 2.50	992	12.5%	7,285	1.9%
2.50–4.99	1,581	20.0%	12,992	3.3%
5.00–9.99	2,190	27.7%	32,670	8.3%
10.00–14.99	1,250	15.8%	38,611	9.8%
15.00–24.99	631	8.0%	63,894	16.3%
25.00–49.99	678	8.5%	52,610	13.4%
50.00 and over	591	7.5%	184,293	47.0%
Total	**7,913**	**100%**	**392,354**	**100%**

Source: Authors, from Guyana Rice Development Board Farmer's Database, 2008

3.3 Support Services

The Guyana Rice Development Board provides a series of services to farmers, services such as farm extension, capacity building, hybrid seed development, and so forth. It maintains a very strong control on rice quality throughout the supply chain. It has agents at each buying station to ensure that quality requirements are maintained, and it operates its own rice lab for monitoring the quality of all export orders. It also provides a mandatory fumigation service for all export rice. GRDB appears to have been successful in ensuring that Guyanese rice maintains its strong reputation for quality with international buyers, as evidenced by almost no occurrences of rejected orders based on quality issues.[9] All Guyanese rice is exported via Georgetown port, which is a relatively shallow port that limits boat sizes to 6,000 tons. There are three main shipping companies in Guyana, one of which is owned by a large rice exporter.

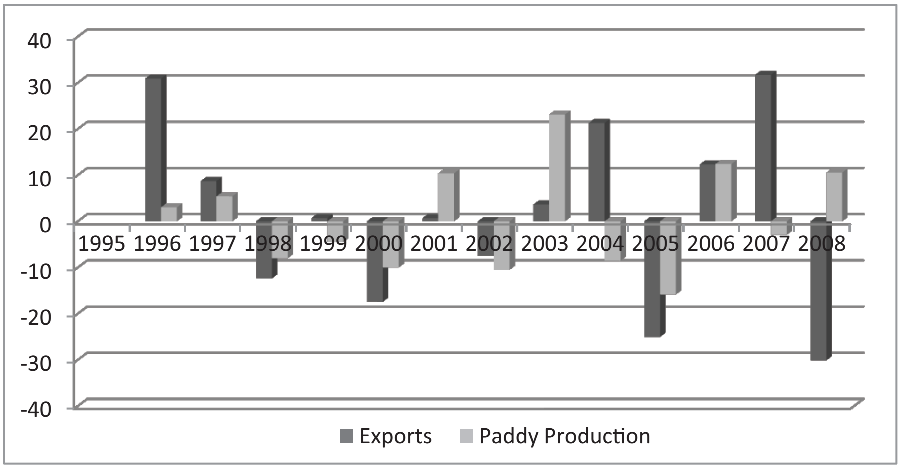
Fertilizers are imported into Guyana primarily from Trinidad but also Eastern Europe. Fertilizers are imported by two commercial enterprises and sold to stores and outlets that subsequently retail them to farmers. Fertilizer is also distributed via millers (on credit) and the RPA (for cash) in some locations. Chemicals for pest and disease control are readily available, and two companies compete to supply those chemicals to the rice sector.

4. Annual Volatility of Rice Production

The period between 1990 and 1997 was marked by a consistent and stable growth in rice acreage, production, and exports. Guyana achieved its peak rice production in 1997 and, since then, the rice supply chain has consistently experienced significant annual fluctuations in production and export, and it has not been able to revert back to its peak production level of 1997. Figure 7 depicts annual volatility in the production and export of rice since 1995.

9 The vast majority of export-focused millers interviewed stated that they had not in recent years had any orders rejected for quality in recent years (although in a few cases orders may have been challenged for an excess of flaws in the rice).

Figure 7: Annual Volatility in Paddy Production and Rice Exports (expressed in %)



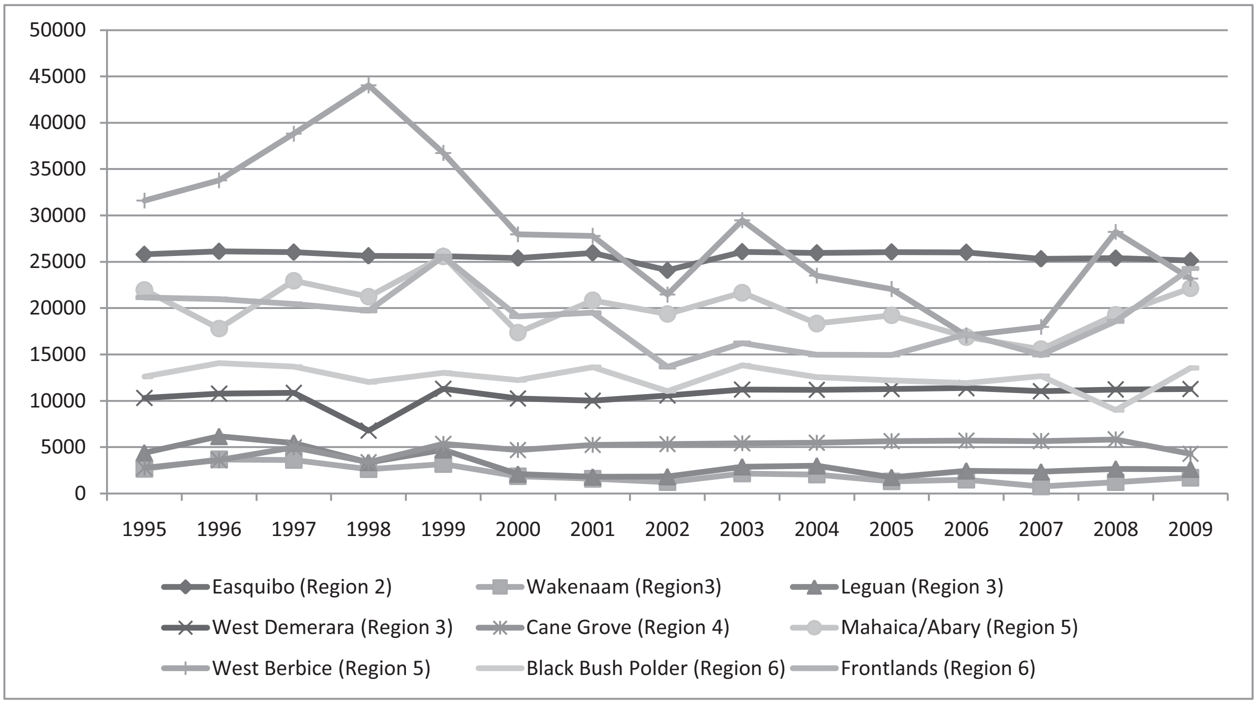
Source: Authors, from Guyana Rice Development Board Annual Reports

Analysis of the paddy-sown area and paddy production (figures 8 and 9) in nine paddy-growing areas of the country indicates that three areas, namely Essequibo (region 2), West Demerara (region 3), and cane grove (region 4) are stable areas and exhibit limited variability in paddy acreage and production. Consistent performance of these regions indicates that the conditions in these areas promote continued and sustained paddy sowing and there are no competing crops vying for farmers' attention—field visit in Essequibo confirmed this. Farmers in Essequibo indicated that they exclusively cultivate rice as there are no suitable alternatives. As a result of the exclusive focus on rice production, the region is geared toward effective rice cultivation: drainage and irrigation systems are well maintained; administration is quite responsive to the needs of the rice farmers; and rice farmers are in general satisfied with the level of services provided by GRDB, RPA, and NDIA.

The majority of the total annual volatility in rice production can be attributed to regions 5 (West Berbice and Mahica/Abary) and 6 (Frontslands and BlackBush Polder), which are also the biggest rice-producing regions. These regions experience relatively high production fluctuations for a variety of reasons, including flooding at harvest time; reductions in total area sown[10]; significant reductions in yields due to weed, pest, and diseases, and lack of irrigation facility. Production volumes in other regions do fluctuate, but at a much lower level than what national rice-production statistics may indicate. Annex 2 provides a detailed analysis of acreage, production, and yield variability for spring and autumn crop for regions 5 and 6 and potential sources behind the annual variability.

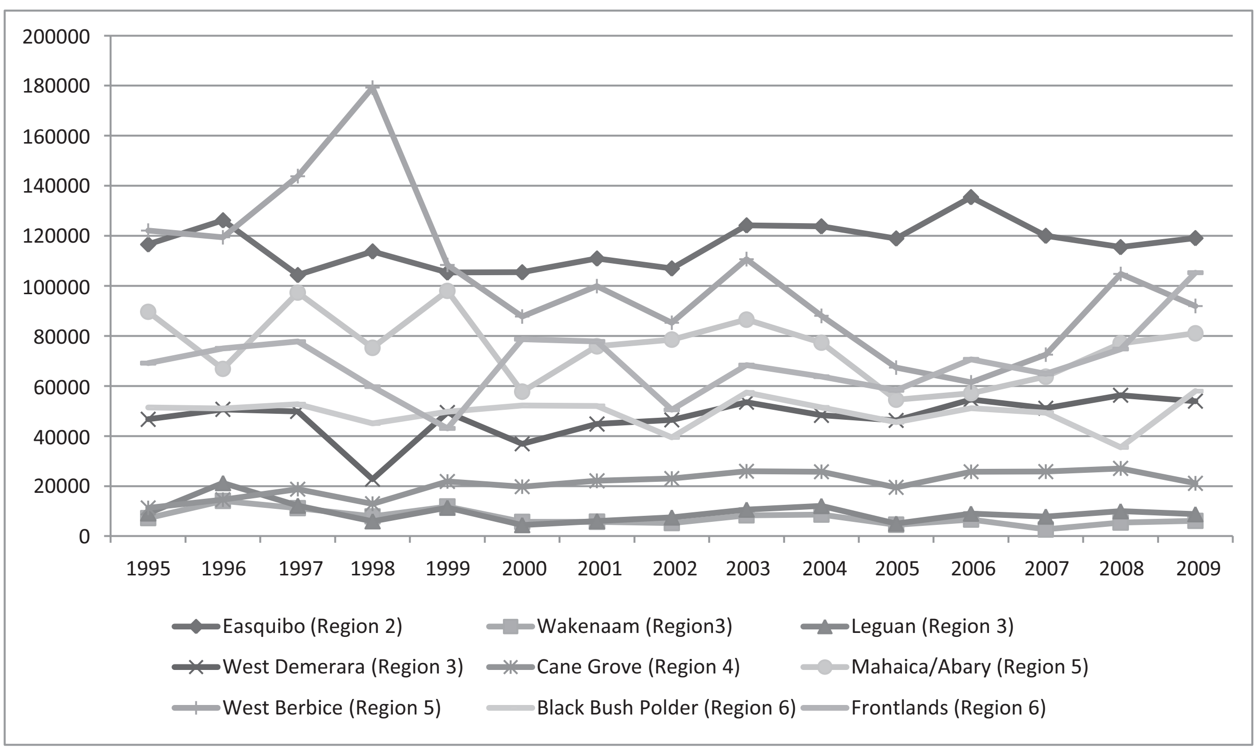
10 On many occasions, farmers are unable to sow paddy because of their inability to drain water out of the paddy fields.

