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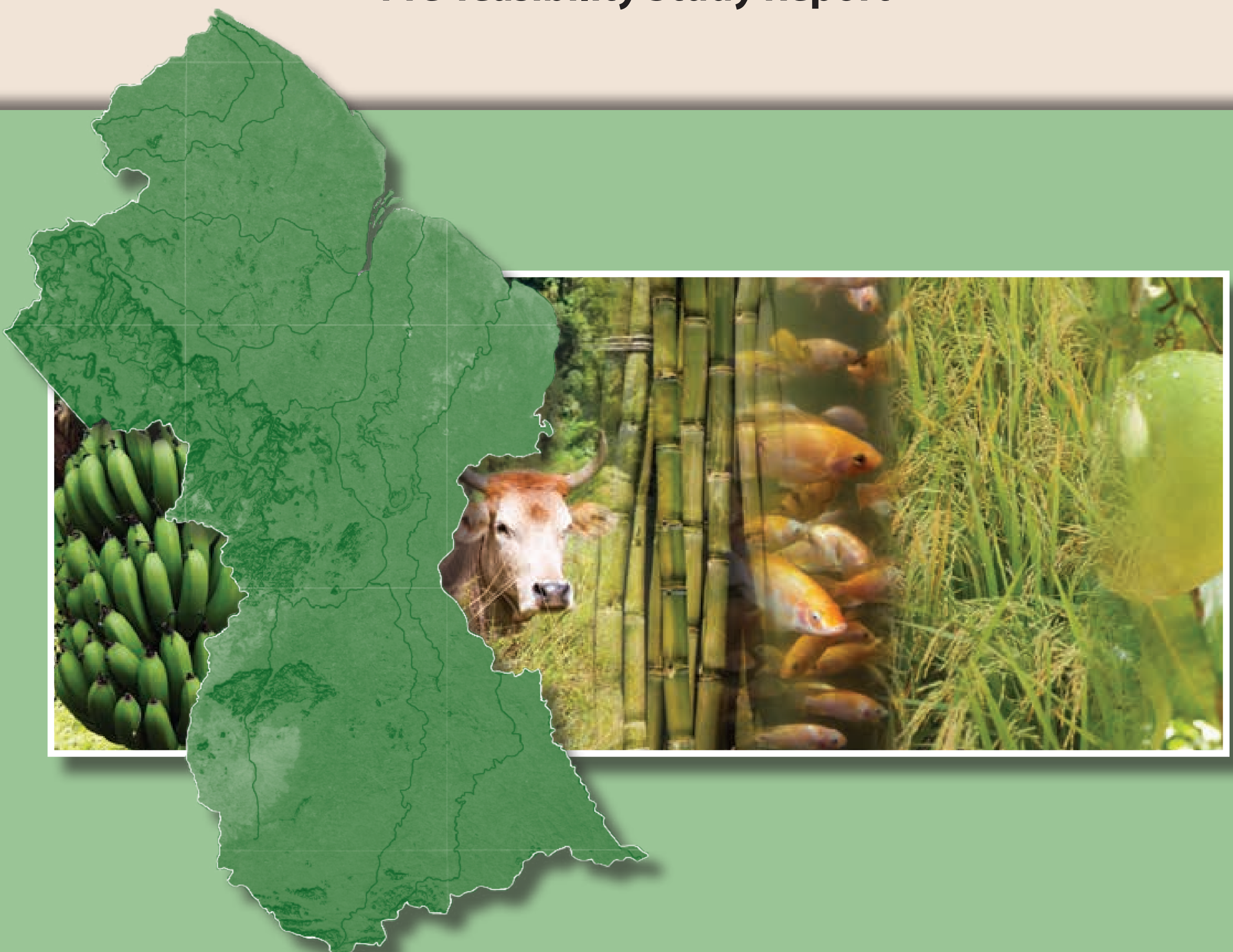
Guyana

Agricultural Insurance Component
Pre-feasibility Study Report



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May 2010

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Acknowledgements

This report was authored by a team led by Diego Arias (Senior Economist, LACR, World Bank). The team comprised multidisciplinary specialists. These included Ramiro Iturrioz (Senior Agricultural Insurance Specialist, Insurance for the Poor Program, GCMNB, World Bank); Charles Stutley (FAO Consultant); and Pablo Valdivia Zelaya (Consultant). The authors would like to specially thank Ms. Evangelia Bachtsetzi, Ministry of Agriculture of Guyana, for her professionalism and extraordinary work in supporting this study.

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Abbreviations

ADP	Agricultural Export Diversification Program, Guyana
ASSP	Agriculture Support Services Program
CAP	Climate Adaptation Plan
CARICOM	Caribbean Region Community of Countries
CRAM	Crop Risk Assessment Model
CWII	Crop Weather Index Insurance
CoV	Coefficient of Variation
DoF	Department of Fisheries
DoL	Department of Livestock
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FMD	Foot and Mouth Disease
GAPA	Guyana Agricultural Producers Association
GCMNB	Global Capital Markets Non Banking Institutions Division
GDP	Gross Domestic Product
GMC	Guyana Marketing Corporation
GoG	Government of Guyana
GRDB	Guyana Rice Development Board
GRPA	Guyana Rice Producer Association
GuySuCo	Guyana Sugar Corporation
HYDROMET	Hydrometeorological Service
IADB	Inter-American Development Bank
IICA	Inter-American Institute for Cooperation on Agriculture
IPED	Institute of Private Enterprise Development
IU	Insured Unit
LACR	Latin American and Caribbean Region
MFI	Microfinance Institutions
MoA	Ministry of Agriculture
MoF	Ministry of Finance
MPCI	Multiple-peril Crop Insurance
NAAG	National Aquaculture Association of Guyana
NBS	National Bureau of Statistics
NDIA	National Drainage and Irrigation Authority
NDVI	Normalized Difference Vegetative Index
NGO	Non Governmental Organization
OCI	Office of the Commission of Insurance
OIE	Office Internationale des Epizooties
PML	Probable Maximum Loss
PPP	Private-Public Partnership
READ	Rural Enterprise and Agricultural Development Project
SHG	Self-help Group
TSI	Total Sum Insured
TSU	Technical Support Unit
VAR	Value at Risk

Executive Summary

Context

1. **Guyana is a small, low-income, sparsely-populated country.** It is the only English-speaking country in South America and has a multi-ethnic and multi-religious population of about 751,000 inhabitants (2002 Census). The country is divided into ten administrative regions. Four of these regions have urban centers, namely Regions 2, 4, 6 and 10. The combined population of these regions' towns and the capital city, Georgetown, was estimated at 213,705 or 28.4% of the total population in 2002. The remaining 71.6% corresponds to rural population clustered in villages mainly along the coastal belt, while a few others are scattered deep in the hinterland of the country. The total GDP in 2008 was US$953.6 million and per capita GDP was US$1,234.

2. **Agriculture is the most important sector of Guyana's economy.** It accounts for around 30% of the GDP, 50% of total employment and 30% of export earnings. Sugar and rice are the most important crops in terms of area, value of production, employment creation and contribution to export earnings. Other agricultural activities, including livestock, have been increasing in importance as sugar and rice markets have become more difficult to access. This sector also comprises grain crops, oil seeds, root and tuber crops, vegetables/"greens", spices and seasonings, and a wide variety of fruits and livestock.

3. **The Government of Guyana (GoG), within its National Development Strategy 2001 to 2010 and its National Competitiveness Strategy of 2006, is committed to increasing the rate of growth of agricultural output and, specifically, to diversify Guyana's agricultural exports.** The strategy includes measures to enhance efficiency and competitiveness within the sector, emphasizing the upgrading of infrastructural facilities, development of market intelligence and research and development capabilities, as well as training and education. Sugar and rice remain the centre of policy attention and each industry has laid out its own policy measures/instruments to address the challenges of the increased competition arising from declining privileged access to the EU market. For the non-traditional sub-sector, better agronomic practices, water management, farming systems, market information and entry facilitation, post-harvest technology and agro-processing, and the establishment of rural development centres and cooperatives, are stressed.

4. **Guyana is not exposed to tropical cyclones, but much of the agricultural area is very vulnerable to excess rain and flooding, and the country also experiences periodic *El Niño* related droughts.** Guyana lies to the south of the North Atlantic and Caribbean Tropical Cyclone belt; therefore, agriculture is not exposed to tropical storms and hurricanes. Much of Guyana's agriculture is located in the coastal plain, a narrow strip of land that lies below sea level and which has a complex drainage and irrigation system. Major flood damage was suffered by farmers and livestock owners in 2005, and again in 2006, 2008 and 2009. Approximately every 10 years Guyana experiences severe *El Niño* related irrigated water shortages/droughts; agriculture was affected by the 1997/98 *El Niño* and again in 2009/2010.

5. **The Climate Adaptation Plan (CAP), which is currently under preparation by the GoG, contemplates aggressive actions to be taken during the forthcoming years in order to improve agricultural risk management in the country**[1]. The CAP includes several main planned actions:

i. Upgrading the infrastructure and assets for flood protection including but not restricted to: (i) maintaining and upgrading the drainage and irrigation systems; (ii) funding the construction and rehabilitation of sluices, "kokers", revetments and embankments; (iii) impoldering, dredging and de-silting major rivers and creeks; (iv) installing additional water pumping stations; and (v) upgrading water conservancies;
ii. implementation of hinterland climate adaptation measures including the reproduction and distribution of plant varieties and training on crop management techniques that are suitable for the rural communities;

1 Guyana's Low Carbon Development Strategy: "Transforming Guyana's Economy while combating the Climate Change", Office of the President, Republic of Guyana, May, 2010.

iii. revamping of early warning systems;
iv. development of flood resistant varieties of crops and the introduction of new technology that allows for cultivation of crops during prolonged flood conditions; and
v. last, but not least, one of the main actions planned under the CAP is the development of **innovative financial risk management and insurance measures.**

These initiatives will include the introduction of financial instruments that will aim to introduce incentives to avoid and reduce possible sources of risk ex-ante while aiming to transfer risks that are outside the control of individuals and firms to third parties, which will compensate the insured in the event of an extreme loss. This agricultural insurance pre-feasibility study report has been prepared by the World Bank specifically to address the GoG's priority to develop suitable agricultural insurance solutions for Guyana. **In 2009 the GoG formally requested the World Bank to provide technical assistance in the area of agricultural insurance.** A workshop on agricultural insurance and credit challenges for Guyana was held in December 2009 in Georgetown, sponsored by the World Bank. In addition to this workshop, the World Bank agreed with the GoG to conduct an agricultural insurance pre-feasibility study for the following sectors: (i) rice, (ii) fruit and vegetables, (iii) cattle and (iv) aquaculture. The World Bank also agreed to conduct a supply chain risk assessment for the Guyanese rice sector.

6. **The objective of the Agricultural Insurance Pre-feasibility Study is to identify the institutional, operational, technical and financial challenges for the development of agricultural risk transfer solutions/insurance for rice, fruit and vegetables, livestock, and the aquaculture sector in Guyana.** The specific objectives of the study include: (i) to identify the production systems, constraints and risks faced by farmers in Guyana; (ii) to assess the institutional, operational and financial capacity in Guyana to manage an agricultural insurance scheme for the selected activities; (iii) to evaluate the availability of information and collect technical data and information needed for the development of an agricultural insurance scheme for the selected activities; (iv) to assess the potential interest of the possible stakeholders that might get involved in the development of an agricultural insurance scheme in Guyana.

7. **This report draws heavily on international experience.** International experience on agricultural insurance is vast, as it is currently being implemented in more than 100 countries around the world. This study benefits from this experience, which has been tailored to the local economic and social context of Guyana.

Challenges for the Development of Agricultural Insurance in Guyana

8. **Guyana faces a series of key institutional, technical, financial and operational challenges**, (a) in developing crop and livestock insurance products and services that are suited to the needs of the country's small and marginal farmers, and (b) in scaling-up the demand for and supply of crop and livestock insurance.

Institutional Challenges

9. **No agricultural insurance provision.** To date, no commercial insurance company in Guyana has underwritten any crop or livestock insurance policy. On several occasions in the past, the commercial insurance market in Guyana has been requested to provide crop insurance – e.g. by the rice sector following the 2005 floods. To this day, however, no company has marketed any form of farmer, crop, livestock or aquaculture insurance in Guyana.

10. **Farmers have limited awareness of agricultural insurance.** In the absence of any agricultural insurance provision in Guyana, most farmers have no experience, knowledge or awareness of crop or livestock insurance and the potential benefits and constraints of such products. In the absence of a functioning agricultural insurance market, it is difficult to objectively quantify farmers' potential demand for these hypothetical insurance products. Significant efforts in agricultural insurance promotion and training of farmers should be performed if and when any agricultural insurance product is implemented in Guyana.

11. **There is currently no clear national policy framework for agricultural insurance in Guyana.** The insurance industry in Guyana has no experience

in agricultural insurance. The general perception among the interviewed insurance companies is that agricultural insurance is a risky business. However, under certain preconditions including: (i) the existence of an accurate risk assessment for the agricultural sector, (ii) the existence of a training program for their underwriters on agricultural insurance, and (iii) full reinsurance protection, they may consider entering into the agricultural insurance business on a pilot basis.

12. **There is a need to design an appropriate Private-Public Partnership (PPP) to promote agricultural insurance in Guyana.** Private commercial insurers do not have the resources to invest in agricultural insurance by themselves and they will need assistance from the government, as well as other public and private institutions to establish a suitable insurance infrastructure. Therefore, one major challenge is to define an appropriate agricultural insurance strategy relying on strong private-public partnerships which would include both the private commercial insurers and the banks/MFIs, plus other rural service organizations.