Figure 8: Paddy Sown Area (Hectare) 1995–2008 (Breakdown by region)



Source: GRDB, Annual Reports, 1995–2009

Figure 9: Paddy Production (MT) 1995–2008 (Breakdown by region)



Source: GRDB, Annual Reports, 1995–2009

5. Constraints in the Guyana Rice Supply Chain

Though this report focuses upon the major risks facing the rice supply chain in Guyana, it is also important to acknowledge the significant constraints which affect the day to day operations of the rice supply chain. Besides reducing the efficiency of the rice sector, some of the constraints may themselves exacerbate the risks facing the supply chain. Two major constraints facing the rice sector in Guyana are:

5.1 Access to Finance

Farmers: Total lending to the rice sector declined from G$11.6 billion in 2000 to G$2.8 billion in 2008. Frequent flooding, bankruptcy of millers, and default by big farmers were cited as the main reasons behind this decline. Lending by commercial banks to the rice farmers in Guyana fell from G$5.7 billion in 2000 to G$1.1 billion in 2008.[11] Mainly larger farmers are able to access loans from commercial banks, and bank lending to small farmers is very limited. Farmers requiring credit either for seasonal inputs or for longer-term farm investments tend to borrow, if at all, from alternative credit providers (rice millers, input suppliers, equipment suppliers, and microfinance institutions). Both the commercial banks and the alternative credit suppliers charge relatively high rates of interest to their borrowers. The commercial bank facilities provided to processors and exporters currently sit at around 14 percent[12] per annum, while the microfinance rates for farmers average around 21 percent.[13] The high costs of finance reduce the profitability of supply chain participants and reduce investment within the sector.

Millers and exporters: Lending to the rice millers declined from G$5.9 billion in 2000 to G$1.7 billion in 2008.[14] Most of the rice millers interviewed during the mission reported difficulties in accessing sufficient finance from local banks, both long-term finance for investment purposes and short-term finance for seasonal buying or trade finance purposes. This constraint has grown in severity with the recent doubling of paddy prices not being matched by an equivalent rise in banking facilities[15] (a doubling of paddy prices doubles the working capital requirements of millers). This constraint is currently being managed by millers by either securing funds from other sources or more commonly by delaying payments to producers (farmers) until payment has been received from buyers, directly increasing the risk of late payment or default between farmers and millers.

5.2 High(er) Shipping Costs

The bulk of the rice exports and imports (fertilizers and chemicals) takes place through Georgetown port, which is a relatively shallow port and limited to a maximum cargo boat size of 6,000 tons. Such boats are relatively small in global shipping terms, and hence shipping costs per unit (for both exports and imports) are relatively high compared to other countries that can access larger ships. Higher shipping costs raise the cost of inputs and the cost of exportation (export orders are based on cost and freight (C and F). In addition, it was suggested that the relative scarcity of smaller cargo boats further aggravates the problem.

11 Source: Presentation by the Chairman of the Guyana Association of Bankers Mr. John Tracey at the Symposium on Agricultural Risk and Insurance, December 7, 2009.
12 Source: Various discussions with commercial banks and rice processors/exporters.
13 Source: Discussions with Institute of Private Enterprise Development. Rate includes interest and fees.
14 Source: Presentation by the chairman of the Guyana Association of Bankers, Mr. John Tracey, at the Symposium on Agricultural Risk and Insurance, December 7, 2009.
15 Bank of Guyana-Banking System Statistical Abstract, December 2009.

6. Major Risks and Capacity to Manage

As mentioned previously, 2 regions account for most of the annual variability in rice production. The current inability of the sector to effectively manage its key risks explains the vast majority of the variability in production and exports. The major risks are detailed below in table 5 and grouped into three main categories: production, market, and other.

Table 5: Major identified risks in the rice supply in Guyana

Identified risks
Production risks
Flood risk
Excess rainfall at harvest
Scarcity of water for irrigation
Paddy bug
Significant rise in red rice
Blast (rice fungus)
Market risks
Price risk
Increase in input prices (fertilizer, chemicals, diesel, etc.)
Delayed payment
Increase in transportation cost
Other risks
Regulatory risk (e.g., levy, taxes, legislation, etc.)
Erosion of preferential market access (CARICOM)
Accessibility to dam roads

Interviews with key rice industry stakeholders and a detailed review of rice sector production and climatic data from the past 20 years were undertaken to identify and analyze the risks. Subsequently, identified risks were assessed according to the potential to produce losses and the frequency of such events occurring. This assessment is captured in table 6 below. The identified risks located in the darkest grey area (upper-right corner) of table 6 represent the most significant risks due to their potential to cause the greatest losses (even at catastrophic levels) and the frequency of their occurrence. The second level of importance is represented by the light grey boxes, whereas the clear boxes (on the left side of the table) represent identified risks that either have low potential to cause damages or their frequency of occurrence is also low.

Table 6: Summary of risks: severity vs. probability

		Potential Severity of Impact				
		Negligible	Moderate	Considerable	Critical	Catastrophic
Probability of Event	Highly probable			Delayed payment	Flood risk	
	Probable		Increase in input prices (fertilizer, chemicals, diesel, etc.) Price risk Accessibility to dam roads	Significant rise in red rice Paddy bug	Scarcity of water for irrigation	
	Occasional		Increase in transportation cost Excess rain at harvest			
	Remote			Blast (rice fungus) Regulatory risk (e.g., levy, taxes, legislation, etc.) Erosion of preferential market access (CARICOM)		
	Improbable					

6.1 Production Risks

Flood, weed, pest, and disease, access to irrigation and rain at harvest are the major production risks for the paddy cultivation in Guyana.

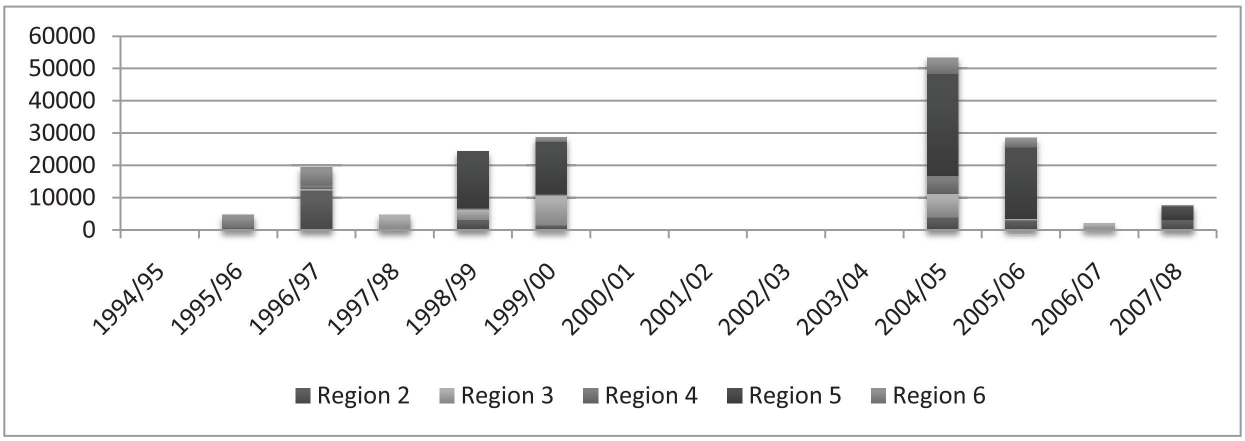
6.1.1 Flood Risk

Severity: Critical
Probability: Highly probable

The geographical setting of paddy-production areas makes rice production vulnerable to flooding. Consequently, paddy production is heavily reliant on the effective operation of drainage systems, which is composed of a complex network of canals and secondary canals, many of which are outdated and require major rehabilitation work. Furthermore, the country is experiencing an increase in the frequency of severe rainfall events that exceed the current design capability of the drainage system to effectively run off the excess water.

Flood is reported to be one of the main causes of paddy crop losses in the country.[16] In all the farmers' focus groups performed for this study (annex 4), the farmers identified flood as one of the top three risks. The historical data indicates that the frequency of flood events[17] is increasing in Guyana. From one single event reported during the 1970s and the 1980s, the number of flood events has risen to five during the 1990s and four events during the first decade of this century. Between 1994–1995 and 2007–2008, paddy farmers in Guyana suffered significant crop losses[18] on nine occasions due to flooding, and region 5 suffered maximum losses. Figure 10 shows the national paddy production losses due to floods during the period.

Figure 10: National and Regional Paddy Production Losses due to Floods (1994–1995, 2007–2008)(metric tons)



Source: Authors, from GRDB Annual Reports, EM-DAT, Stabroek, and Dartmouth Observatory

Several factors are converging to increase the frequency and severity of these events. The most important are: (a) the increased frequency and severity of rainfall events; (b) the outdated conservancy and drainage systems; and (c) D&I and flood-management issues. Rather than acting in isolation, each of these factors, described below, is closely interrelated and contributes to the severity of flood in the country.

(a)The paddy-production areas in Guyana are affected by extreme rainfall events. The occurrence of extreme rainfall events (i.e., excess of rain and lack of rain) affecting the paddy crops is higher during the spring crop season than during the autumn crop season. Between 1974–1975 and 2007–2008, there were seven excess rain events[19] during the spring crop season(figure 11) but only one excess rain event during the autumn crop season(figure 12). These events lead to flooding of paddy fields, and the D&I system is unable to drain the water out of the fields, leading to losses to the paddy crop.

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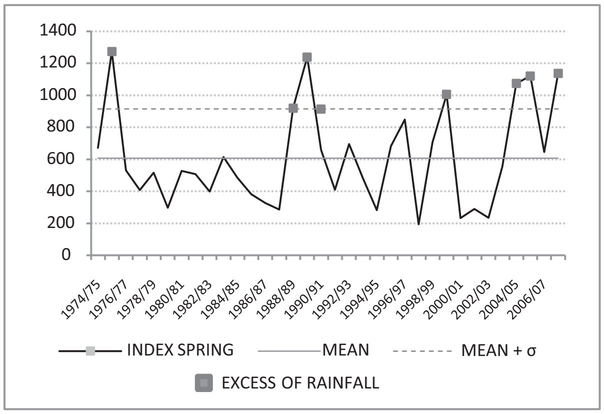
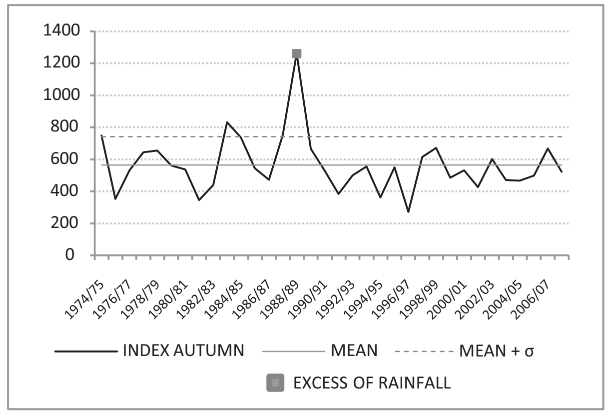
16 Guyana Sugar Corporation (GUYSUCO). Vulnerability and Capacity Assessment. Impacts of Climate Change on Guyana's Agricultural Sector. March 2009.
17 For the purposes of this prefeasibility study, flood event is considered as the occurrence of flood in any particular region.
18 The methodology used to calculate the rice production losses involves the calculation of (a) area totally damaged and (b) area partially damaged due to flooding. (Production losses = area impacted * expected yield at harvest.) The expected yield at harvest was determined by corresponding historic yield trend value for the year under analysis.
19 For the purposes of this analysis an excess of rain event is defined as rainfall event that is above the threshold established as the historic average rainfall for each of the periods under analysis plus one standard deviation of the historic rainfall of the period under analysis.

Figure 11: Rainfall for the Period December–March (Spring Crop Season), 1974–1975, 2007–2008 (mm/season)



Source: Hydro-Met

Figure 12: Rainfall for the Period July–October (Autumn Crop Season), 1974–1975, 2007–2008 (mm/period)



Source: Hydro-Met

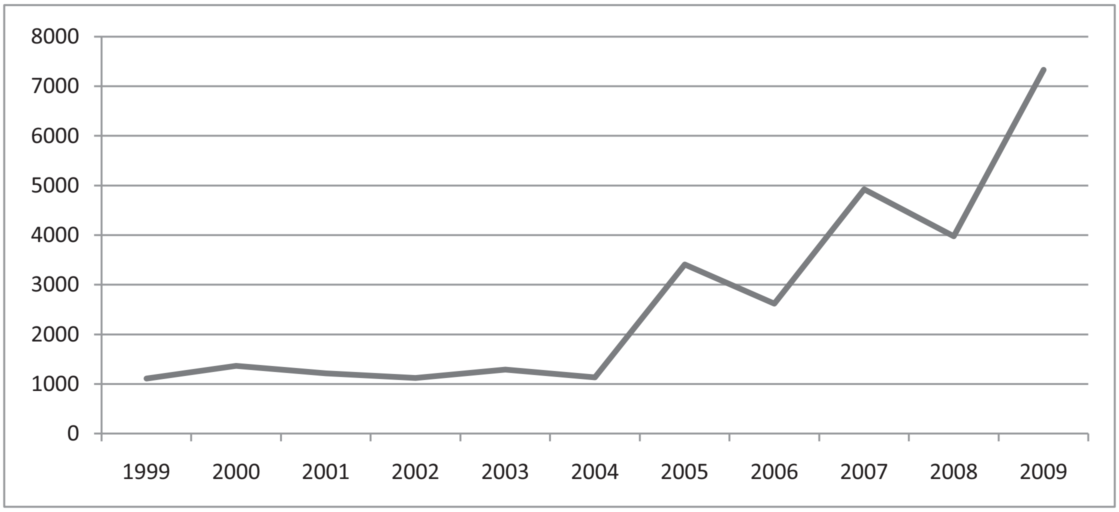
Source: ECLAC 2005 from Hydro-meteorological Service

(b) The outdated conservancy and drainage system in Guyana is unable to cope with the current discharge of water caused due to extreme rainfall events. Drainage infrastructures were designed to accommodate 38.1 mm (1.5 inches) of rainfall over a 24-hour period. In the past and in normal conditions, these structures functioned adequately; however, with increase in severe rainfall events and a slight rise in the sea level, the physical infrastructure is unable to cope with the increased water-drainage requirement, resulting in more frequent and severe flooding.

The conservancy and drainage system in place in Guyana presents severe infrastructural limitations on its ability to prevent flooding and manage flood waters. The current structural conditions of the dams of many conservancy areas are unsafe and have exhibited failures in many sections. Many of the drainage canals suffer from silting and a lack of maintenance. In most of the cases, human activities such as backfilling canals and cuts in the levies have changed the functional dynamics of the system. Many of the various outlets of the system *(kokers)* are currently dysfunctional. Since 2004, GoG has carried out extensive work on all major drainage and irrigation systems, and as a result, the government has pointed out that flooding in 2006 was significantly less severe than it might have otherwise been.

(c) Drainage and irrigation and flood-management issues increase the vulnerability of rice farmers in Guyana to floods. At present, flood control is managed on an emergency basis and focused on responding to immediate needs rather than on developing long-term control strategies. This ad-hoc system of flood control is no longer effective and there are limitations on its ability to manage water levels in the coastal plain and prevent flooding. Furthermore, in many areas the D&I system is poorly managed and/or clogged, blocking the flow of water outlet and contributing to flooding. In region 2, on the other hand, D&I system is fairly well managed, resulting in limited losses due to floods. The majority of the farmers, millers, and other stakeholders in the rice supply chain pointed to the poor management of the D&I system as a major contributor to flooding.

Figure 13: Investment in D&I Works



Source: Government of Guyana

Flooding is the biggest risk for the Guyana rice industry, and risk mitigation rather than risk transfer (e.g., insurance) might be a more effective risk-management strategy. In response to frequent flooding, the GoG has had to invest significant public resources in rehabilitating damaged agriculture infrastructure (mainly D&I). The graph above (figure 13) shows the drastic increase in D&I investments after the 2005 floods. While significant investments have been made in D&I in the past few years, a lot more is still required.

6.1.2 Scarcity of Water for Irrigation

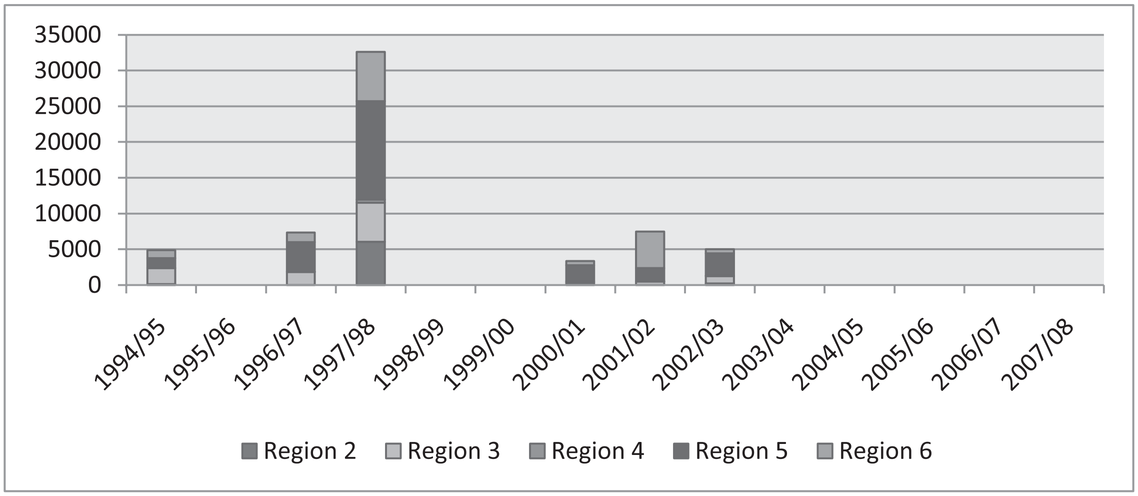
Severity: Critical
Probability: Probable

Although in most years water supply is ensured throughout the year, if a severe rainfall shortage occurs during one or both of the paddy crop seasons, the conservancies used for irrigating paddy cultivation may not be sufficiently replenished and may therefore become incapable of meeting the water demand for rice crops.

According to the information obtained from the farmers' focus groups performed for this study, lack of irrigation is cited as an important risk. Literature review by Guyana Sugar Corporation (2009) indicates that 59 percent of the farmers in region 5, and 70 percent of the farmers in Leguan Island suffered losses in the past because of lack of irrigation.

Crop production losses due to the El Niño event of 1997–1998 amounted to 33,000 metric tons of paddy. According to the farmers' opinion, the current drought, in effect since the beginning of the spring crop season 2009–2010, might have a worse impact on paddy crop yield than the drought of 1997–1998, which started in the middle of the crop season. The GoG is currently making efforts to mitigate the water shortage for irrigation by pumping water from rivers into the irrigation system. However, despite the GoG's efforts, it is estimated that 10,000 acres of paddy have already been lost in regions 2 and 3. In regions 5 and 6, despite suffering the problems associated with the dry conditions, the performance of spring paddy seems to be better than in the western regions of the country. Figure 14 shows the national paddy production losses due to irrigation water shortage[20] from 1994–1995 up to crop year 2007–2008.