13. **Need for amendments to the insurance regulatory framework.** The Office of the Commission of Insurance (OCI) will need to decide whether the introduction of agricultural insurance will require any changes to the existing insurance legislation and whether or not index-based agricultural insurance is specifically authorized in Guyana. The Commissioner of Insurance has suggested that the introduction of agricultural insurance may require changes in the existing insurance law or, at least, the authorization of agriculture as a new class of approved non-life business. Conversely, the insurance industry believes there is no need to amend the insurance law or to create a new line of business in order to offer agricultural insurance. Instead, insurers propose to place agricultural insurance under the general fire-risk and all-risk property policies that are currently in place in the market. Additionally, the OCI needs to consider the case of index-based products as insurance products.

14. **Reassessment of the role of post-disaster compensation payments.** If agricultural insurance cover is to be introduced in Guyana in the future, it will be necessary for the GoG to reconsider its strategy of providing ex-post financial disaster compensation (e.g. in the form of fertilizer vouchers) to any group of farmers for the following reasons: (i) if insurance and disaster relief payments are made to farmers, this would amount to a double indemnity; and (ii) international experience shows that where free public sector disaster relief is provided, it acts as a major disincentive for farmers to purchase crop insurance. One option may be, for example, to replace the ad-hoc disaster compensation payments made by the government to the rice sector with an ex-ante macro-level rice (government) insurance program (discussed further below).

Technical Challenges

15. **Data and information are critical to the design and rating of any crop and livestock insurance program.** In the case of rice, Guyana has the high-quality time-series crop production and yield data needed to design traditional indemnity-based crop insurance products and area-yield index products. However, the crop production and yield data time-series for fruit and vegetable production, as well as livestock mortality statistics, do not seem to be available for Guyana; thus, it is not possible to perform any risk assessment exercise and/or to design any agricultural insurance product for these agricultural activities. Quality time-series of meteorological weather data is a basic input needed to design weather index products. However, out of the 147 weather stations in Guyana, it appears that very few would comply with the data quality requirements to design weather index insurance products.

16. **Complexities for designing agricultural insurance products in Guyana.** Agricultural production in Guyana relies heavily on drainage and irrigation; thus, its performance is affected both by weather and man-made factors. Insurance is a financial tool that covers unpredictable and unforeseen losses. While the agricultural losses produced by weather factors are considered unpredictable and unforeseen, the agricultural losses produced by inadequate drainage and irrigation infrastructure or by water mismanagement are considered predictable, so any foreseen losses from the latest are not covered by insurance. This situation would lead to adverse selection problems against the insurance company portfolio. Managing the aforementioned problem is a very difficult task which requires an exhaustive and

expensive follow-up work from insurance companies. The implementation of an agricultural insurance program in Guyana would need to take into account this potential problem in order to build the capacity in the insurance industry and generate the information needed to manage adverse selection.

17. **Lack of exposure to international agricultural insurance practice.** Private insurance companies in Guyana have had no exposure to international practice in agricultural insurance. They lack knowledge and awareness in the design, rating and implementation of agricultural insurance. The GoG could usefully support the provision of specialized technical assistance from international sources to assist the Guyanese Insurance Association and the OCI to design, rate and prepare policy wordings for these new agricultural insurance products.

Financial Challenges

18. **Farmers' low capacity to afford agricultural insurance.** An initial survey for demand of area-yield crop insurance was conducted within the farmer focus group meetings performed during the mission. The results show that, assuming no government intervention, between 10% and 20% of the interviewed rice farmers may be interested in purchasing crop insurance coverage of 80% of the actual production history at zone level, at a maximum premium cost of no more than 4% to 6% of the sum insured. In due course it will, however, be necessary to follow-up these small-rice-farmer panel meetings with a formal farm-level survey which should address farmers' demand for crop insurance and their ability to pay premiums for different coverage and premium rate levels.

19. **Private commercial insurance companies in Guyana have limited financial capacity** and seem to be, in general, reluctant to invest in agricultural insurance, which is considered to be a high-risk class of insurance. Commercial insurers are also concerned about the access to international agricultural reinsurance capacity to reinsure these types of risks.

Operational Challenges

20. **Private commercial insurers do not have rural branch networks to underwrite agricultural producers' crop and livestock insurance policies.** The lack of insurance companies rural branch networks leads to high transaction costs in delivering agricultural insurance, in particular, for small and marginal farmers. Conversely, farmers associations, banks/MFIs, input providers and rice millers are currently working directly with crop and livestock producers and there is a well-established rural finance network through which insurance products and services could also be distributed and administered at a lower cost.

21. **Supply chain issues are a major obstacle for the development of insurance products for fruit and vegetable production, and livestock.** There is an absence of formal market mechanisms for these agricultural activities in Guyana. The ADP and the GMC are currently trying to develop such mechanisms; however, until the supply chain issues have been addressed, the demand for insurance for these agricultural sectors appears to be very low.

22. **Poor agricultural extension services.** With the exceptions of the rice and aquaculture sectors, the other agriculture sectors are not receiving appropriate rural extension services. One precondition for agricultural and livestock insurance is the existence of best practice crop/livestock management and husbandry practices. Unless these preconditions are met, the development of agricultural insurance is not possible.

Options for Consideration

23. **No one size fits all.** Any agricultural insurance programs in Guyana are likely to be location specific and will need to reflect the local risk exposures, taking into account infrastructural constraints and the presence of local service organizations. The agricultural insurance products analyzed under this pre-feasibility study and the conclusions about their suitability for Guyana are shown in Table 1.

Crop Insurance Options for the Rice Sector

24. **Individual grower Multiple-peril Crop Insurance (MPCI) is not suitable for rice farmers in Guyana and similarly the opportunities are very limited for developing individual farmer crop weather index insurance for rice producers.** On the basis of this pre-feasibility study, individual grower

Table 1. Agricultural Insurance Products and Potential Suitability for Guyana

Type of Agricultural Insurance Product	Basis of Insurance and Indemnity	Suitability for Guyana in Start-up Phase?
a) Traditional Individual Farmer Crop Insurance		
1. Named-peril (e.g. fire, excess rain)	Percentage damaged	Not suitable in the short term
2. Multiple-peril Crop Insurance (MPCI)	Loss of yield	Not suitable
3. Crop Revenue Insurance	Loss of yield/sale price	Not suitable
b) New Index-based Agricultural/Livestock Insurance		
4. Area-yield Index	Area-yield loss	Possibly for the rice sector
5. Crop Weather Index Insurance	Weather index payout scale	Not suitable
6. NDVI (Normalized Difference Vegetative Index) Insurance	NDVI index payout scale	Not suitable
7. Livestock Mortality Index Insurance	Livestock mortality index	Not suitable
c) Traditional Livestock Indemnity Insurance		
8. Mortality Cover for individual animals	Animal accident and mortality	Not suitable in the short term
9. Livestock All-risk Mortality Cover	All-risk mortality/loss of use	Not suitable
10. Livestock Business Interruption Cover	Epidemic diseases in livestock	Not suitable
11. Bloodstock Cover for high-value animals	All-risk mortality/loss of use	Not suitable
d) Aquaculture Insurance		
12. Named-peril Cover	Loss of fish-stock	Possibly for fish and shrimps
13. All-risk Cover	Loss of fish-stock	Not suitable

Source: Authors.

MPCI cannot be recommended for Guyana in the start-up phase of any new crop insurance initiative: individual grower yield data is not available and the insurance companies do not have the technical expertise to operate this product. It also appears that the possibilities of developing suitable crop weather -index insurance products for growers of irrigated rice are very limited in the short term: while flood is a major issue for rice growers, currently the lack of suitable river flow flood recording equipment means that such a product could not easily be designed for Guyana.

25. **Area-yield index insurance for rice is technically feasible in Guyana, but basis risk is likely to be a serious drawback for an individual farmer micro-level insurance program operating at a zonal level and further research is required before such a cover can be recommended for implementation.** The GRDB is adopting a statistically designed and comprehensive system for seasonal rice-yield measurement which, with minor improvements, would meet international reinsurers' requirements for operating an area-yield index insurance program for rice. However, the preliminary analysis of individual farmer's paddy yields indicates that the variations in individual farmer's yields within each GRDB risk zone are often very high and that the element of basis risk due to this high yield variation may pose a serious problem to the successful operation of an area-yield index insurance program.

26. **Area-yield index insurance for rice could also be underwritten in Guyana as a meso-level product designed to protect the season loan portfolio of agencies that are lending to rice producers (banks or MFIs).** By protecting the loan portfolios of the financial institutions against climatic-peril induced losses, it is hoped that formal bank lending will increase in the form of seasonal crop loans to rice farmers. There would be two advantages

in offering area-yield index insurance at a meso-level (as an aggregate product) rather than a micro-level individual farmer product: (i) the basis risk would be much less of a concern than under an individual grower program, and (ii) the transaction costs involved in this coverage would be considerably lower than for an **individual farmer micro-level insurance program.** This option is reviewed further in Chapter 4.

27. **A third option for area-yield index insurance for rice could also be underwritten in Guyana as a macro-level product designed to protect a governmental contingency fund to assist rice farmers affected by catastrophic events.** Under this option, the GoG would purchase an area-yield index insurance policy that provides payouts to the government in case that the actual production for paddy in any of the paddy production zones defined as "insured units" falls short of the guaranteed yield established in the policy. **It is recommended that this insurance policy is designed to provide a basic catastrophe coverage** (i.e. to provide coverage for relatively low-frequency but high-severity events) to all the farmers registered with the GRDB[2] in the different paddy production zones along the country. This type of insurance instrument has three main advantages. The first one is that the GoG would get the funds to assist the affected farmers relatively quickly in the event that the actual average paddy yield in a certain zone falls short of the guaranteed yield: the GoG would receive the insurance payouts as soon as the determination of the actual yield for the affected zone is done after the crop season. The second advantage for the GoG is that the cost of a contingency fund backed by an aggregate area-yield index insurance policy would be financed through an annual premium which could be easily included in the annual budget. The third advantage is that the basic coverage provided by the GoG could easily be complemented by whoever is interested in purchasing additional cover in the insurance market. Preliminary estimates indicate that the premium that the GoG would have to pay to obtain catastrophe coverage for 278,000 acres of rice at a coverage level equal to 50% of the historic average yield for the spring and autumn seasons would be about G$205 million (US$1 million) per year. This macro-level insurance cover could be used to substitute the current ex-post disaster relief payments made by the government to rice farmers.

28. **It is recommended that before any decision is taken on whether to proceed with the design and implementation of an area-yield index insurance program for rice, the local stakeholders should first conduct a more detailed analysis of yield variability and basis risk in the GRDB defined zones.** This follow-up study should be conducted on a sample as large as possible of historical GRDB and Rice Lab individual farmer rice yields and for as many years as possible, focusing on: (i) quantifying the degree of basis risk, especially in major flood or drought prone areas and years; and (ii) examining whether it is feasible to reduce basis risk by redefining the current GRDB zones and by scaling down to a smaller geographical area unit.

29. **Farmers' demand for and willingness to pay for crop insurance for rice will also have to be studied further** before any decisions are made to proceed with the design of an area-yield index insurance program. The pre-feasibility study has identified a low level of voluntary demand for rice crop insurance by the admittedly small sample of farmers in the focus groups that were organized for this study. Prior to investing further time and effort in the design of area-yield index insurance, it is recommended that a formal crop insurance demand assessment study be implemented by the interested parties.

30. **A phased approach is recommended for the development and implementation of area-yield index insurance for rice in Guyana.** The first phase should consist of the development of the macro-level product in order to protect a governmental contingency fund to assist rice farmers affected by catastrophic events. The second phase should be to develop, if possible, a "top up" micro-level area-yield index insurance for individual farmers. The advantage of this phased approach is that it will give the GoG the time to address the problems of basis risk identified for the implementation of micro-level individual farmer area-yield index insurance, while ensuring in the meantime that a basic level of catastrophe protection for rice growers, provided by the government, is in place.

2 The fact that the GRDB maintains a comprehensive register of every rice grower in each zone would facilitate the operation of this macro-level catastrophe insurance cover and ensure that, in the event of a loss being triggered in a specific zone, all rice farmers located in that zone would be beneficiaries of the payouts.

Insurance Options for Aquaculture

31. **In principle, it should be relatively easy to introduce aquaculture insurance into Guyana, but initially this is likely to be available only on a case by case (facultative basis) through specialized international aquaculture reinsurance underwriters.** Aquaculture is currently a small but commercially organized sector which has major potential for expansion in Guyana. Aquaculture producers are very interested in purchasing named natural peril protection (especially floods) against loss of fish-stock and fish ponds and equipment. There is a well-defined international reinsurance market for aquaculture and this market may be willing to analyze aquaculture insurance proposals from commercial aquaculture companies in Guyana and to offer restricted cover against natural perils including flood; however, as a precondition for their support, they will require full pre-inspection and risk surveys of the fish farms to be carried out by designated international aquaculture risk surveyors and to appoint their own loss adjusters. These two factors will add significantly to the costs of aquaculture insurance in the start-up phase.

Insurance Options for Livestock (Cattle)

32. **The possibility of developing livestock (cattle) accident and mortality insurance in Guyana is very limited in the short term.** There are several reasons for this conclusion. First, most small-scale livestock production in Guyana is performed for subsistence purposes and is not suited for livestock mortality insurance. During the mission, very few cattle producers identified livestock mortality insurance as a priority; rather they identified a need to overcome their constraints including: (i) lack of access to credit to invest in livestock production; (ii) lack of grazing land and high costs of purchased animal feeds; (iii) low output prices for beef and milk; and (iv) in some regions, severe theft problems. Second, most of the livestock production systems in Guyana are free-grazing (roadside and savannah); livestock insurers would not accept the risk under these conditions. Third, individual animal registration and tagging are preconditions for livestock insurance; in Guyana there is currently no such system. Fourth, the country lacks a formal livestock mortality reporting system and database; thus, it is not possible to perform any rating exercise for livestock insurance purposes. Last, but not least, the livestock veterinary services are stretched and there are very limited animal disease pathology/laboratory services in Guyana.

33. **Opportunities for developing Remote Sensing NDVI pasture/grazing indexes for livestock owners are currently very limited in Guyana** for a number of reasons. NDVI indexes are most applicable in territories with large-scale homogeneous pasture and grazing areas such as the ones found in Canada and the US and parts of Spain, and where changes in grazing quality due to drought stress can readily be indexed using remote sensing technology. Conversely in Regions 2 to 6 of Guyana, grazing land is very fragmented and interspersed with irrigated annual cropping, and variations in soil type and salinity, etc. may complicate any attempts to develop a NDVI pasture index. Furthermore, until the livestock industry in Guyana moves onto a commercial footing with improved grazing and pasture management there is little role for a NDVI index cover.

34. **The ADP intends to overcome many of these constraints** by the introduction of improved cattle breeding stock, investment in the development of improved livestock husbandry and veterinary services, including a national animal pathology laboratory, and investment in a new abattoir that meets international export stands. **Once these improvements are in place, and a commercial beef production and export industry has been established, there may be demand from cattle farmers for some form of livestock mortality insurance cover.**

Crop Insurance Options for Fruit and Vegetables

35. **There is little opportunity for the development of named-peril crop insurance for fruit and vegetable crops in the short term.** The main reason for the impossibility of developing named-peril crop insurance is the lack of any detailed vegetable production and yield statistics and gross margin data, as well as the lack of recorded damage data in the country, needed to design and rate suitable crop insurance cover for these crops. The second reason is the absence of formal market mechanisms and major price risk exposure for fruit and vegetable producers in Guyana; until these supply chain issues have been addressed, farmers' demand for fruit and vegetable

crop insurance appears to be very low. Since 2009, the GMC has started the creation of a national database of fruit and vegetable growers and it is expected that in the near future a more reliable market information system for fruit and vegetable production will be in place. Furthermore, it is considered that the role of crop insurance will remain very limited until the ADP project is able to develop a constant supply of high-quality fruit and vegetables for export from local farmers and guaranteed export markets have been established. At that stage, it may be appropriate to consider the design and implementation of named-peril fruit and vegetable insurance programs.

Other Considerations

36. **The role of the private commercial insurance sector may be limited in the short term.** In the short term, the Guyanese private commercial insurance sector appears to lack the underwriting capability and rural infrastructure to implement and administer agricultural insurance without support from the government and other rural service institutions.

37. **The role of the government appears to be essential for the development of agricultural insurance in Guyana.** The GoG may play different roles in enabling agricultural insurance. The GoG may promote the appropriate policy and regulatory framework for agricultural insurance. It may also finance the start-up cost of a coinsurance pool for agricultural insurance. Other options for the GoG include: (i) the generation of data needed for agricultural insurance purposes; (ii) the support of insurance literacy training and education for farmers; and (iii) specialized crop insurance training for local insurers. The GoG can also act as a reinsurer of last resort providing financial capacity for the catastrophic levels. None of these roles are exclusive of one another.

38. **The fiscal impact of any public support to agricultural insurance should be carefully analyzed.** Should the GoG want to provide direct premium subsidies to the farmers/herders, the fiscal cost of such a program should be carefully reviewed. Preliminary analysis shows that a 50% premium subsidy program on an area-yield crop insurance scheme for rice, with an 80% coverage level and a 10% uptake rate in the initial years, might cost about G$33.4 million (US$167,000) per year. If over time the program proves to be successful and demand for insurance increases, the potential costs for the government of premium subsidies could rise to G$334.3 million (US$1.67 million) per year assuming a 100% uptake. Insurance premiums subsidies should be targeted to small and marginal farmers and/or specific crops/livestock as part of a social program. Targeted premium subsidies may help farmers of small and marginal farms to access agricultural insurance. Such a public crop insurance premium subsidy program should be carefully devised (with a clear exit strategy) to provide the adequate financial incentives, and its costs should be carefully analyzed to avoid unsustainable public expenditures. An alternative option to providing direct premium subsidies to agricultural insurance premiums is for the GoG to assume the insurance cost of purchasing a catastrophe insurance to be provided to farmers on a universal basis (this option has been successfully implemented in Mexico and Argentina). Under such an option, the GoG would provide basic coverage for low-frequency but high-severity events affecting rice production; the rice farmers would have the option to complement the catastrophe basic coverage provided by the government by purchasing upgrades in the private insurance market. Preliminary analysis shows that the fiscal cost to provide government financed catastrophe coverage to rice farmers through a macro-level area-yield index crop insurance with 50% coverage level and on a universal basis (to all rice farmers), might cost the GoG about G$205 million (US$1 million) per year.

39. **There is a need for technical assistance in the design and implementation of agricultural insurance products.** Technical assistance would be required to enable insurers to develop an agricultural risk assessment methodology; develop a rate-making methodology; develop crop and livestock products; develop loss-adjustment procedures; train underwriters and sales agents; train field advisers and loss adjusters; and to educate farmers and livestock producers on the role and functions and benefits of risk transfer/insurance. **The GoG could consider the creation of an Agricultural Insurance Technical Support Unit which would assist local public and private stakeholders involved in agricultural insurance** on: (i) data and information collection and management; (ii) insurance demand assessment; (iii) product design

and rating; (iv) design of operating systems and procedures, most notably underwriting and claims control and loss assessment procedures; (v) training for insurance companies, MFIs, farmer organizations and farmer groups; and (vi) awareness campaigns. The Technical Unit would create direct links to provide technical support to those insurer(s) or their partners, such as MFIs or banks, committed to the development of agricultural insurance. The Technical Unit would be staffed by two or three agricultural insurance specialists and report to a steering committee of public and private stakeholders. The Technical Unit would act as the focal point for external technical assistance programs.

40. **The findings and recommendations of this agricultural insurance pre-feasibility study report with respect to rice risk management and insurance options for Guyana, should be read in conjunction with the separate Rice Supply Chain Risk Assessment Study Report** which was conducted at the same time by a World Bank team.

Chapter 1. Introduction and Objectives of the Study

Importance of Agriculture in Guyana

1.1. **Guyana is a small, low-income country belonging to the Caribbean Region Community of Countries (CARICOM), which is located on the Atlantic Coast of South America.** The country is sparsely populated with a total population of about 751,000 inhabitants (2002 Census), but has a relatively large land area of about 215,000 km^2. The country is divided into 10 administrative regions. Approximately 72% of the population lives in the Coastal Regions 2, 3, 4, 5 and 6. Total GDP in 2008 was US$954 million with a per capita GDP of US$1,234[3].

1.2. **Agriculture is the most important economic sector in Guyana accounting for approximately 50% of employment, 30% of GDP and about 40% of export earnings[4].** Most agricultural production is concentrated in Regions 2 to 6 of the coastal plain, a low lying fertile strip of land between 5 and 7 km wide which is up to 1.5 meters below sea level and which is bisected by several major rivers that drain into the Atlantic Ocean. The coastal plain is protected by a sea wall and an integrated drainage and irrigation system which was constructed by the Dutch in the 19th Century.

1.3. **Traditionally agricultural production in Guyana has been dominated by 2 major export crops, sugar cane and rice** which occupy the bulk of the 400,000 acres of irrigated land in Regions 2, 3, 4, 5 and 6. Irrigated sugar cane production occupies about 130,000 acres of land: it is mainly grown on large estates which deliver to nine sugar cane factories all of which are operated by GuySuCo, the national sugar corporation. This crop accounts for 41% of agricultural GDP, directly employing over 25,000 people or 10% of Guyana's labour force. About 75% of Guyana's sugar is exported to the European Union (EU) often at prices more than double the world market prices[5]. Irrigated rice is cultivated in about 200,000 acres; it is mainly a small-holder crop and of the 8,000 rice farmers in the country about 60% cultivate less than 10 acres of rice[6]. Rice is grown under irrigation in two main seasons: the spring harvest (1st crop) and the autumn harvest (2nd crop). The rice sector in Guyana is centrally coordinated by the Guyana Rice Development Board (GRDB) and is a major source of export earnings. Together, sugar and rice account for 74% of agricultural GDP and 65% of total agricultural exports.

1.4. **The GoG is committed to increasing the production and export of non-traditional sectors including fruit and vegetables, livestock and aquaculture.** Non-traditional crops include fruit and vegetables which are grown on a small scale for domestic consumption and export; over 80 different fruit and vegetables are currently produced by farmers and are increasingly being exported to other CARICOM countries. The livestock sector in Guyana contributed about 2% of 2008 GDP[7]. Cattle rearing is an additional source of employment and income for farmers in Regions 4, 5 and 6, but is mainly practiced on a semi-subsistence scale with very low domestic sales of milk and/or beef. Guyana currently does not have slaughter facilities that meet international standards and therefore its exports of livestock products are very restricted. There is high internal demand for both poultry and fish protein in Guyana and the poultry industry is organized on commercial lines. Finally, there is some limited aquaculture production mainly of shrimp and tilapia.

1.5. **Guyana enjoys a fairly stable climate.** The country enjoys an equatorial climate with rainfall distributed throughout the year, but with a drier winter period. Guyanese agriculture is not exposed to catastrophic tropical cyclone windstorm damage. However, much of the coastal agricultural regions are very susceptible to flooding in the rainy season and, in addition, there is a marked *El Niño* drought exposure in the country. Crop pests and diseases are also a problem in rice and vegetable production.

3 FAO (2009), Guyana Rural Sector Review (Draft).

4 Ibid (2009).

5 IADB (undated), Guyana Agricultural Export Diversification Program (GY-L1007) Loan Proposal.

6 Data provided by GRDB, 2010.

7 GoG, Budget 2009, Appendix 2.

Government Policy for Agricultural Development

1.6. **Agricultural production in Guyana enjoys comparative and competitive advantages over neighboring countries.** The comparative advantage arises due to the availability of land, water and low labour costs relative to its CARICOM neighbors. In particular, for non-traditional commodities (including a wide range of fruit and vegetables, livestock, and aquaculture), the fact that the country is free of fruit fly and foot and mouth disease is a strong comparative advantage. In the past, Guyana has enjoyed preferential quotas for both sugar and rice with the European Union (EU); in the case of sugar, the EU has paid for it more than double the world market price. However, these preferential prices are due to be phased out by 2010.

1.7. **The Government of Guyana (GoG), within its National Development Strategy 2001 to 2010 and its National Competitiveness Strategy of 2006, is committed to increasing the growth rate of agricultural output and specifically to diversify Guyana's agricultural exports.** This strategy is supported by the implementation of three main programs: (i) the Agricultural Export Diversification Program (ADP); (ii) the Agriculture Support Services Programme (ASSP); and (iii) the Rural Enterprise and Agricultural Development Project (READ).

1.8. **The Agricultural Export Diversification Program (ADP)** adopts a cluster approach to export development of non-traditional commodities including fruit and vegetables, livestock products and aquaculture. The program is supported by a loan of US$22 million from the Inter-American Development Bank (IADB). The ADP is comprised of four components: (i) promotion of Private Sector Entrepreneurship (PSE) for fruit and vegetables, livestock and aquaculture; (ii) improving the capabilities of Agribusiness Export and Facilitation Services (AES); (iii) strengthening and consolidation of Agricultural Health and Food Safety Services (AHFSS); and (iv) Drainage and Irrigation Rehabilitation (DIR). The key outputs of the ADP include: (i) exports under contract farming increased from US$216,000 to US$5.6 million; (ii) meat exports increased from US$60,000 to US$7.2 million; (iii) aquaculture exports increased to US$6.5 million; (iv) private investment on the selected commodities increased to US$19 million; and (v) foreign investors engaged in joint ventures with local farmers.

1.9. **The Agriculture Support Services Programme (ASSP) aims to raise rural incomes by increasing the efficiency of agricultural production in the coastal plain of Guyana.** This requires improving competitiveness in the sector through the timely availability of irrigation and improved drainage. More specifically, the Program will rehabilitate Drainage and Irrigation (D&I) structures, organize farmers to manage the Operation and Maintenance (O&M) of rehabilitated D&I structures and support rice research and agricultural diversification The program is supported by a loan of US$22.5 million from the Inter-American Development Bank (IADB) and US$2.5 million from the GoG.

1.10. **The Rural Enterprise and Agricultural Development Project (READ) aims to increase the productivity of the non-traditional agricultural activities on which small farmers are engaged and to enable them to participate in the synergistic benefits of integrating production, processing and marketing of their produce.** More specifically, the project will contribute to increase market opportunities available to small-scale rural producers; increase the capacity of rural producers to efficiently and effectively produce and market non-traditional products and develop small-scale enterprises; strengthen rural services available to small-scale producers; increase access by small-scale rural producers to financial and other capital services; and build human and social capacity at the community level to facilitate increased self-reliance in addressing challenges to sustainable development. The READ has a budget of US$6.9 million, which is financed mainly by IFAD – 83% of total project costs, the GoG – 12% of total project costs, and the beneficiaries – 5% of total project costs.

Government Objectives for Agricultural Insurance

1.11. **The GoG is keen to introduce agricultural insurance for rice and for the non-traditional commodities targeted under the ADP** including fruit and vegetables, cattle (livestock) and aquaculture. In 2009 with the assistance of IICA, a Canadian consultant conducted a preliminary assessment for the introduction of agricultural insurance into Guyana.