Figure 14: Paddy. National and Regional Production Losses due to Water Shortages (1994/1995–2007/2008) (tons)



Source: Authors, from GRDB Annual Reports, Stabroek, EM-DAT, and Dartmouth Observatory

Severe rainfall shortages and suboptimal irrigation management are the two prime causes for this risk. Under the current irrigation-management system, it is difficult to implement irrigation-management measures needed to avoid water shortages during dry periods. During water shortages, farmers pump water from the remaining water streams in the irrigation canals. Since the government does not have mechanisms to control these activities, farmers can divert almost as much water as they want from the canals. As a result of this situation, farmers who are downstream from the irrigation canal do not have enough water to irrigate their fields.

6.1.3 Excess Rain at Harvest

Severity: Moderate
Probability: Occasional

Excess rain at harvest was identified by paddy famers as a source of risk for their production, and excess rain had two major impacts. First, sometimes excess rain results in paddy fields becoming inaccessible, thereby exposing the crop to pests such as rodents and birds and increasing the risks of lodging and grain shattering. As a result, quality decreases or, in the worst-case scenarios, paddy goes rotten. The second impact of excess water is that during rainy harvests the paddy ripens with a high moisture content, resulting, due to drying costs incurred by millers, in farmers receiving a lower price. Paddy crops that are sown late in the season are more likely to be affected by excess rain at harvest. For the current, 2009–2010 crop season, since much of the paddy was sown late, a delay in harvest is expected, raising the probability that the harvest will coincide with the onset of the rainy season and, consequently, the risk of excess rain at harvest will be high.

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20 The methodology used to calculate the rice-production losses involves the calculation of the area affected due to water scarcity. (Production losses = area impacted * expected yield at harvest.) The expected yield at harvest was determined by corresponding historic yield trend value for the year under analysis.

6.1.4 Paddy Bug

Severity: Considerable
Probability: Probable

The paddy bug, primarily *Oebalus poecilus* (Dallas) species, is a serious rice pest that causes reductions in both yield and quality. They feed on rice particles from the milk to dough stages. When they attack the grains during the former stage, the result is emptied or atrophied glumes, with concomitant yield loss. When the attack occurs during the latter stage, grains become discolored and break at milling, with a resultant decrease in both grain quality and milling yield. Financial loss due to paddy bug damage was estimated to range between 10.1 percent (first crop) and 17.7 percent (second crop), and it was found that paddy harvested at the end of the crop season had a higher percentage of bug-damaged grains (Rai, 1974).[21] In 2002, the spring paddy crop suffered the highest level of paddy bug infestation in years. Regions 5 and 6 were the most affected areas, where the bugs were responsible for some 38 percent[22] of the damage.

In the past, paddy bug outbreak affected the country on several occasions. However, in recent years, due to the improvement in pest-management practices, the losses due to this pest have been reduced. Yet, paddy bug is still an important risk (annex 4) and farmers suffer considerable looses due to it. Integrated pest management involving cultural, chemical, and biological control, and monitoring and surveillance needs to be adopted by the farmers to manage this risk.

6.1.5 Significant Rise of Red Rice Infestation

Severity: Considerable
Probability: Probable

One of the major risks to the production of rice in directly seeded areas is the incidence of red rice (*Oryza barthii* and *O. longistaminata*), which leads to considerable volume and quality losses. In 1998, light red rice infestation was found in 46 percent of the planted area, while 15 and 5 percent of the planted area showed moderate and high infestation,[23] respectively. Agronomic practitioners estimate that a 10 percent infection of red rice weeds in a field will reduce yield by 25 percent. Crop losses due to red rice incidence may be as high as 60 percent in heavy field infestation. It is difficult to assess the actual levels of loss related to quality reductions, as these are dependent on individual deliveries and prevalent market conditions.

The main sources of red rice infestation are contaminated rice seeds, the existence of red rice seeds in soil, and poor weed management. Therefore, any control measure should be aimed at the reduction of infestation from these sources. In that regard, the use of seeds free of red rice must be promoted by the government, and the implementation of weed management must be conducted by the farmers. Besides that, good agronomic practices, including better water management, will help reduce red rice infestation.

21 Rai, B. K. Losses caused by the paddy bug and "red rice" in Guyana. Lanham: FAO, 1974, pp. 82–86 (Plant Protection Bulletin, 22).
22 Source: Stabroek News; June 4, 2002.
23 http://www.fao.org/docrep/005/Y4347E/y4347e03.htm.

6.1.6 Blast Infestation

Severity: Considerable
Probability: Remote

The occurrence and severity of rice blast, caused by the fungus *Pyricularia grisea*, varies by year, location and even within fields, depending on environmental conditions and crop-management practices. Whenever the disease occurs, it causes severe yield reductions that can account for up to 75 percent of the expected yield of the crop. The disease is favored by long periods of high moisture, high humidity, little or no wind at night, and mild night temperatures. Other factors that favor the disease are the excessive use of nitrogen fertilizer, aerobic soils, and the drought stress. Owing to the high relative humidity and lack of air movement, vulnerability and severity increases in the paddy fields within 3–5 miles [5–8 km] from the tidal flat or riverbank. According to the information collected from the field, 1987–1988 and 1997–1998 were years with a high ratio of blast infestation on paddy crops, which added to the drought problems associated with El Niño.

With the introduction of blast-resistant rice varieties in 2004, the incidence of this disease is currently under control. Although the adoption of rice-blast resistance varieties keeps the disease at acceptable levels, there is a possibility that the pathogen causing blast undergoes genetic mutation. If that happens, the current blast-resistant varieties might not be effective in coping with the mutation, and new varieties will have to be developed.

6.2 Market Risks

There are multiple market risks facing the Guyana rice sector and most are interrelated in their cause and effects. Price, both for rice and inputs, delayed or nonpayment, and rising transportation costs are the dominant market risks for the rice supply chain.

6.2.1 Price Risk

Severity: Moderate
Probability: Probable

There are three distinct dimensions of price risks for the rice supply chain in Guyana: (a) substantial decline in international rice prices; (b) rise in international rice prices; and (c) uncertainty of paddy prices at harvest.

Substantial decline in international rice prices: The price that Guyanese exporters can sell rice for is determined by the international rice markets, with Caribbean export prices determined by North American rice prices and European export prices determined by Asian (Thailand and Vietnam) rice prices. Millers calculate the paddy price for the farmers by working backwards from the international market prices. Overall, the rice supply chain appears relatively efficient and the cost structure is relatively set, indicating that there is little scope for reducing the costs of production in response to a global fall in the price of rice.

Rise in international rice prices: Rise in international rice prices is generally perceived as good news for the Guyanese rice industry as farmers see the price paid for their paddy rise (e.g., in 2008 and 2009), enabling them to raise their rice-related incomes. However, significant rise in rice prices can lead to difficulties for the processing and exporting sectors due to an increase in working-capital requirements that come from rising prices. The availability of bank lending, however, is limited and a rise in rice prices may not necessarily be accompanied by an equivalent expansion in credit facilities (loan sizes). In 2008, the average price paid by millers for paddy more than doubled from the previous year; yet total loan amounts to the rice sector only rose by 6 percent between September 2007 and September 2008.[24] This shortage of working capital resulted in some farmers remaining unpaid by the millers for a number of months (until the millers received payment from buyers). This risk, however, is not of major concern since the benefits of the rising price more than compensates for the losses.

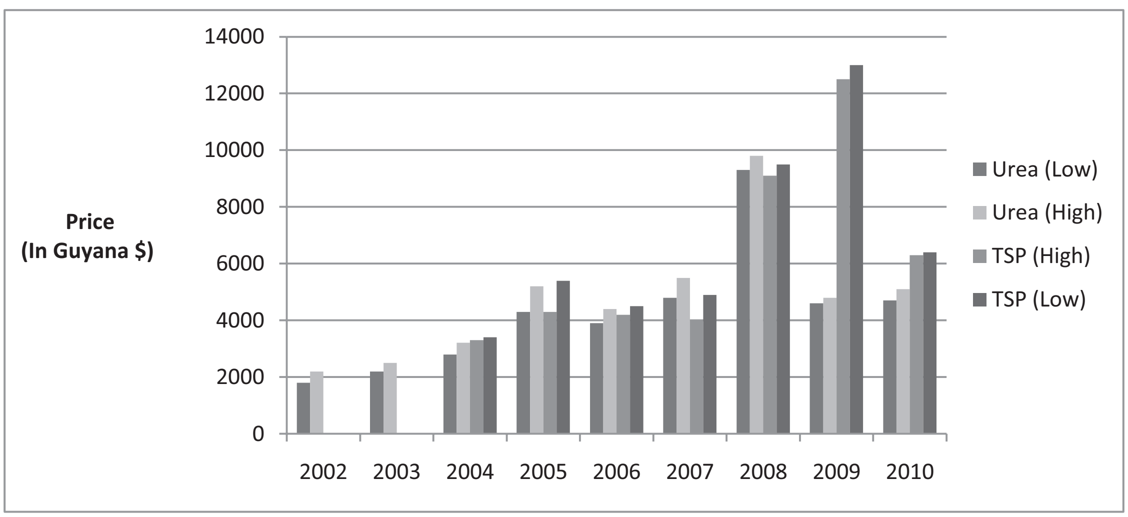
Uncertainty of paddy prices at harvest: Rice farmers incur input and labor costs at the start of and during the rice season, without any clear knowledge or awareness of what prices they will receive for their paddy at harvest time. At times, farmers even sell their paddy to the millers without a clear understanding of the prices they would receive later. This creates a risk that the farmers might, at the end, receive a lower price for their paddy that is below their cost of production. This uncertainty might act as a disincentive, and the inability to recoup their investment costs might force farmers to default on loans and/or cease the production of rice.