1.12. **In December 2009 the GoG also formally requested the World Bank to provide technical assistance in this area.** A workshop on agricultural insurance and credit challenges for Guyana was held in December 2009 in Georgetown, sponsored by the World Bank. In addition to this workshop, the World Bank agreed with the GoG to conduct an agricultural insurance pre-feasibility study for the following sectors: (i) rice, (ii) fruit and vegetables, (iii) cattle, and (iv) aquaculture. Also, the World Bank agreed to conduct a supply chain risk assessment for the Guyanese rice sector.

Scope and Objectives of the Pre-feasibility Study

1.13. **The objective of the Agricultural Insurance Pre-feasibility Study is to identify the institutional, operational, technical, and financial challenges for the development of an agricultural risk transfer solutions/insurance for rice, fruit and vegetables, livestock and aquaculture sectors in Guyana.** The specific objectives of the study include:

i. to identify the production systems, constraints and risks faced by the farmers in Guyana;
ii. to assess the institutional, operational and financial capacity in Guyana to manage an agricultural insurance scheme for the selected activities;
iii. to evaluate the availability of information and collect technical data and information needed for the development of an agricultural insurance scheme for the selected activities;
iv. to assess the potential interest of the possible stakeholders that might get involved in the development of an agricultural insurance scheme in Guyana (i.e. farmers, insurance companies, banks and MFIs, etc.).

1.14. A World Bank mission visited Guyana between March 1 and 12, 2010 to undertake the agricultural insurance pre-feasibility study and the rice supply chain risk assessment. During the mission, meetings were held with the Ministries of Agriculture (MoA) and Finance (MoF), the National Bureau of Statistics (NBS), the National Drainage and Irrigation Authority (NDIA), the Guyana Hydrometeorological Agency (HYDROMET), the Insurance Commission, private commercial insurance companies, the commercial and national banking sector and MFIs, the GRDB and the Guyanese Rice Producers Association (GRPA). In addition, field visits were conducted in Regions 2, 3, 5 and 6 to meet representatives of the rice industry and attend farmer panel meetings with groups of rice farmers, fruit and vegetable producers, livestock owners, and aquaculture producers. The World Bank is very grateful to these organizations for their cooperation and assistance during the elaboration of the agricultural insurance pre-feasibility study.

Report Outline

1.15. **The remainder of this report is set out in four sections.** Chapter 2 presents an overview of agricultural production systems and markets in Guyana followed by an assessment of the climatic hazards and other risks affecting the rice, fruit and vegetables, livestock, and aquaculture sectors in the coastal regions. Chapter 3 reviews the agricultural insurance opportunities and challenges for each of the selected crop, livestock and aquaculture sectors drawing, where appropriate, on both traditional indemnity-based insurance products and the new range of index solutions. Chapter 4 deals with some of the key institutional planning considerations which will need to be taken into consideration if agricultural insurance is to be introduced for the first time in Guyana, including the role of the private insurance companies, the commercial and rural banks and MFIs and farmer institutions, and finally the role that the GoG might play in supporting the introduction of agricultural insurance under a Private-Public Partnership. The final Chapter presents the conclusions of the pre-feasibility study and briefly considers the next steps to be taken by the GoG.

1.16. **The findings of the Rice Supply Chain Risk Assessment are presented in a separate report** which should be read in conjunction with this crop insurance pre-feasibility study report.

Chapter 2. Agricultural Risk Assessment in Guyana

2.1. **To date, in Guyana there has been no formal risk assessment for crop insurance purposes** of the key climatic, biological and natural perils and their impact on crop production, yields and farm incomes. Furthermore, there has been no assessment of causes of losses in livestock and aquaculture with the purpose of insuring these classes. This Chapter starts with a review of Guyana's climate and the climatic and natural risk exposures which affect agriculture, followed by a review of the main agricultural crop, livestock and aquaculture production systems in Guyana. This is followed by a separate risk assessment for the four selected agricultural sectors: rice, fruit and vegetables, livestock and aquaculture.

2.2. **Risk assessment is highly dependent on the availability of historical time-series data and statistics** and, while there is a good database for rice production in Guyana which has enabled a rigorous risk analysis to be conducted for this crop, in the case of the other sectors (fruit and vegetables, livestock and aquaculture) the lack of data and statistics has been a major constraint to conducting any formal risk assessment.

Overview of Climatic Risk Exposures to Agriculture in Guyana

2.3. **Guyana enjoys an equatorial climate.** There are two rainy seasons, a long rainy season from May to July and a short rainy season from November to January. The annual rainfall averages about 2,300 mm in the coastal regions, about 3,550 mm in the interior tropical forest region and as low as 1,520 mm in the savannah region. During the rainy seasons, sunshine averages about five hours per day, but during the dry seasons, seven hours or more of sunshine per day are common. Temperatures rarely rise above 31°C or fall below 22°C and relative humidity is high at 80% or more in the coastal zone.

2.4. **Guyana, in contrast with most other countries located in the Caribbean, is not affected by hurricanes, tornadoes, earthquakes or volcanoes, but it faces an appreciable exposure to flood and drought.** Flooding and drought have been the two main recurrent events that have caused millions of dollars of economic losses in the past in Guyana. Between the period 1988 to 2006[8], 7 natural disasters have caused major losses in the economy, of which two correspond to drought and four to flooding. The total economic damage caused due to these natural hazards was US$663.1 million (US$34.9 million per year) and a total of 954,974 people were affected[9].

2.5. **Flood is a serious threat for crop production in Guyana.** The main source of flood exposure is due to excess rain events that cause the overflow of rivers, dams, water reservoirs and drainage canals. Agricultural activities in Guyana are mostly located along the coastal belt. The coastal belt consists of a low-lying strip of land mostly between one meter and one and a half meters below sea-level at high tide; therefore, agricultural production is heavily reliant on the protection provided by a sea wall and an elaborate system of conservancies, sluices, pumping stations, and drainage canals which were built by the Dutch over a century ago. Flood exposure in the coastal plains is highly influenced by the level of maintenance and management of the dams, dykes, sea wall, irrigation and drainage canals, pumping stations, locks and sluice gates. For this reason agricultural flood exposures vary according to the level of maintenance and management of the drainage and irrigation area where the production is situated. The National Drainage and Irrigation Authority (NDIA) is responsible for maintaining the drainage and irrigation systems.

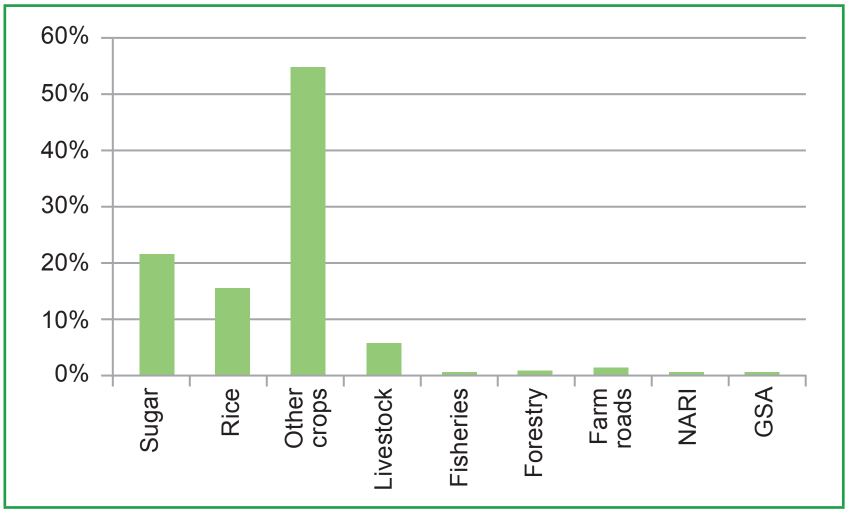
2.6. **In January 2005, the coastal regions of Guyana experienced the heaviest rainfall since 1888 and this resulted in extremely severe flooding in Georgetown and surrounding agricultural areas.** In the first two weeks of January 2005, rainfall was the heaviest since 1888 and more than three times the average for the whole month, with more than 10 inches (250 millimeters) of rainfall recorded on the night of Friday, January 14th. The excess rain caused flooding of three to four feet for several weeks in much of Georgetown (AXCO, 2006)[10]. According to the UN/ECLAC (2005) flood assessment report, the total losses

8 OFDA/CRED. International Disaster Database.

9 Ibid.

10 AXCO, 2006. Insurance Market Report Guyana: No-Life (P&C).

Figure 2.1. January 2005 Estimated Flood Damage to Agriculture by Sector (% of Total Value of Losses, G$ 10.9 billion)



Source: UN/ECLAC (2005).

in agriculture were valued at G$10.9 billion (Figure 2.1) of which nearly 55% of total losses were incurred in non-traditional "other crops" including fruit and vegetables, followed by sugar cane (21% of total value of losses), rice (15%) and livestock (6%). The worst flood losses were incurred in Region 4 (55% of the total value of losses), followed by Region 3 (23%) and Region 5 (19%). Damage from this flood event was negligible in Regions 1 and 6 (see Annex 4 for further details).

2.7. **Flood in Guyana is both a natural phenomenon and a water management problem.** The irrigation and drainage system is very old and in need of repairs, and in periods of high rainfall the canals are unable to drain the excess water from the reservoirs resulting in canal overflow and flooding. On several occasions in recent years, including in January 2005, the NDIA has been forced to open the reservoir sluice gates in the East Demerara Water Conservancy (EDWC) in order to prevent dam burst and/or the uncontrolled flooding of Georgetown and instead flooding agricultural areas adjacent to the conservancy[11]. The "man-made flooding" of agricultural land is an issue that will need to be considered very carefully under any future crop insurance scheme, as it would normally be deemed an uninsurable risk by the industry.

2.8. **Guyana is influenced by the ENSO cycle with severe droughts in *El Niño* years and excess rain/flooding in *La Niña* years.** The annual rainfall in Guyana is directly influenced by the ENSO cycle. During *El Niño*, Guyana, like the rest of countries located in the south-eastern part of South America (Suriname, French Guyana, and north-eastern parts of Brazil), experiences less rain than normal. Conversely, during the *La Niña* events, more rain than normal is commonly registered in the same area.

2.9. **Guyana experienced very severe drought conditions during the *El Niño* of 1997/1998 and currently, in 2009/2010, is experiencing a further major drought.** The 1997/98 *El Niño* was one of the most intense *El Niño*'s recorded and in Guyana was accompanied by severe drought during the period of January to May 2008 with accompanying irrigation water shortages and major rice production losses in Regions 2 to 5. Since mid-2009, Guyana has experienced abnormally dry conditions which are again thought to be related to the current *El Niño* phenomenon. By mid-March 2010, the water conservancies were nearly dry and the spring rice and sugar cane crops were suffering from drought/inadequate irrigation, especially in parts of Regions 2, 3 and 4. In the first quarter of 2010, the GoG has allocated G$342 million to *El Niño* amelioration measures including investment in emergency irrigation pumping from the major rivers in an attempt to save the sugar and rice crops in the drought affected regions. These measures appear to have had a significant impact in reducing the drought damage to about 8,000 acres of rice (compared to initial estimates that up to 30,0000 acres might be lost) and only 150 head of cattle lost[12]. According to the latest April 2010 reports, the projection for the first

11 For a description of the January 2005 excess rain event and a review of the water levels in the East Demerara Water Conservancy (EDWC), as well as the decision to release water from the EDCW into the Mahaica River basin in order to avoid a dam burst and the potential for much more severe flooding of Georgetown with significant human and environmental impacts, see UNEP/OCHA 2006, Guyana Floods: Geotechnical and hydraulic assessment of the East Demerara Water Conservancy dam. Joint UNEP/OCHA Environmental Unit, February 2005.

12 GINA. April 28, 2010, "Agricultural Sector in full recovery".

rice crop harvest has been increased from 160,000 to 172, 000 tons[13].

2.10. Further information on Guyana's climate and climatic risk exposures are presented in Annex 1.

Agricultural Production Systems in Guyana

Importance of the Agricultural Sector in Guyana

2.11. **Agriculture is the most important sector of Guyana's economy. It accounts for approximately 30% of GDP, 40% of export earnings and more than 50 % of employment.** Sugar cane and rice are the most important crops in terms of area, value of production, employment creation, and contribution to export earnings. In 2008, agriculture accounted for 27.6% of GDP of which sugar accounted for 11.2% of GDP, followed by rice – 3.2% of GDP, and other agriculture – 7.8% of GDP.

2.12. **Most of the agricultural production, as well as other economic activities, are located in the coastal plains of Regions 2, 3, 4, 5 and 6** (see Annex 2, Maps 1 and 2). The coastal plain is a fertile flat strip of 5 to 7 km wide along the seashore. The coastal plain lies about 1.4 meters below the sea level at high tide; thus, in order to avoid sea ingress it is protected by a sea wall and a dense network of irrigation and drainage canals.

2.13. **Agricultural crop production in the coastal plain is mostly irrigated.** More than a century ago, the Dutch established an integrated drainage and irrigation system in the coastal flood plain using water from the major rivers and a series of water conservancy dams. About 400,000 acres of agricultural land is irrigated in Regions 2, 3, 4, 5 and 6, of which about 130,000 acres are planted with sugar cane, 200,000 acres are under rice production and 70,000 acres are allocated to other crops and livestock (see Annex 2 for further details).