6.2.2 Increase in Input Prices

Severity: Moderate
Probability: Probable

A key element in rice-production costs for farmers are the input prices of chemicals (fertilizers and pesticides) and fuel (diesel for tractors and water pumps). An unexpected rise in the price of one or more inputs (figure 15) can dramatically reduce the profitability of a farmer or even generate losses, depending upon the level of the increase.

Figure 15: Fertilizer Prices (2002–2010)



Source: GRDB Annual Reports

Farmers at times respond to such increase in input prices by reducing the use of inputs, leading to reduced yields and incomes. There is little scope for farmers to mitigate against the risk of rising input prices as they purchase their inputs at specific times as and when required, and they are unlikely to have the financing or facilities for pre-ordering or pre-purchasing inputs to lock in prices. This risk is rated as probable and in recent years farmers have

24 Bank of Guyana, Statistical Abstract, December 2009—Commercial Banks Loans and Advances pp. 21 and 23.

experienced increase in input prices, including rise in the price of fertilizers (figure 15). Volatility in input prices is likely to continue; however, the impact of such volatility is generally manageable across the supply chain.

6.2.3 Delayed Payments

Severity: Considerable
Probability: Highly probable

Risk of delayed payment, as well as nonpayment in many cases, affects all the supply chain actors in different ways. Farmers are at risk from millers delaying, or even defaulting, on payment for their paddy; both types of event have occurred very recently in Guyana. During farmer workshops a number of farmers indicated that they had delivered rice to millers who had subsequently gone out of business without paying them for the rice. Many more farmers also reported delivering rice to millers and not receiving payment for up to six months (and in some exceptional cases even longer). This can create significant cash-flow problems for the farmers and may impact their ability to buy inputs for the following season.

There is a risk that exporters may delay payment to the miller until they, the exporters, receive payment from their buyers. This could lead to millers defaulting on their obligations or payment to the bank, generating additional interest on outstanding bank loans. This could also prevent them from paying farmers for their paddy on time. The impact of this risk on the industry is considerable since it generates financial losses, leads to erosion of trust between actors, and raises transaction costs across the supply chain.

Most exporters believe that their knowledge of, and relationship with, their buyers provides them with reasonable protection against the risk of buyer default. Financial instruments for managing this risk at the exporter level do exist, specifically letters of credit; however, exporters are reluctant to use such instruments due to cost and time. The Guyana Rice Development Board has recently enacted a regulation mandating millers to make full payment to the farmers within 56 days of the delivery of paddy.[25] This regulation, if enforced properly, could lead to timely payments to the farmers.

6.3 Rising Transportation Costs

Severity: Moderate
Probability: Occasional

Guyana's rice-export industry already faces significantly higher transportation rates than other rice-exporting countries due to the need to utilize more costly smaller-sized cargo boats. In addition, imported fertilizers and chemicals also have higher prices due to high transportation costs. A substantial rise in cargo costs into and out of Guyana could greatly reduce the rice sector's competitiveness.

25 The Bill, No. 35 of 2009, was approved by President Bharrat Jagdeo on December 22, 2010, after it was tabled in the National Assembly on October 15 and passed on October 22, 2009, after three readings. Millers have a period of two weeks by which to pay 50 percent of total sale to individual farmers as opposed to just 50 percent of total paddy sale. They are also granted an additional 42 days to pay the remainder, failing which they face the possibility of having their license revoked. (Source: http://agriculture.gov.gy/Bulletins/January%202010/Rice%20 Factories%20(Amendment)%20Bill%20now%20in%20force.html.)

6.4 Other Risks

"Other risks" refer to risks faced by the Guyanese rice supply chain that are not market or production based. The major risks within this section relate to regulatory risks (both domestic and international) and physical access to paddy fields for farmers.

6.4.1 Regulatory Risk

Severity: Considerable
Probability: Remote

This supply-chain assessment identified that the regulatory regime for rice in Guyana is relatively supportive of the industry, providing stability and security to supply-chain actors. However, it was noted by some supply chain actors that a recent rise in the GRDB levy (2009) was introduced with insufficient warning or consultation and might have had a negative impact on the largest millers and exporters who had been storing rice for future export to buyers. While no clear figures are available to identify the impact of the rise in levies, it was verbally reported that the rise turned profitable forward contracts with buyers into loss making forward contracts.

6.4.2 Erosion of Preferential Market Access (CARICOM)

Severity: Considerable
Probability: Remote

Guyanese rice benefits from the CARICOM tariff regime, which imposes a 25 percent tariff on extraregional rice imports. This tariff assists Guyanese rice exporters in maintaining their competitiveness in the region, especially against U.S. rice exports. There is a potential risk of the current CARICOM tariff structure for rice being reduced, thereby diminishing the protection and support currently provided to Guyanese exporters supplying rice to the Caribbean markets. Already there are concerns that exemptions are being granted to extra-regional rice imports that are being sent to Caribbean mills for polishing and further processing. A reduction in the tariff rates will expose Guyanese rice to full market competition.

6.4.3 Accessibility to Dam Roads

Severity: Moderate
Probability: Probable

Rice harvesting is undertaken using mechanical combines, which need to be able to access rice fields to harvest the rice. Guyana's rice fields are contained within a system of dams and irrigation and drainage canals, and access to fields is often via dam roads. During rainy periods the dam roads may become unusable by heavy combine vehicles and, as such, the rice fields may be inaccessible to combine harvesters. Delays in harvesting can result in rice being damaged and failing to be collected at the appropriate time, either reducing yields or leading to no harvesting at all. This risk is location specific (for farms that are reliant on dam roads), but where the risk exists, it appears to be a regular occurrence and one with a reasonably high impact upon the farmers.

7. Vulnerability to Risks

Based on the risk assessment and capacity to manage described in the previous sections, this section offers an additional step to classify the risks according to different levels of vulnerability. For the purpose of this exercise we define vulnerability as a function of the expected losses from an adverse event and the capacity to respond to this risk. This last step in the analysis of risks not only allows a more comprehensive assessment of the level of risk, but it also helps *to identify priorities to improve current risk-management approaches*. At this stage, the analysis seeks to pinpoint clear gaps in the prevailing approach(es) to risk management and/or circumstances where prevailing practices are unlikely to be sufficient, given the potential severity of loss.

Even though at this stage the analysis is more qualitative than quantitative, the results shown here are useful for contrasting these findings with current risk-management practices by stakeholders in the supply chain. Based on the information that was collected during the mission and background information, the effectiveness and current capacity for managing pertinent risks has been reviewed and rated utilizing the 1–5 scale outlined in table 7 below.

Table 7: Vulnerability to risky events based on expected loss + capacity to manage risk

	(–) -------------- Capacity to Manage Risks -------------- (+)				
Expected losses	1	2 T1	3 T2	4	5
High	Flood risk : 1. due to inadequate drainage infrastructure, 2. due to excessive rainfall and 3. due to water management issues			Erosion of preferential market access T3 Regulatory risk Blast	T4 T5
Medium T1	Weed, pest and disease : 1) red rice and 2) paddy borer	Scarcity of water for irrigation	Delayed payment	Price risk Increase in input prices	Risk of increase in transportation cost
Low	T2	T3	T4	Accessibility to dam roads T5	

Source: Authors

The resulting matrix classifies vulnerabilities to the identified risks into three groups, from the highest vulnerability (with the risks shown in the darkest boxes in the upper-left corner marked as T1, or tier 1) to the lowest (with risks shown in the boxes with the clear shades toward the right-bottom side of the table marked as T5, or tier 5). There are in between three additional intermediate vulnerability levels that are in lighter shade. The importance of this matrix is that, through a process of prioritization, it is possible to identify those risks in tiers 1 and 2 that are mainly responsible for causing volatility of earnings for the various stakeholders. Managing these risks will, to a large extent, reduce vulnerability of the rice industry.

8. Priority Measures for Risk Management

Though it is beyond the scope of this risk-assessment exercise to come up with a comprehensive framework with detailed measures on how to manage the identified risks, *an illustration on how this next step can be approached* is presented in table 8. For illustration purpose, this table only deals with the major risks grouped under tiers 1 and 2 in the previous section.

For a comprehensive risk-management framework it is useful to classify the measures or tools for risk management in terms of three main groups:

Risk Mitigation. Actions taken to eliminate or reduce events from occurring, or reduce the severity of losses (e.g., water-draining infrastructure, crop diversification, extension, etc.).

Risk Transfer. Actions that will transfer the risk to a willing third party, at a cost. Financial transfer mechanisms will trigger compensation or reduce the losses in the case of a risk-generated loss (e.g., insurance, reinsurance, financial hedging tools, etc.).

Risk Coping. Actions that will help cope with the losses caused by a risk event (e.g., government assistance to farmers, debt re-structuring, etc.). It could also be managed by shifting a country's focus from a post-disaster response to a proactive (ex-ante) risk management (e.g., through financial provisioning).

Table 8: Illustration of measures for a risk-management framework

Identified Risks	Proposed Risk Mitigation	Proposed Risk Transfer Tools	Proposed Risk Coping
Flood risk			
1. Due to inadequate drainage infrastructure	Invest in new infrastructure Improve conservancy capacity Upgrade existing infrastructure Repair existing infrastructure Invest in drainage equipments (e.g., dredging equipments and pumps)		
2. Due to excessive rainfall	Early warning system Improved metrological infrastructure Investment in weather forecasting and dissemination mechanism Flood-hazard mapping Flood-resistant rice varieties	Crop/weather insurance (if feasible)	Better national coordination mechanism for flood management Flood-management protocol

Identified Risks	Proposed Risk Mitigation	Proposed Risk Transfer Tools	Proposed Risk Coping
3. Due to water-management issues	Capacity building Performance management Improved user (farmer) involvement in management Improve water-managements systems and processes Improved drainage-maintenance strategy Improve water-use efficiency Public-awareness program for clean-drainage system		
Weed, pest, and disease			
(1) Red rice	Better farm-management practices Improved and increased farm-extension services Improved and increased access to quality seed (improving seed-quality and seed-commercialization standards) Better water management Effective mapping and targeting of infected regions and farmers		Better farm-management practices Improved and increased farm-extension services Better water management
(2) Paddy bug	Paddy bug–resistant seed variety Better farm-management practices Improved and increased farm-extension services Effective usage of chemicals and pesticides		Better farm-management practices Improved and increased farm-extension services Effective usage of chemicals and pesticides
Scarcity of water for irrigation	Capacity building Improved user (farmer) involvement in management Improved water-management systems and processes Improved water-use efficiency Investment in irrigation equipment (e.g., pumps, etc.)	Crop/weather insurance (if feasible)	

Table 8 above is merely an illustrative, and not an exhaustive, set of activities that could be undertaken for managing the risks in the rice supply chain. Risk-transfer solutions, owing to the nature of the risk and specific structures in the Guyana rice supply chain, might have limited applicability. Risk mitigation and coping solutions, on the other hand, might provide better return on investments. Some solutions, especially those pertaining to managing flood risks, will not only reduce volatility in rice production but will also have a larger impact on flood prevention for the entire country. In-depth evaluation of the individual solutions was beyond the scope of this exercise; however, exhaustive listing of activities and an assessment of costs and benefits of different options to manage these risks needs to be undertaken by GRDB and MoA. Annex 1 provides a snapshot of the cost-benefit ratio of flood risk mitigation measures in Guyana undertaken by McKinsey in 2008.

9. Final Remarks

The rice supply chain in Guyana has, to date, proven itself to be quite resilient, having successfully survived several shocks over the past 50–100 years. The supply chain is relatively well functioning and efficient, having retained its competitive position, despite challenging local and global conditions. The industry stakeholders have so far been successful in managing most of the risks confronted.

While the industry faces multiple market and regulatory risks, production risks are primarily responsible for causing variability in rice production and have a negative impact on the long-term competitiveness of the industry. Sustained competitiveness will require effective management of production risks, leading to reduced volatility in production and export volumes. Good management practices are often also good risk-management practices and consist of mitigation-transfer-coping with the risks.

Guyana is the "land of many rivers" and while the abundance of water has provided rich fertile ground for rice and sugarcane cultivation, excess water is one of the biggest risks that farmers confront on a regular basis. Floods in Guyana stem from three interrelated factors: excessive rainfall, inadequate drainage infrastructure, and sub-optimal water management. Given this situation, a risk-transfer solution (e.g., insurance) might have limited applicability. Instead, effective flood-mitigation strategies focusing on further physical improvement and better management of D&I system, and better national and local-level coordination mechanisms might yield richer dividends, not only for the rice supply chain, but also for the entire country.

Weed, pest, and disease—namely, paddy bug and red rice—cause significant losses to farmers and have a negative impact on the quality of rice milled and exported. Every year, the rice supply chain loses a sizeable amount of volume and value due to this, which could be averted by further investment in weed, pest, and disease control. The Guyana Rice Development Board is doing commendable work in farm extension and has been able to reduce the losses due to weed, pest, and disease; yet more needs to be done.

This document highlights and prioritizes risks in the Guyana rice supply chain and could be used to stimulate discussion and inform the planning of a rice supply chain risk-management strategy. The GoG has already taken various initiatives to mitigate many of the risks described in the document. Many of the existing initiatives needs to be continued and strengthened, and many new activities added for a comprehensive management of the risks in the rice supply chain. This report provides an indicative list of potential solutions to address the dominant risks in the rice supply chain; however, the assessment or evaluation of the individual solutions was beyond the scope of this exercise. To ensure the greatest return on future public investments in implementing risk-management solutions, GRDB and MoA need to undertake an exhaustive cost-benefit assessment of different options. This will enable MoA to indentify and implement the necessary activities to reduce the vulnerability of the rice supply chain in Guyana.

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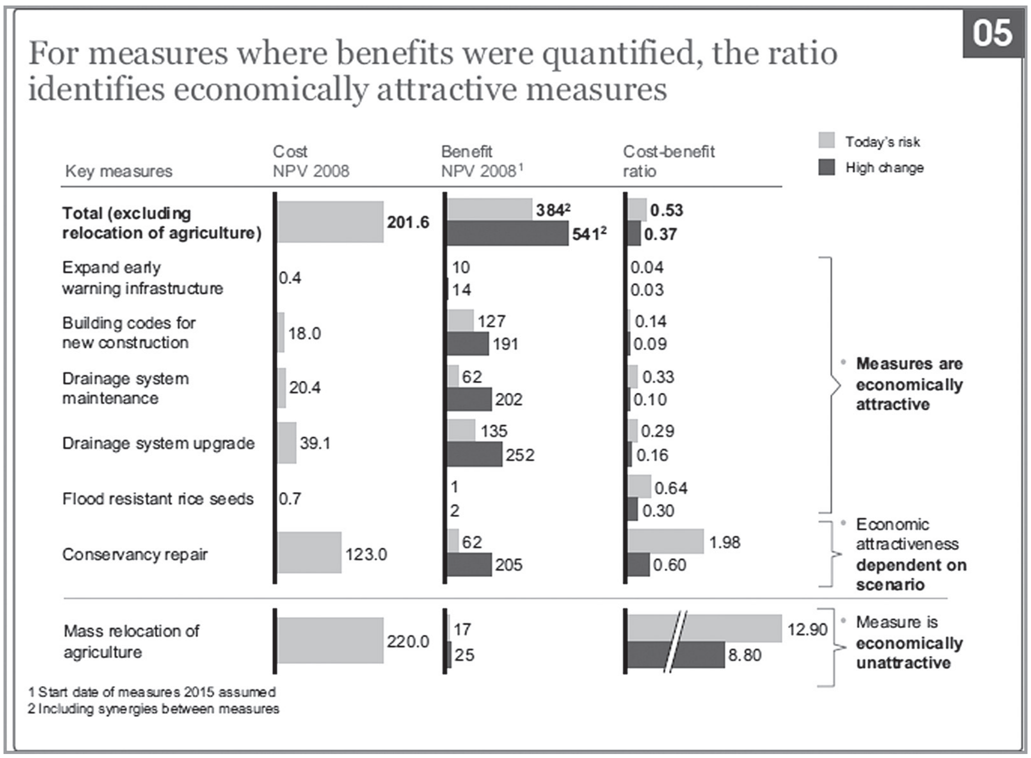
Annex 1. Cost-Benefit Ratio of Flood-Risk–Mitigation Measures in Guyana

The McKinsey report on shaping climate-resilient development (2009) analyzed measures to address the current and future flood risks around Georgetown and the immediate surrounding parts of the Demerara coast. Figure 16 below presents some of the key mitigation measures and their economic attractiveness in terms of cost-benefit ratio. Conservancy repair, flood-resistant rice seeds, drainage-system upgrade, and drainage-system maintenance yield highest cost-benefit ratio.

Figure 16: Cost-Benefit Ratio of Flood-Risk–Mitigation Measures in Guyana



Source: Shaping Climate-Resilient Development: A Framework for Decision Making (2009), Economics of Climate Adaptation Working Group, p. 99

Annex 2. Paddy: Annual Sown Area, Production, and Average Yields at Regional Level

Figure 1: A. Region 5: Spring Crop Season. Historic Sown and Harvested Area and Production (And main events affecting crops)

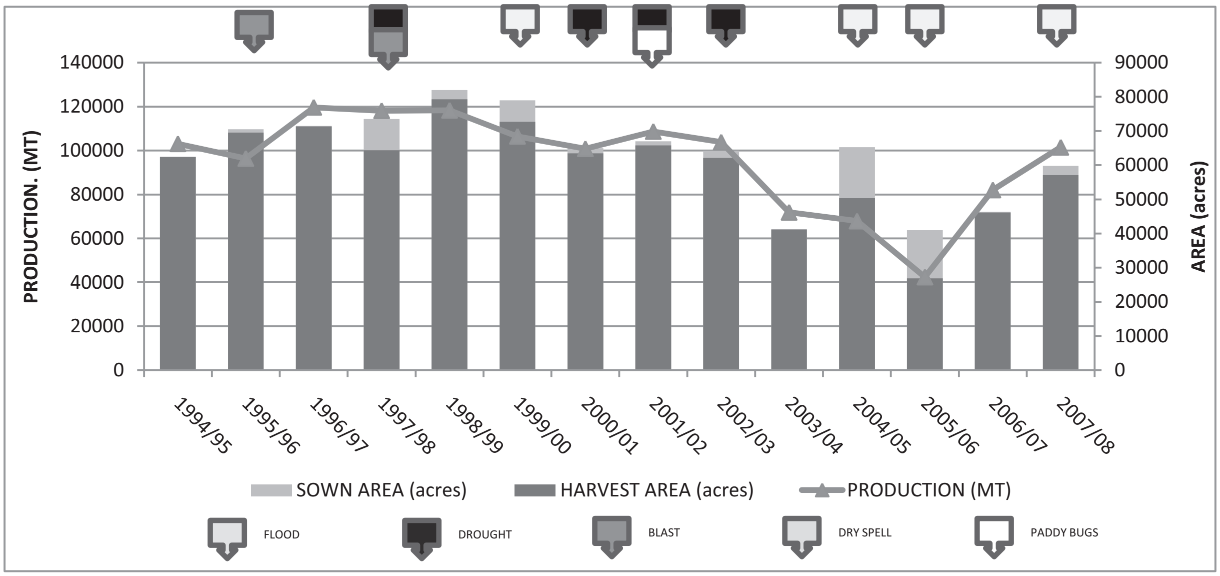


Figure 1: B. Region 5. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

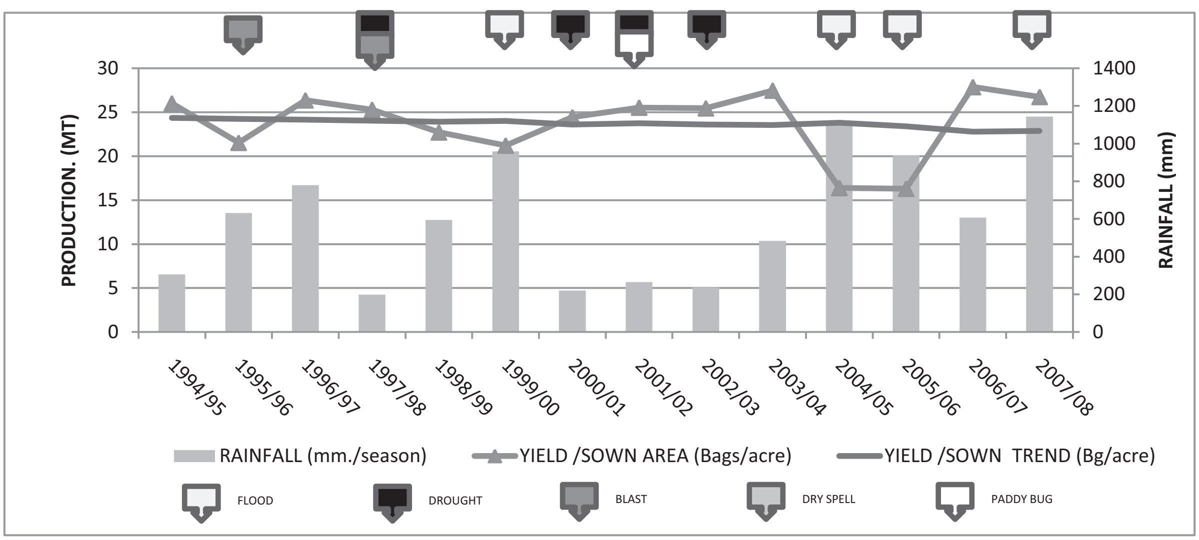


Figure 1: C. Region 5: Autumn Crop Season. Historic Sown and Harvested Area and Production (And main events affecting crops)