Traditional Crops (Sugar and Rice Production)

Sugar Cane

2.14. **Sugar cane is the most important crop in terms of employment and foreign exchange earnings.** The sugar cane industry is controlled by GuySuCo, the state-owned sugar production and export corporation which owns all of the country's 9 sugar processing factories. Sugar cane is produced under irrigation in Regions 3, 4, 5 and 6. Sugar cane is mainly produced on large estates and less than 10% of total sugar cane is produced by individual farmers. In 2007, 245,000 tons of sugar, valued at G$21.1 billion, were exported from Guyana and this crop is the largest source of net foreign exchange earnings. The sugar cane industry directly employs 25,000 people or 10% of Guyana's labour force and indirectly provides employment to an additional 30% of the population. Traditionally the EU provided Guyana and other ACP countries with preferential market access and support for high sugar prices under the European Union Sugar Protocol: however, the WTO has successfully challenged this protocol and sugar prices are set to decline by 37% in 2010 with a major loss of export earnings for Guyana equivalent to 6% of GDP.

2.15. Sugar cane is not one of the selected crops for this study and therefore this crop is not considered any further in this report.

Rice (Paddy)

2.16. **Guyana's rice industry is the second most important agricultural industry in Guyana.** Currently, the rice sector accounts for 12.5% of agricultural GDP and 14.9% of exports earnings of the country. Additionally, the rice sector is the largest user of agricultural lands with a total net cultivated area of about 150,000 acres which is double cropped. About 8,000 farmers are directly involved in rice production but the industry supports at least 20% of Guyana's population directly and many more indirectly. Rice is predominantly a small-holder crop, and 59% of all rice producers cultivate less than 10 acres of rice per year. Conversely the 7% of rice growers cultivating more than 50 acres of rice per year account for about 47% of total cultivated rice area (see Annex 2 for further details).

13 GINA April 30, 2010. Guyana: Rice sector records good first crop despite extreme dry conditions, Government Information Agency.

2.17. **In Guyana, the rice sector is highly organized, with centralized coordination provided by the Guyana Rice Development Board (GRDB).** The GRDB's mission is to efficiently utilize the resources of Guyana to produce high quality rice and rice by-products as a staple food for the domestic market and international export markets. The GRDB has several functions including: quality control of rice production, the provision of rice research and extension services to rice producers, and to provide certified rice seeds to these farmers.

2.18. **Farmers associations also have an active role supporting rice farmers in Guyana.** The Guyana Rice Producers Association (GRPA) has a membership of about 70% of the rice farmers in Guyana. The GRPA's main objectives are: (i) to protect, promote and enhance the interests of rice producers; (ii) to promote associative mechanisms in the rice farming sector; and (iii) to represent the rice farming sector on the discussions about any matter affecting rice production. The GRPA has twelve Field Officers who are in charge of monitoring the paddy crops during the crop season, collecting production data and stock data in the rice mills.

2.19. **In Guyana the stable equatorial climate allows farmers to produce two irrigated rice crops each year including a spring season crop and an autumn season crop.** The spring crop is sown between November and December and is harvested between March and April. The autumn crop is sown in June and July and harvested between September and October. The sowing of paddy is synchronized with the rainy seasons while the harvest is designed to coincide with the dry seasons. Rice production is mechanized and the entire crop is directly seeded as opposed to being transplanted.

2.20. **There are major differences in the regional distribution of rice production and average farm size.** Historically Regions 5 and 6 have been the most important rice producing regions, respectively accounting for 38% and 24% of total annual cultivated rice acreage and the average size of rice farms in these regions is large, at about 100 acres of rice per year. (Table 2.1). The next most important rice-growing area is Region 2, Essequibo, but in this case the annual average cultivated area of rice is much smaller at about 20 acres per farmer. Average total cultivated rice area in Regions 3 and 4 is also less than 20 acres. The cultivated area of irrigated rice is very similar in both the spring and autumn harvest seasons. The average rice yields achieved in Guyana are low at about 1.6 metric tons per acre for both the spring season and the autumn season crops.

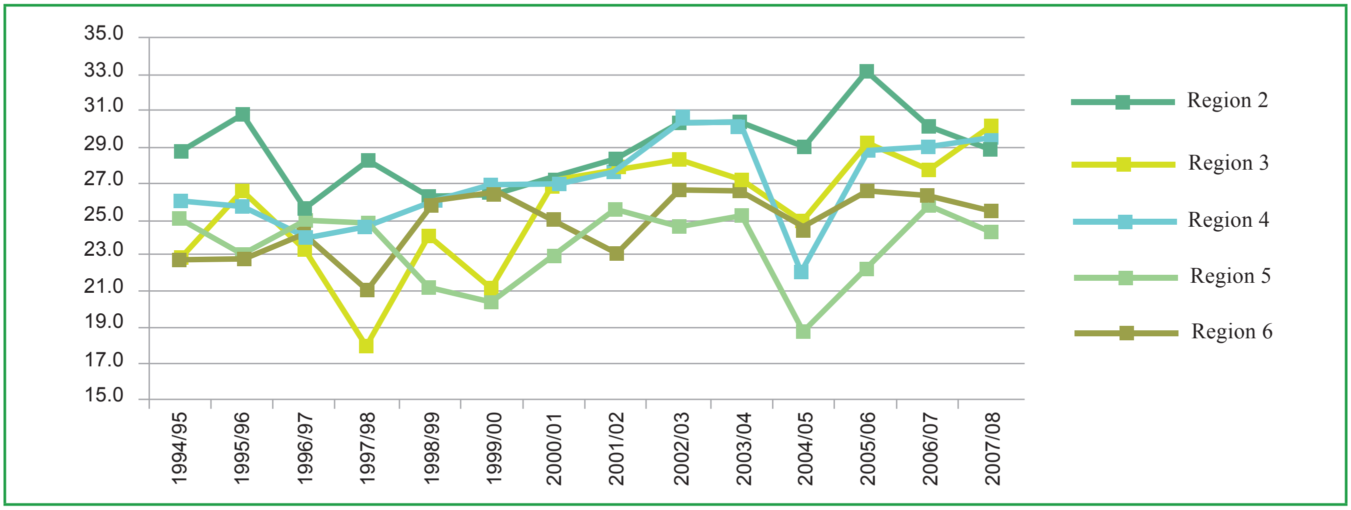
2.21. **There are considerable variations in average annual rice yields across each region, and in several years major yield loss has been experienced.** Figure 2.2 reports the GRDB annual average rice yields in 140 pound bags per acre by region for the 14-year period from 1994 to 2007/08. Normal rice yields have been stable over the past 14 years and there is only a very

Table 2.1. Distribution of Paddy Farmers and Seasonal Paddy Sown Area and Production per Region

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

Source: GRDB (2008).

Figure 2.2. Paddy. Annual Average Yields per Region, 1994/95 – 2007/08 (140 lb bags/acre)



Source: **GRDB, Annual Reports 1995-2009.**

small trend in increasing rice yields due to technology improvements. The highest average rice yields are found in Region 2 (about 30 bags per acre) and the lowest average yields are found in Region 5 (about 23 to 24 bags per acre). The analysis in Figure 2.2 is notable for the major yield reduction experienced in Regions 3 and 6 in 1997/98 (a severe *El Niño* drought year) and again in 2004/05 when flooding reduced the average rice yields in all regions, but especially in Regions 3, 4 and 5. In the next section a detailed risk assessment is conducted of the causes of yield reduction and loss in rice grown in Guyana.

2.22. **The average irrigated rice yields obtained by Guyanese farmers are much lower than those obtained by their closest competitors, and due to low average yields and volatile rice prices, the financial margins for paddy production in Guyana are low.** The average irrigated rice yields of about 27 bags per acre (1.6 MT/acre) in Guyana are much lower than those achieved by US farmers (about 43 bags per acre in Arkansas and 39 bags per acre in Texas/ Louisiana). In Guyana the average cost of paddy production ranges from G$50,000 to G$70,000[14] per acre, depending on the region and whether or not the farmer is renting or owning the land. Assuming, similar paddy prices to 2008/09[15] or an average of G$2,500 per bag, the break even yield that rice farmers must obtain to cover the costs of production is between 20 and 24 bags per acre. Under these conditions the gross margin returns from paddy production are low. Only those Guyanese rice farmers who harvest more than 35 to 40 bags per acre are able to obtain high profits from paddy production.

2.23. **The rice farming sector in Guyana faces several constraints.** These constraints include: (i) inadequate drainage and irrigation facilities; (ii) pervasive influence of natural perils, like flood and drought, in paddy production; (iii) high cost of inputs; (iv) high paddy price volatility; and (v) problems of access to seasonal production credit. These constraints are reviewed in more detail under the separate rice value chain risk assessment study which was conducted in parallel with the agricultural insurance pre-feasibility study.

Non-traditional Crops: Fruit and Vegetable Production

2.24. **The Guyana Marketing Corporation (GMC), under the jurisdiction of the Ministry of Agriculture**

14 It is expected that the production costs for paddy during the 2009/10 spring crop season will be higher due to the additional costs borne by the farmers for pumping water to mitigate the current effects of the *El Niño* phenomenon.

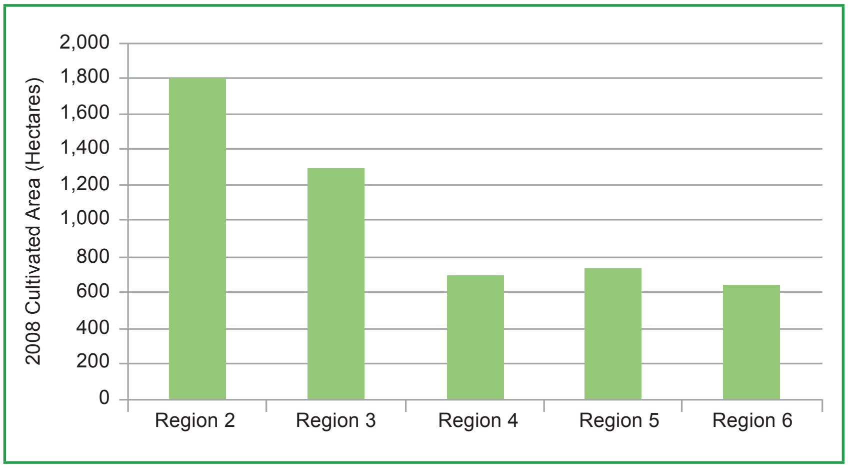
15 Paddy prices at the start of the harvest of the 2009/10 spring crop season as of March 2010 were as high as G$3,500/bag to G$4,000/bag. However it is expected that these prices will fall at the peak of the crop season, when the millers will have more certainties about the evolution of the harvest season.

(MoA), is responsible for promoting the increased production and export of non-traditional crops (which include all crops other than sugar and rice) including fruit and vegetables. The GMC's key activities include: (i) since 2009, a "Grow More Food" campaign involving the distribution, at no cost, of seeds, fertilizer, chemicals, farming tools and agricultural inputs to commercial and household farmers; (ii) establishment of a national grower register and database, which is an ongoing task; (iii) investment in new fruit and vegetable packing stations, for example the new facility at Parika; (iv) provision of retail and wholesale market price intelligence to farmers through the internet and/or a mobile phone text service; (v) licensing services for fruit and vegetable exporters; and finally (vi) assistance to the fruit and vegetable export component of the IDB funded ADP (Agricultural Export Diversification Program). Further details of the GMC's activities are presented in Annex 5.

2.25. **According to the GMC, there are about 7,500 non-traditional fruit and vegetable growers in the coastal Regions 2 to 6 cultivating about 5,180 hectares (12,800 acres) of non-traditional crops (excluding coconuts).** Currently the GMC's grower database is being established and caution must be taken in interpreting the limited available data on fruit and vegetable production in Guyana. The GMC estimates that in 2010 there may be about 7,500 farmers of non-traditional crops in Regions 2 to 6, with one third of these growers concentrated in Region 5, followed by Region 6 (20% of growers). Over 80 types of non-traditional crops are grown in Guyana but the GMC was not able to provide details of the area and production of these crops by region.

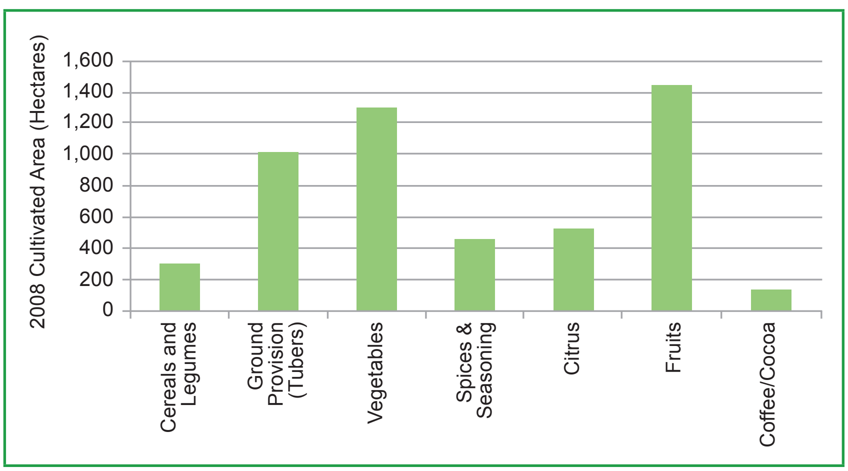
2.26. **The only available data on fruit and vegetable production in Guyana is from the National Bureau of Statistics (NBS)/GoG for 2008,** which reports that a total of 5,180 ha (12,800 acres) of non-traditional crops were grown in Regions 2 to 6, of which Region 2 was the most important with 1,806 ha (35% of total area), followed by Region 3 (1,293 ha, 25% of total area) and then much smaller areas in Regions 4, 5 and 6 (Figure 2.3). The most important crops grown are fruits (1,441 ha, 28% of total area), followed by vegetables (1,300 ha, 25% of area), tubers and root crops (20% of area) and then spices (Figure 2.4) (Full details are given by crop type in Annex 5). There is no information on the average cultivated area of non-traditional crops, but in Regions 5 and 6 most farmers produce these crops on a very small scale (0.25 to 1.0 acre). The 2008 NBS/GoG data require further validation because they appear to

Figure 2.3. 2008 Cultivated Area of Non-Traditional "Other" Crops by Region (hectares)



Source: NBS/GoG (2008).