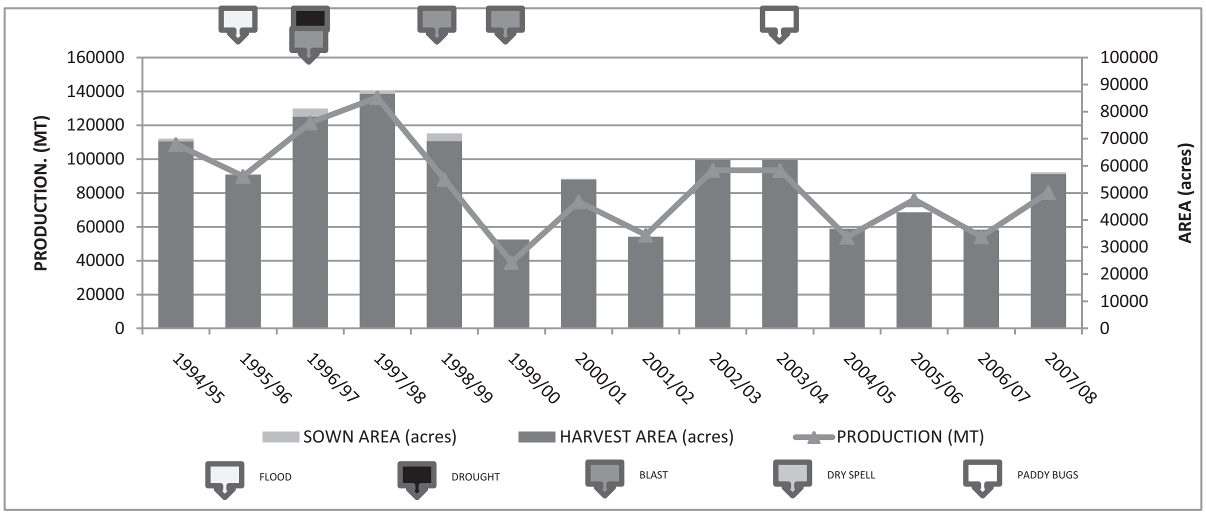


Figure 1: D. Region 5: Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

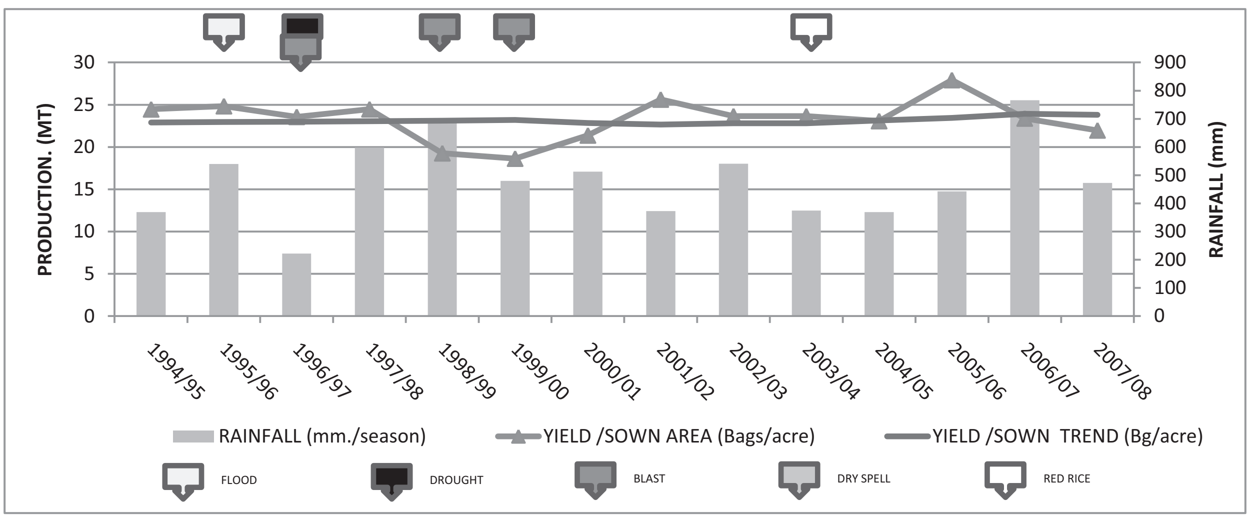


Figure 2: A. Region 6: Spring Crop Season. Historic Sown and Harvested Area and Production (And main events affecting crops)

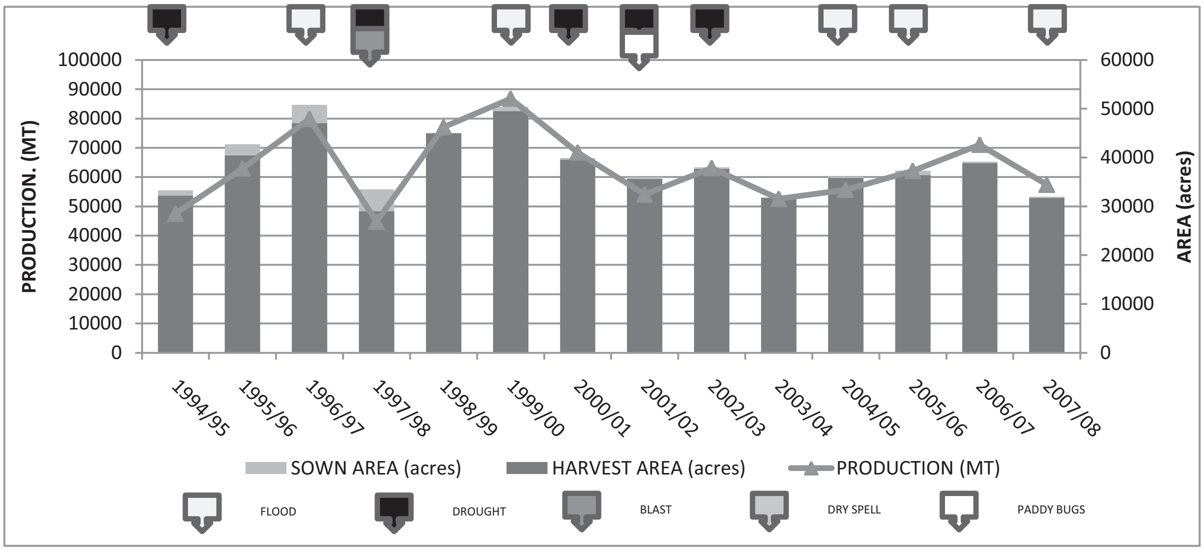


Figure 2: B. Region 6: Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

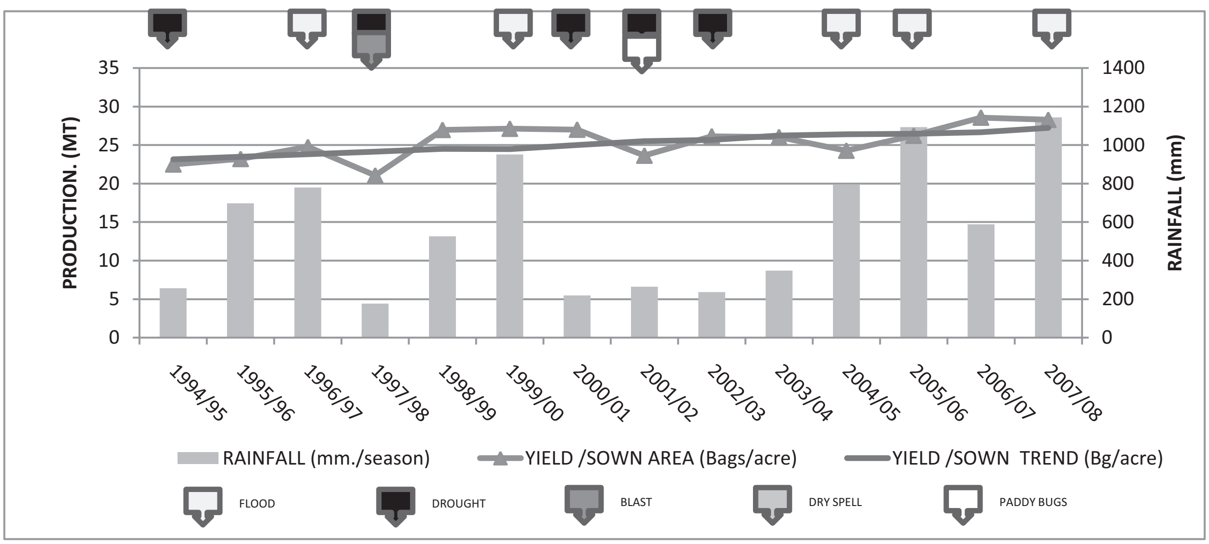


Figure 2: C. Region 6: Autumn Crop Season. Historic Sown and Harvested Area and Production (and main events affecting crops)