Figure 2.4. 2008 Cultivated Area of Major Non-Traditional "Other" Crops (hectares)



Source: NBS/GoG (2008).

contradict the statements made by GMC/MoA officials met during the World Bank mission which were that fruit and vegetable production is concentrated in Regions 3 to 5 closest to the main urban markets, while production is very limited in Region 2.

2.27. **Guyana enjoys comparative advantages over its CARICOM neighbors in the production of fruit and vegetables and, under the Agricultural Export Diversification Program, the intention is to strengthen the fruit and vegetable supply chain in order to exploit this export market.** Under the ADP, the intension is to increase exports of non-traditional fruit and vegetables from US$216,000 to US$5.6 million. The IDB aims to overcome a series of mainly supply chain constraints affecting the fruit sub-sector as listed in Box 2.1. Component 1 of the Project intends to promote Private Sector Entrepreneurship (PSE) into agribusiness through the formation of cluster groups of fruit and vegetable producers and to assist them in formulating agribusiness plans to increase fruit and vegetable supply under contract to agro-processors and exporters. Loans of up to US$50,000 will be provided for each fruit and vegetable project.

2.28. **The farmer panel group discussions conducted under the current study identified the following main constraints to the production and marketing of fruit and vegetables:** (i) inadequate selection of cultivars and scarcity of planting material; (ii) lack of extension services; (iii) high cost of inputs; (iv) lack of farmer's access to credit; (v) insufficient/inadequate market information; (vi) the virtual absence of formal contract farming arrangements; (vii) the lack of organization and association by the farmers; and (viii) the poor condition of drainage and irrigation.

Livestock (Cattle) Production

2.29. **The livestock industry is an important source of employment and rural income in Guyana.** The livestock industry contributed about 7% to agricultural GDP in 2008. There are no accurate livestock statistics available for Guyana, but best estimates indicate that there may be between 280,000 and 350,000 heads of beef and dairy cattle in the country. Beef production is estimated by the Department of Livestock (DoL) at only 1.4 million kg per year and milk production at 6-8 million gallons per year.

2.30. **Cattle production systems are generally dual purpose, being managed for both beef and milk production.** Milk production takes place on small farms with herds of less than 10 head of cattle

Box 2.1. Main Constraints Affecting the Fruit (and Aquaculture) Sub-sectors in Guyana

The fruit and aquaculture sub-sectors' main constraints are:

i. Lack of volume at the farm level; the supply chain is characterized by lack of organization and association, low productivity, and lack of quality standards and processes. A major weakness is the virtual absence of formal contract farming arrangements.

ii. Although there are several domestic agricultural input and equipment providers, research and transfer of technology services are quite limited and not effectively linked with specialized networks to facilitate screening and adaptation of new varieties and fingerlings for these agribusiness chains, and those will be essential to increase the supply.

iii. Non-traditional farmers have very limited access to markets and to market information.

iv. Scarce supply of professional services.

v. The drainage and irrigation main infrastructure, including access roads, for those areas amenable for diversification require rehabilitation.

vi. Low awareness on the impacts of pesticides and chemicals coupled with limited monitoring and enforcement capabilities.

vi. The fruit sub-sector also requires investment for the retooling of its phytosanitary systems to increase exports. Poor sanitary hygienic practices are pervasive in food production and food retailing.

Source: **IDB Loan Proposal (GY-L1007).**

and is concentrated in the coastal regions. The average milk production per cow per day is low at about 4-5 pints, average lactation length is 120-180 days, and average calving interval is often more than 400 days. Beef production in Guyana is characterized by a large number of small farmers, or about 16,000, with less than 5 head of cattle which are kept primarily as an asset to be realized in times of hardship, and a few medium to large commercial beef producers. The beef production system competes for land with rice production and when rice prices are low beef cattle are grazed on rice lands. When rice prices are high cattle are placed on savannah lands farther away from the coast and the farmers' homesteads.

2.31. **The livestock husbandry and extension services in Guyana are under-resourced.** The Department of Livestock (DoL/MoA), is responsible for promoting livestock production in Guyana and for providing animal breeding, veterinary and livestock extension services to the country's livestock owners. The DoL is headed by a technical manager supported by 3 senior veterinary officers. There are a total of 23 trained veterinary officers in Guyana, who are supported by 9 livestock extension officers and 15 livestock assistants. These staff have to serve the requirements of all livestock and poultry farmers in seven of Guyana's ten regions (Regions 2, 3, 4, 5, 6, 9 and 10): there are currently no livestock veterinary or extension officers in Region 6. Given the small number of staff, the DoL focuses on the beef cattle and dairy sectors, including the National Dairy Development Program (NDDP), under which farmers can obtain artificial insemination services for their cattle at highly subsidized charges. There is no national database for livestock, animals are not tagged or registered, and livestock extension and veterinary services have limited impact on improvements to livestock productivity and animal health.

2.32. **Livestock production in Guyana is well below its potential capacity and livestock breeders face numerous constraints.** Inadequate feeding programs both pasture and supplement related, lack of veterinary services, and inadequate breeding programs result in low productivity and low quality products. Systems for controlling cattle movement within the country are lacking and competition with crops for land leads to community conflict: lack of access to grazing land is a major constraint for livestock producers in the coastal plains. Theft is also a significant problem for livestock owners especially in Region 6. Abattoir facilities are currently inadequate and do not meet the health and safety and certification standards required by international export markets in North America and Europe. There is limited knowledge on meeting Good Manufacturing Practices (GMP) and Good Agricultural Practices (GAP) in the livestock chain.

2.33. **The livestock sector has been identified as a priority sector under the ADP (Agricultural Export Diversification Program) funded by the IADB.** The GoG's strategies for improving the livestock sector include: (i) the development of a master plan for the sector; (ii) the establishment of a livestock working group; (iii) the construction of a state-of-the-art abattoir; (iv) the improvement of grading standards for beef; (v) the improvement of land use planning and tenure arrangements; and (vi) to increase the extension and veterinary services for livestock production in the country (see Annex 2 for further details).

Aquaculture Production

2.34. **The history of fresh-water aquaculture in Guyana dates back to the late 1940's when tilapia (*Oreochromis niloticus*) was introduced.** In the late 1990's the Department of Fisheries (DoF) of the MoA attempted to promote aquaculture production through the establishment of a fresh-water aquaculture demonstration farm at Mons-Repos. According to figures provided by the DoF in 2010, there are about 20 fresh-water farmers in Guyana cultivating about 200 acres of fish ponds (Annex 7). The main species include tilapia, hassar (*Holosternum littorale*) and water pacu (*Colossome macropomum*).

2.35. **In addition to fresh-water aquaculture, Guyana has a lengthy history of swamp shrimp (*Mesopenaeus tropicales*) production in the low-lying coastal strip using seawater.** Shrimp are currently produced under extensive, low-stocking density, low-input systems. There are about 2,000 acres of shrimp farms in Guyana (Annex 7).

2.36. **In January 2006 the National Aquaculture Association of Guyana (NAAG) was formed to promote Guyanese aquaculture.** Its members include private fish farmers, feed producers, fish processors, lending agencies and government agencies. The NAAG has conducted important work in the fields of market identification, provision of technical information, feed and fingerling production. The DoF is working closely with the NAAG and the aquaculture sector to promote and develop aquaculture in Guyana. In addition, since 2009, USAID has funded an aquaculture technical assistance program through the Guyana Trade and Investment Support (GTIS).

2.37. **According to aquaculture producers, the aquaculture sector in Guyana faces several constraints to development** including: (i) lack of access to investment capital to build fish farms and to install the necessary equipment for fish production; (ii) irregular supply of and costs of electricity for pumping water; (iii) non-availability of locally produced quality feeds-stock for aquaculture production: imported fish-feed from the US is expensive but of good quality; and (iv) the high costs of international air freight from Guyana to export markets in North America. So far, however, no major disease outbreaks have occurred either in the tilapia farms or the shrimp farms in Guyana.

2.38. **The GoG has targeted aquaculture as one of the non-traditional sectors with major potential for export driven expansion, which will receive funding from the IDB-financed ADP program.** According to the DoF, Guyana has the potential to develop up to 40,000 acres of aquaculture shrimp farms in the low-lying coastal strip behind the sea wall which is currently not utilized for agriculture because of salinity problems. The development of this land for fish farming will require major investment in fish ponds, and in seawater extraction (pumping) and drainage infrastructure. The DoF has also worked closely with the NAAG and the aquaculture sector and has drawn up plans to develop and implement a legal framework for the aquaculture sector; standards and good practices within the sector; a strong and competent aquaculture authority; fish health and veterinarian laboratory and quarantine mechanisms; and aquaculture production and marketing services[16].

16 DoF, 2009. Aquaculture Development and Support Program: Project Proposal. Department of Fisheries, Ministry of Agriculture, August 31, 2009.

Rice Crop Yield Risk Assessment

2.39. **Rice is an important export crop and the GRDB maintains an extensive database on regional rice production and yields which permits a detailed risk assessment to be conducted.** The GRDB field level extension staff are actively involved in recording rice sown and harvested area, production and yields in each zone and region on a seasonal basis, as well as compiling monthly records of the damage to rice production in terms of affected area and 100% lost area due to major perils such as flooding, drought, pests and diseases. This section presents an analysis of the GRDB rice sown area, production and yield data for the 14-year period from 1994/95 to 2007/08 based on the authors' Crop Risk Assessment Model (CRAM) which is a model designed to estimate the value of expected losses using an analysis of variation in time-series crop yields. Full details of the CRAM model and the results of the rice risk assessment are contained in Annex 3.

Causes of Loss in Rice Grown in Guyana

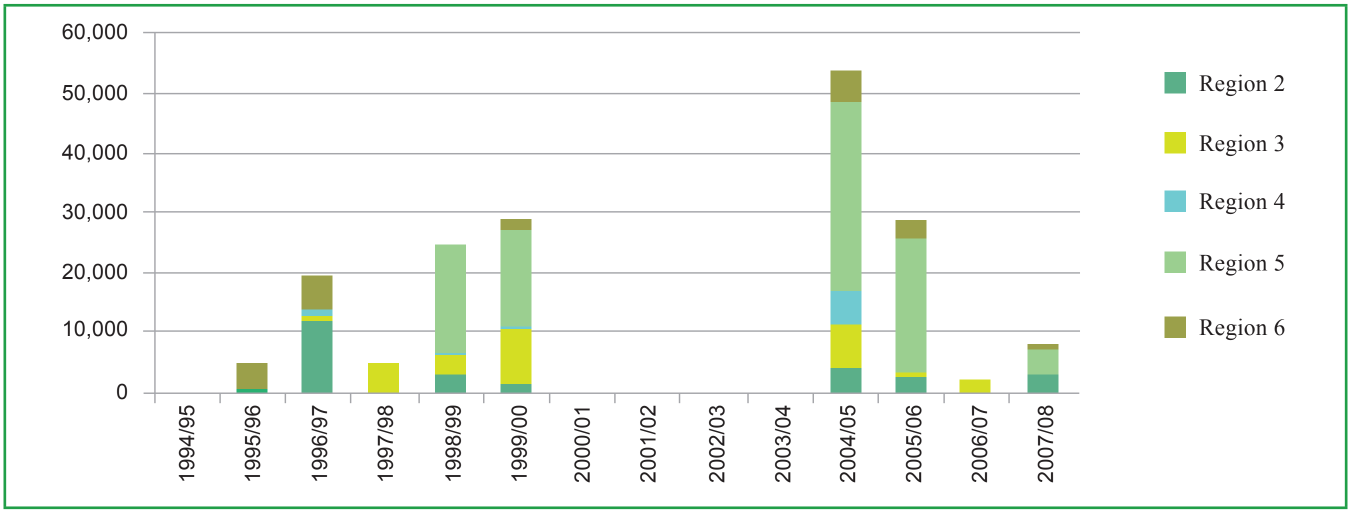
2.40. **Natural calamities have a strong impact on paddy production in Guyana. The major natural calamities affecting paddy production in Guyana include: flood, droughts, saline intrusion, excess of rain at harvest and, potentially, tidal impacts and rice pests and diseases.** In Guyana, flood is not only associated with events of high rainfall intensity but also with issues relating to the inability of the current irrigation and drainage system to extract and drain-off excess rainfall water. Droughts, in the Guyanese context, are mostly associated with shortages of water for irrigation and are often associated with *El Niño* events. Saline intrusions are risks which are in connection with either droughts and/or tidal impacts. A summary of the risks affecting paddy production is presented below and full details are given in Annex 3.

Flood Losses in Rice

2.41. **Paddy farmers in Guyana have suffered rice production losses[17] due to floods on eight**

17 The methodology used under this study to calculate the rice production losses is explained in Annex 3 and involves the calculation of (a) the 100% damaged area production losses and (b) the estimated expected yield shortfall for partially damaged areas.

Figure 2.5. Paddy Rice: National and Regional Production Losses Due to Floods from 1994/95 – 2007/08 (metric tons)



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

occasions over the past 14 years, equivalent to a flood return period of approximately one in every two years. Between 1994/95 and 2007/08, paddy farmers in Guyana suffered significant crop losses in eight of the fourteen years as shown in Figure 2.5. The most severe flood event occurred in January 2005 with an estimated loss of 53,300 metric tons of paddy. This represented 13% of the annual crop production and 26% of the spring crop production of 2004/05. Region 5 was the most affected with production losses accounting for approximately 47% of the regional expected production for the spring crop season. In January 2006, another severe flood affected the spring paddy production. This time the production losses amounted to approximately 28,700 metric tons, which was equivalent to 6% of the national rice production in 2005/06 and 13% of the paddy production of the spring crop season. Region 5 was the most severely affected region with paddy production losses accounting for 52% of the regional expected production in the 2006 spring crop season. In December 2008, floods affected the country causing a loss of 8,000 tons in the spring 2008/09 paddy production.

2.42. **The flood damage figures for paddy production between 1994/95 and 2007/08 suggest a possible increasing trend in the severity of flood losses on paddy production in Guyana.** This trend is suggested by the very severe flood losses in rice in 2004/05 and again in 2005/06 and 2007/08.

Drought Losses in Rice

2.43. **Most of the paddy production in Guyana relies on irrigation; however, the system of lakes and reservoirs used to supply gravity-flow irrigation may suffer occasional water shortages.** In most years, gravity flow irrigation water supply is ensured throughout the year; however if severe rainfall deficits (droughts) occur during one or both of the paddy crop seasons in the year, the conservancy reservoirs may experience water shortages and be incapable of meeting farmers' demand for water to irrigate the sugar cane, rice and vegetable crops.

2.44. **There is evidence that paddy production in Guyana has faced rainfall deficit/irrigation water shortages and droughts on about seven occasions over the past 30 years and that these events are closely related to the *El Niño* phenomenon.** According to the records obtained from EM-DAT[18] and HYDROMET, during the period from 1974/75 to 2007/08, paddy production has been affected by severe water shortages and droughts in 1979/80, 1987/88, 1994/95, 1997/98, 2000/01, 2001/02, 2002/03 and 2009/10, averaging approximately one drought event every five years. Most of these years coincide with the *El Niño* phenomenon which is known to cause reduced precipitation (especially in the first quarter of

18 EM-DAT. OFDA/CRED International Disaster Database. www.em-dat.net. Universite Catolique de Lovrain, Brussels, Belgium.

the year) in countries located in north-eastern South America. Estimations based on the aggregate annual paddy production indicate that, for the 1988 crop year, the total losses on paddy crops due to water shortages and/or drought accounted for over 30,000 metric tons or 10% of the expected paddy production. Figure 2.6 shows the national paddy production losses due to drought and/or irrigation water shortages from 1994/95 up to 2007/08. The spring harvested paddy crop tends to be more severely affected by *El Niño* induced irrigation water shortages than the autumn harvested crop (see Annex 3 for further details).

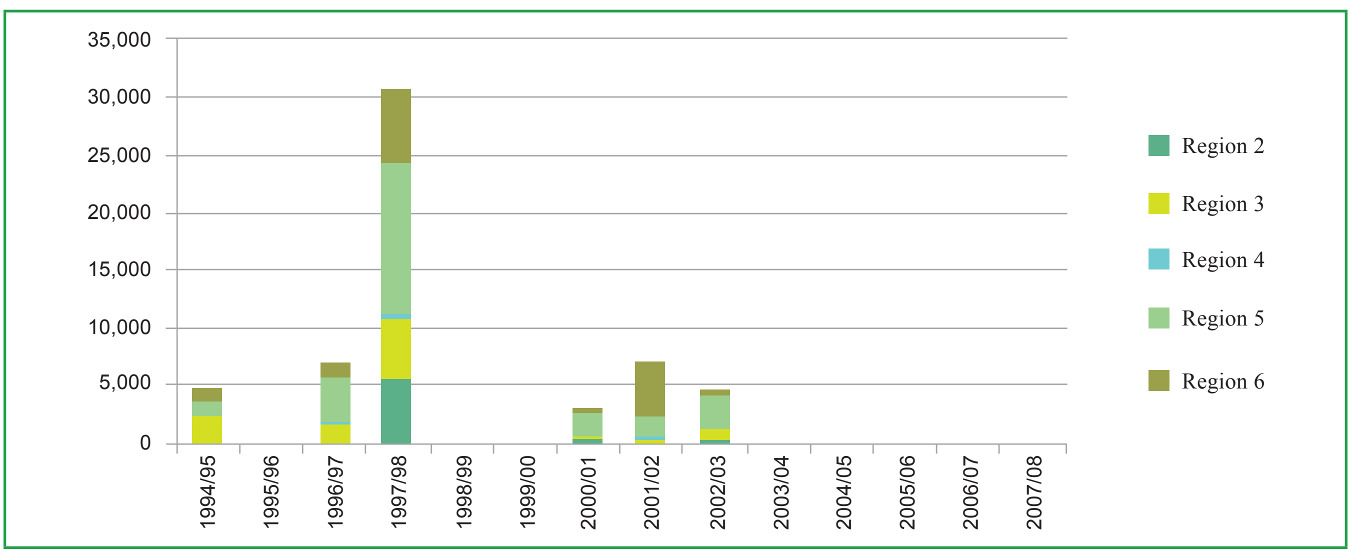
2.45. **Currently in March 2010, the spring paddy crop is suffering from severe *El Niño* induced drought/lack of irrigation water. Although rice harvest estimates are not yet available, it is expected that unless the country receives significant rainfall in March, severe paddy production losses will be incurred in Regions 2, 3 and 4.** According to the farmers met during the study, the current 2010 drought which has existed since the start of the spring crop season, may have a worse impact on paddy crop production and yields than the *El Niño* drought of 1997/98, which was previously the worst drought loss year ever recorded in Guyana.

2.46. **In 2010, the GoG is making a major effort to alleviate the reservoir water shortage for irrigation by pumping water from rivers into the irrigation system.** However, in spite of the GoG's efforts, it is estimated that as of March 2010, 10,000 acres of paddy have been already damaged or lost due to lack of irrigation water in Region 2 and Region 3. In Regions 5 and 6, although the rice crop is also subject to drought stress/lack of irrigation water, the performance of spring paddy appears to be better than in the western regions of the country.

Saline Intrusion

2.47. **Saline intrusion is a risk faced by paddy producers in Guyana in areas closest to the sea coastline. There are two main causes of saline intrusion in Guyana. The first cause is connected to irrigation water shortage problems.** Sometimes, during extremely dry periods, farmers have no other source of water for their crops than water which is pumped directly from the rivers and estuaries entering the sea. During dry periods, reduced river flow means that the waters in the estuaries tends to be more saline than brackish, and when used for irrigation purposes this often results in damage to farm lands. Saline intrusion during dry periods is a frequent problem along the paddy production areas closest to the seashore and, in particular, in Leguan and Wakenaam Islands in Region 3 where there are no irrigation reservoirs and the only source of irrigation water is water pumped out of the Essequibo River estuary.

Figure 2.6. Paddy Rice: National and Regional Production Losses due to Water Shortages (Drought) from 1994/95-2007/08 (metric tons)



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

2.48. **The second cause of salinity in Guyana is the intrusion of saline water in the paddy fields directly from the sea.** Much of the coastal plain is below sea level and it is susceptible either to seawater intrusion caused by high tides which flow over the sea wall or due to breaches in the sea wall. In the event of high tides accompanied by strong winds, storm surges may overtop the sea walls and cause salt water flooding: such an event occurred in 2008 between the Montrose and Better Hope areas in Region 4[19], and at several other places such as the Island of Leguan in Region 3 and Crane Grove on the West Coast of Demerara in Region 4.

2.49. **Guyana is also exposed to coastal flooding due to a rise in sea levels.** Currently the sea level rise in Guyana is 10.2 mm/year[20]; however, Guyana's sea defenses are only designed to accommodate a sea level rise of 6 mm per year. It is important to note that, if a severe coastal saline flood event occurs, agricultural losses could be as high as 20% of GDP in low lying coastal states (IPCC, 2007).

2.50. **To date, saline intrusion problems have been limited to certain areas close to the seashore; however, it is expected that due to the rise in the sea levels this problem will become worse in future years.** It is expected that the rise in sea levels will cause that waters in the estuaries become more saline than the current levels. Moreover, during dry periods, the intrusion of saline water will reach inland areas that currently are not affected by this phenomenon. Also, due to the rise in the sea level, it is expected that the sea wall will be less effective in containing direct seawater intrusion at times of high tides.

Tsunami Exposure

2.51. **Although tsunami exposure has a very low probability in the region,** it is within the realms of probability that a distant seismic event in the Caribbean sea could trigger a major tsunami which could result in catastrophic losses in the low-lying coastal regions of Guyana where the bulk of the population and economic activity is concentrated. Guyana's tsunami exposure is ranked 0 out of 265 countries worldwide[21] implying a very low probability. However, the sea wall defenses are only 2 meters above sea level and in the event of a catastrophic tsunami they would be overwhelmed resulting in major loss of life and damage to agriculture.

Excess Rain Losses in Rice

2.52. **The effect of excess rain at the time of the paddy harvest was identified by rice growers as a source of risk in their rice production.** The effects of excess rain at the time of the paddy harvest are two-fold. Firstly, excess rain at harvest results in paddy fields becoming inaccessible, exposing the crop to crop lodging and rotting of the rice grains, accompanied by damage caused by rodents and bird pests. The second effect of excess rain is that the paddy ripens with a high moisture content and farmers suffer a discount on the paddy price due to the additional cost the miller incurs to dry the paddy to storage levels. This reduction in price is proportional to the moisture content of the paddy; however, the price discounts applied due to excess of moisture are always onerous for the farmers. Paddy crops that are sown late in the season are more likely to be affected by excess rain at harvest.

2.53. **Unseasonal rainfall events are becoming more frequent in Guyana causing losses in the rice sector.** In 1973, excess of rain at harvest was a severe problem, the fields were not accessible and, as a result, several paddy fields were lost during that crop year. In May 2007, the occurrence of intense and early rainfall prevented the harvesting of about 1,000 acres of rice in various regions of Guyana. In the current, 2009/10 spring crop season, due to the *El Niño* drought, much of the paddy crop was late-sown in January or February 2010: it is highly probable that the late rice harvest will coincide with the beginning of the autumn rainy season and, consequently, the risk of excess of rain losses at harvest will be higher.

Pests and Diseases in Rice

2.54. **Pest and diseases may also cause significant losses in rice.** The main causes include Paddy Bugs, Blast and Red Rice. Pest and disease losses in rice are

19 Reported in the Guyana Chronicle, March 23, 2008.

20 Guyana's National Vulnerability Assessment to Sea Level Rise, 2002.

21 See PreventionWeb: http://www.preventionweb.net/english/countries/statistics/risk.php?iso=guy

reported further in Annex 3, Appendix B by region/zone and year (1994/95 to 2007/08). It is noted, however, that most crop insurance policies do not insure against pests and diseases as these are considered manageable perils.

Rice Estimated Values at Risk in each Region/ Zone and Expected Value of Losses

Rice Values at Risk

2.55. **The current estimated values at risk[22] of spring harvested rice and autumn harvested rice are presented in Figure 2.7 for each region and GRDB rice production zone.** The total value at risk (VAR) of Guyanese national rice production is estimated at G$17.1 billion (US$85.5million)[23], divided almost equally between the spring crop (VAR of G$8.9 billion) and the autumn crop (VAR of G$8.2 billion). There is, however, considerable spatial variation in the rice VARs across regions and zones with a concentration of values in Region 2, Essequibo (23% of total spring VAR and 26% of total autumn VAR) and in Region 5, Mahaica-Arbary and West Berbice (38% of total spring VAR and 33% of autumn VAR). Conversely, rice production is much less important in the Leguan and Wakenaam zones of Region 3 as reflected by the very low VARs in these zones; this also applies to Region 4, Cane Grove.

2.56. **The major spatial differences in rice VARs will need to be addressed carefully in the design of any future crop insurance scheme.** The principle of any crop insurance scheme is to ensure that an optimal spread of risk is achieved both spatially and temporally. The concentrations of VARs in Regions 2 and 5 will need to be assessed closely under the planning and design of any future rice crop insurance scheme.

Estimated Value of Expected Losses in Rice Production

2.57. **An estimation of the expected value of crop losses for the spring and autumn rice crops in each region and zone has been conducted** based on an analysis of variance in time-series average seasonal rice yields in each zone under the CRAM model (see Annex 3 for full details of the model's assumptions).

2.58. **The analysis of expected losses shows that rice production in Guyana is very risky.** The annual average expected losses for spring rice are valued at G$710 million per season, equivalent to 8.0% of the total VAR of spring rice of G$8.9 billion and, in the case of the autumn rice crop, the annual average expected losses are slightly lower at G$557 million or 6.5% of the autumn crop VAR of G$8.5 billion. Figure 2.8 shows the average expected losses per region and per zone expressed as a percentage of the VAR in each zone. The highest expected annual losses are estimated for spring rice grown in Region 3, with percentage losses as high as 14.1%, 12.0% and 12.7% of VAR in Leguan, Wakenaam and West Demerara, respectively; this is, by large, a reflection of the lack of an assured irrigation water supply and/or drainage problems in Region 3. Conversely, expected losses are much lower for both the spring and autumn crops in Region 2, Essequibo, and in Region 6 (Black Bush Polder and Frontlands). Both Regions 2 and 6 have relatively efficient and well-managed drainage and irrigation infrastructure.

2.59. **The variation in expected losses in rice, both by season and by region and zone, will have a bearing on the future design of any form of indemnity-based crop insurance policy for rice.** The finding that there are major zonal differences in expected value of losses will have a bearing both on the yield-coverage levels offered in each zone and in the calculated technical premium rates.