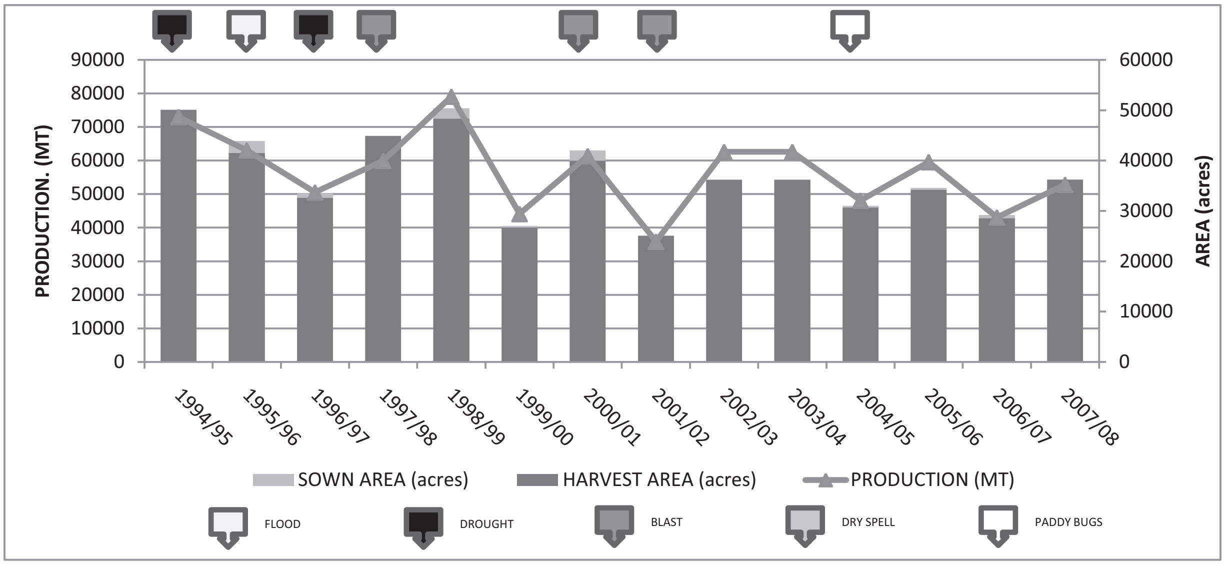
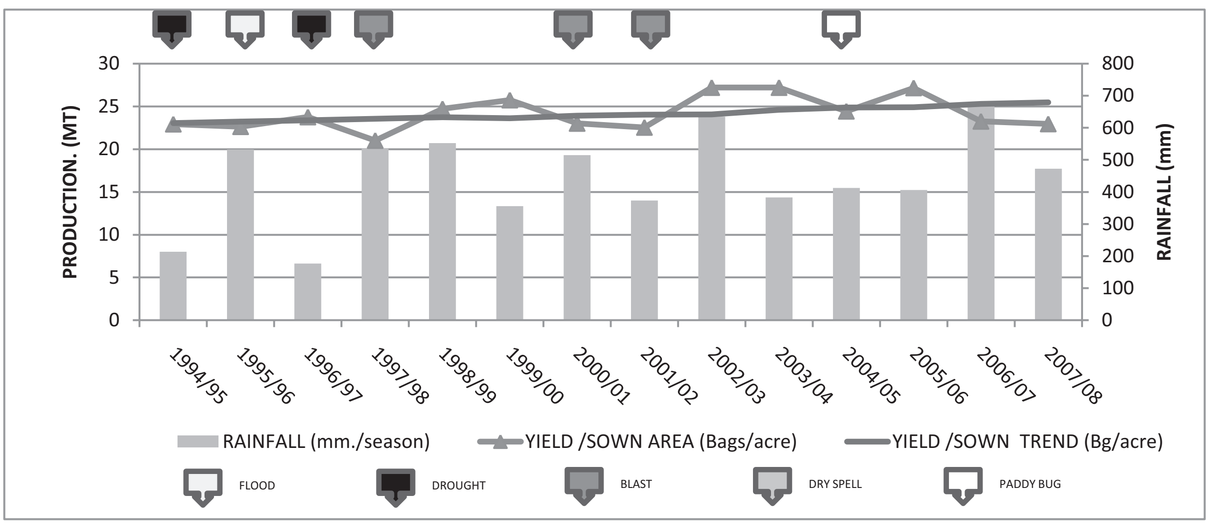


Figure 2: D. Region 6: Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall



Annex 3. Rice Supply Chain Risk Assessment Agenda (March 2–11, 2010)

Date	Meetings	Category
March 2 (Tue.) Georgetown	Logistics meeting with Eva and Steve (MoA boardroom)	Govt.
	Guyana Rice Development Board	Govt.
	Rice Producer Association (RPA)	NGO
	RiceLab (Mr. Boucher)	Quality certification company
	Guyana Stockfeed (Mr. Badal)	Miller and exporter
	General Equipment (Mr. Vandyke)	Farm equipment distributor
March 3 (Wed.) Georgetown	Insurance companies stakeholder workshop	Insurance companies
	Meeting with agriculture minister	Govt.
	National Drainage and Irrigation Authority (Mr. Wordsworth)	Govt.
	Scotia Bank (Ms. St. Aubyn, country mngr.)	Bank
	Demerara Bank (Mr. Dave, CEO)	Bank
	Small Business Development Finance Trust, Inc. (Ms. Brijmohan, MD)	Microfinance institution
	IPED	Microfinance institution
March 4 (Thur.) Georgetown	Sea Rice (Mr. Ali, operations mngr.)	Rice exporter
	Caribbean Chemicals (Mr. Pires, MD)	Fertilizer and chemicals importer and distributor
	John Fernandes (marketing director)	Logistics company and miller
	Saj Rice Company	Miller
	Demerara Shipping Company Limited (Mr. Murray, operations manager)	Logistics company
March 5 (Fri.) West Demerara (Region 3)	Focus group discussion with rice famers	Farmers
	Field visit to rice farmers	Farmers
	Abdool Hakh & Sons (Mr. Hakh, MD)	Miller
March 6 (Sat.) Essequibo (Region 2)	Meeting with farmers	
	CARICOM Rice Mill	Miller and exporter
	Imam Bacchus & Sons (Sam, CEO)	Miller
	Farm visit	Farmer
	Golden Fleece (Mr. Hakh, Director)	Miller
	Vincent Persaud (Bounty Hall—small rice miller and medium-sized farmer)	Miller and farmer
March 7 (Sun.)	Mission meeting	

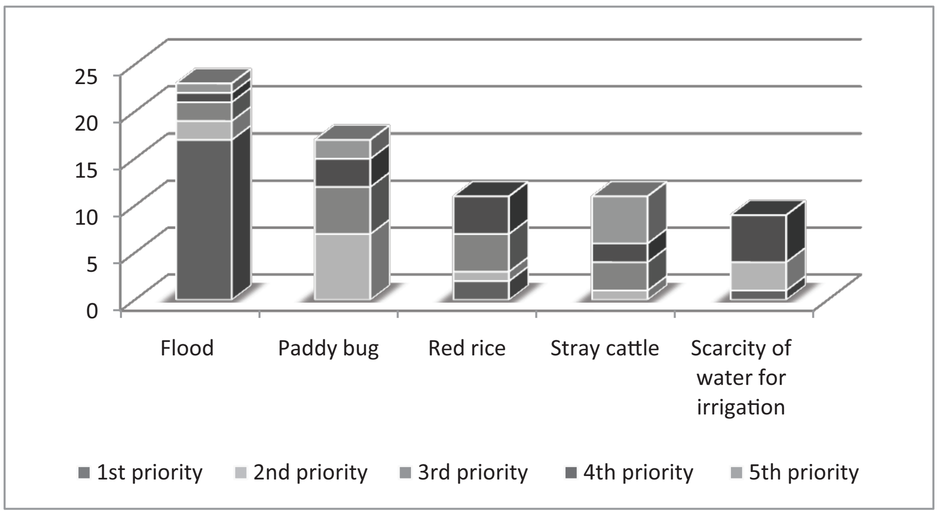
Date	Meetings	Category
March 8 (Mon.) Frontlands (Region 6)	Focus group discussions with rice farmers	
	Nand Parsand	Miller
	Field visit to rice farms	
	Meeting with GRDB regional coordinator	
March 9 (Tue.) West Berbice (Region 5)	Visit to Burma Rice Research station	Govt.
	Focus group discussions with rice farmers	Farmer
	Mr. and Mrs. Singh	Fertilizer importer, distributor, and retailer
	Mahicony Rice Mill	Miller and exporter
March 10 (Wed.) Georgetown	GRDB (Ricky) and RPA (Ricky)	GRDB and RPA
	Bank of Guyana (Mr. Ganga, Deputy Governor)	Central Bank
	Presentation preparation	
March 11 (Thur.) Georgetown	Wrap-up workshop	
	Meeting with finance minister	

Annex 4. Farmer's Risk Perception and Prioritization

The figure below presents the findings of a ranking exercise that the team conducted during the focus group discussions in region 5. This exercise is by no means academically rigorous or authoritatively conclusive on the risks faced by the farmers. It is, however, a good illustration of the farmers' perceptions and ranking of their risks. Twenty-three farmers participated in this exercise identifying and ranking their risks in their perceived order of adverse impact. Flood risk, paddy bug, weed (red rice), stray cattle, and scarcity of water for irrigation were perceived as the greatest risks by the participants.

Top 5 Risks Identified by Farmers: Region 5

Number of farmers (sample size n = 22)



The risk profile and farmers' exposure to risk vary by region, and similar exercises conducted in regions 3 and 6 affirmed this fact. The figure below depicts the risk ranking by farmers in regions 3 and 6. Weed (red rice), flood, delayed payment, paddy bug, and scarcity of water for irrigation were perceived by farmers as their biggest risks.

Top 5 Risks Identified by Farmers in Regions 3 and 6

Number of farmers (sample size n = 12)