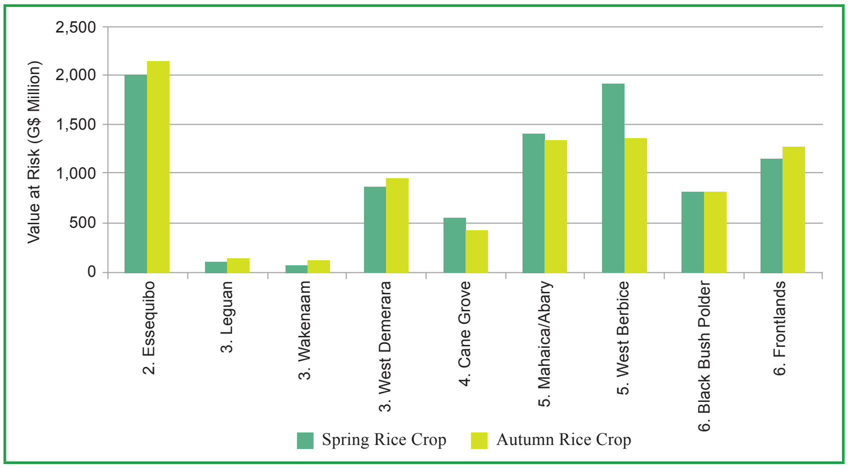
Rice: Probable Maximum Loss (PML)

2.60. **The analysis of 14-year (1994/95-2007/08) paddy zonal yields for spring and autumn paddy in Guyana shows that 2004/05 was the worst loss year in this series with total production losses of 53,300 metric tons of paddy, which was equivalent to a financial loss of 13% of the total value of the 2004/05 national paddy crop and 26% of the value of the 2004/05 spring harvest paddy crop.** Although 2004/05 was a severe loss year in Guyana, even worse crop losses could occur in the future. From an insurance view point, underwriters need to know with a high degree of confidence the maximum losses that they might incur (termed the Probable Maximum Loss,

22 The assumptions used are presented in Annex 3.

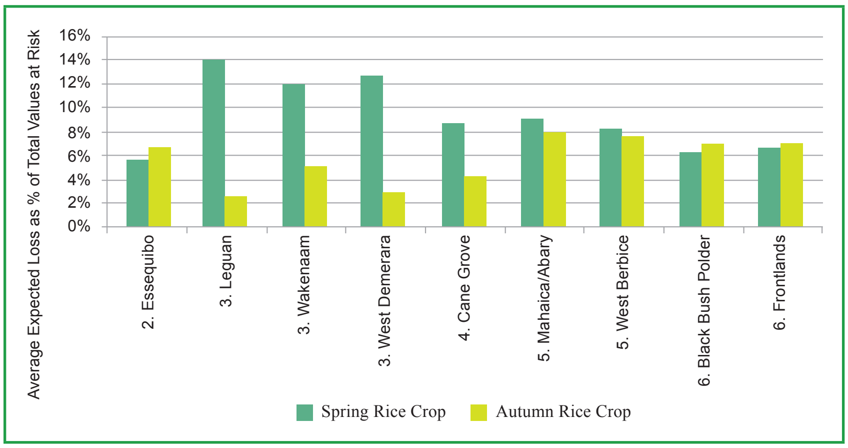
23 An exchange rate of G$200 = US$1.00 is used throughout the analysis presented in this report.

Figure 2.7. Estimated Values at Risk for Spring and Autumn Rice Crops by Region and by Zone (G$ millions)



Source: World Bank CRAM analysis of GRDB Data.

Figure 2.8. Estimated Average Annual Value of Losses in Spring and Autumn Rice Crops by Region and by Zone (% of VAR)



Source: World Bank CRAM analysis of GRDB Data (see Annex 3 for full details).

PML[24]) either 1 in 100 years, or if it is necessary to be even more conservative, 1 in 250 years. This information is an invaluable aid to structuring an insurance and reinsurance program and to determining how much capital must be reserved to cover the PML.

2.61. **The results of the World Bank's PML loss cost analysis at 100% yield coverage level show that the 1 in 10 year expected PML is equivalent to a loss of 17.0% of the total value of the national rice crop or a loss of G$2.97 billion, while the 1 in 100 year PML loss is calculated at 27.8% of the national rice VAR or a loss of G$4.8 billion (US$24.2 million).** These PML estimates show that the rice crop in Guyana is very exposed to catastrophic (mainly flood) losses and that these losses greatly exceed the retention capability of local insurance companies. The preliminary PML presented in this report will need to be developed in the future and used to (a) establish the catastrophe loading which must prudently be added to the calculated base rates and (b) assist in the design of a risk financing and risk retention, and risk transfer/reinsurance strategy for the Guyanese insurance market.

2.62. **The PML analysis performed separately for the spring and autumn rice crop seasons shows that the PMLs for each season are higher than the PML for the aggregate portfolio.** The estimated 1 in 100 year PML cost for the spring season rice crop is very high at 43.6% of the spring crop VAR at 100% coverage level, equivalent to a financial loss of G$3.86 billon (US$19.3 million). The corresponding 1 in 100 year PML for the autumn rice crop season is 40.6% at 100% coverage level, equivalent to a financial loss of G$3.47 billon (US$17.3 million). The reason for the higher PML values on each of the seasonal portfolios in comparison with the aggregate portfolio PML analysis is that the spring and autumn crop seasons are not correlated; thus, it is improbable that both spring and autumn paddy crop portfolios could suffer losses simultaneously.

Conclusions to Rice Risk Assessment

2.63. **The analysis of zonal level crop production and yields for spring and autumn paddy in Guyana shows that paddy production throughout the country is exposed to a combination of flood, drought/irrigation water shortages, saline intrusion, excess rain at harvest, and pest and disease losses.**

24 The Probable Maximum Loss is defined as "An estimate of the maximum loss that is likely to arise on the occurrence of a single event considered to be within the realms of probability, remote coincidences and possible but unlikely catastrophes being ignored".

This is evidenced by the average loss cost estimated by the CRAM for a 14-year period, (1994/95 to 2007/08) of 7.3% of the total gross value of paddy production and a calculated 1 in 100 year PML of 27.8% of the national paddy crop gross value of production.

2.64. **In the design and planning of any future crop insurance program for paddy production in Guyana, special consideration should be given to management issues affecting the drainage and irrigation system, and protection against sea intrusion.** This paddy crop risk assessment has shown that paddy production risks are highly influenced by crop husbandry and water management-related issues. Insurance is a financial tool designed to cover unpredictable and unforeseen losses. Management issues are neither unpredictable nor unforeseen; thus they are not the object of insurance. In the design of any crop insurance program for Guyana, the insurers/reinsurers must avoid insuring any man-made aspect influencing paddy production. High levels of insurance deductibles and specific provisions in this regard should be expected in the insurance policy wording.

2.65. **The design of any crop insurance program for irrigated rice in Guyana should take into account the different production and yield levels, as well as yield variability by season and by region and zone.** The analysis of spring and autumn crop seasons as well as the different paddy production zones in Guyana shows different levels of rice production and yield risk and this should be reflected both in the coverage levels and the crop premium rates which are established for each season and each paddy producing zone/region.

Crop Weather Index Risk Assessment

2.66. **Extreme rainfall events have been associated with agricultural losses and failures in the past.** The major excess rainfall event ever recorded since 1888 took place in January 2005 when the value recorded at the Georgetown Botanical Gardens (1,108.2 mm) surpassed by far the 30-year average rainfall (185.2 mm) and also exceeded in 86.2 mm the previous historical record captured in the same station (1,022 mm, December, 1942). Due to the occurrence of another major flooding event (between December 2005 and January 2006), the economical losses estimated on the rice industry and other non-traditional farming were around G$1.9 billion and G$1.7 billion[25], respectively. Due to the flood, the contribution to the GDP during this time dipped from 36% to 30% in 2005, and 22% of agricultural GDP, underscoring the major impact on agriculture. A survey performed by Doodnauth, P. (2004) and Bynoe & Bynoe (2000) among vegetable farmers in Leguan, revealed that they suffer significant losses during the annual episodes of flooding on the island, with 48% of farmers indicating that they have suffered total losses at one point or another.

2.67. **Drought events have also been associated with agricultural losses in the past.** Between September 1997 and February 1998 rainfall was only about 25% of normal precipitation over the coastal areas. Due to the dry conditions caused by *El Niño* influence, practically all of the lakes, reservoirs and other irrigation sources were almost completely dried up and, in many of the main rivers and creeks, saline intrusion was reported to reach as far as thirty miles inland. For the 1997/98 spring crop season, GRDB records show that 18,000 acres of paddy were not sown, about 9,000 acres were lost and overall yields were reduced because of lack of water for irrigation. About 1,300 rice cultivators, most of them small farmers, were estimated to have lost their entire crop due to this event.

2.68. **The availability of weather data that meets the standards required for crop weather risk assessment purposes is an issue in Guyana.** In order to be used for crop weather risk assessment purposes, the historical weather data should meet minimum quality and integrity requirements. The Hydrometeorological Service (HYDROMET/MoA) is responsible for managing the national network of meteorological stations in Guyana and for providing weather forecasting services. It is understood that there are about 147 weather stations in Guyana, but that only 72 of these stations are currently transmitting weather data (mainly rainfall data) to HYDROMET on a daily basis. Other organizations, including GuySuCo are also involved in recording rainfall and other weather data. For this pre-feasibility study the World Bank team was able to get data from 32 weathers stations; however, major daily rainfall data values were missing and, therefore, just a very limited number of

25 According with the ECLAC report, the non-traditional crops that were most affected were bananas, plantains, root crops, legumes, vegetables and fruits.

weather stations (4 out of 32) were able to with data requirements to perform a weather risk assessment; thus, a great deal of work will need to be done to reconstruct, clean and make use of the available data sets. Currently, the very low number of usable weather stations is a major constraint to perform a crop weather risk assessment, and therefore, to the development of weather index insurance in Guyana.

2.69. **The relationship between agricultural production performance and weather is not straightforward.** As noted previously, agricultural production takes place in an equatorial climate and relies heavily on a drainage and irrigation system. The fact that the country enjoys an equatorial climate allows farmers to have extended sowing windows for their crops, making it possible to find -at the same time- different phenological stages of the same crop. Phenology stages respond, even within the same crop, in different ways to the exposure to weather events (i.e. drought, excess of water). On the other hand, agricultural performance is also heavily affected by the influence of man-made factors in connection with the drainage and irrigation systems. For instance, depending on the state of maintenance of the drainage infrastructure and the effectiveness of water management, the same event could cause different losses in different conservancy catchment areas or, even, within a same conservancy catchment area.

2.70. **Spatial and temporal conditions of the rainfall variable must be considered in order to define a weather index.** A preliminary analysis indicates that the development of an index based on a rainfall measurement over a seasonal or yearly basis is not a good proxy to estimate correlations between real losses and the rainfall index. In the period between the spring crop seasons of 1994/1995 and 2007/2008, the highest cumulative rainfall value (around 1,190 mm) was registered during the spring season of 2007/2008 in Region 4, followed in second place by a rainfall value of 1,415.6 mm for the 2004/2005 season; nevertheless, the difference in the yield performance of rice paddy between both crops seasons was almost the double. The intensity of rainfall that Guyana received in January 2005 not only surpassed records with respect to the historical rainfall values, but also exceeded soil water infiltration capacity and the capacity of the drainage system to discharge excess water (see Annex 4 for further details).

Fruit and Vegetables Crop Risk Assessment

2.71. **Fruit and vegetable farmers interviewed under this study in Regions 5 and 6 face major supply chain constraints and, especially, difficulties in marketing their small volumes of produce: these constraints are often of much greater concern to farmers than climatic risks per se.** Constraints voiced by farmers to the production, marketing and trade of fruit and vegetables include: (i) inadequate selection of cultivars and scarcity of planting material; (ii) lack of extension services; (iii) high cost of inputs; (iv) lack of farmer's access to credit; (v) insufficient/inadequate market information; (vi) the virtual absence of formal contract farming arrangements and the poor prices received for their produce from market intermediaries (traders); (vii) the lack of organization and associations by the farmers; and (viii) the poor conditions of the drainage and irrigation infrastructure.

2.72. **In the past, neither the GMC nor the MoA have formally recorded losses in the fruit and vegetables sub-sector, and it has not been possible under this study to quantify the causes, frequency and severity of losses in different fruit and vegetable crops.** Crop risk assessment relies on farm-level and regional time-series damage data/statistics for each crop type which is damaged, the peril/cause of the loss and the extent/severity of the damage, which is usually recorded in terms of area 100% damaged, area partially damaged and estimates of the lost production. While such data is routinely recorded in Guyana by the rice industry, it seems that no such crop damage database exists for fruit and vegetables. It is much more complicated to record damage in fruit and vegetables given the wide range of products which are typically grown on a very small scale by farmers, and the overlapping planting dates and continuous harvest of many of these crops.

2.73. **The most comprehensive information on losses in the non-traditional fruit and vegetables sub-sector is provided by the UN/ECLAC for the catastrophic flood event of January 2005 and then again for the February 2006 floods.** In 2005, a total of 4,441 acres of non-traditional crops were damaged by flood with total losses valued at a very high G$6 billion or G$1.3 million per affected

Table 2.2. 2005 Flooding ECLAC Damage Assessment for Non-Traditional Crops*

Region	Acreage affected	% of damaged area	Direct losses (G$)	Indirect losses (G$)**	Total losses (G$)	Loss/ affected area (G$/acre)	% of total losses
2	124	3%	159,811,000	11,447,785	171,258,785	1,376,568	3%
3	1,189	27%	1,589,412,000	118,644,615	1,717,056,615	1,444,300	29%
4	2,740	62%	3,337,318,000	144,245,371	3,481,563,371	1,270,852	58%
5	388	9%	584,694,000	23,539,365	608,233,365	1,566,602	10%
Total	**4,441**	**100%**	**5,680,235,000**	**297,877,136**	**5,987,112,136**	**1,346,100**	**100%**

Source: UN/ECLAC (2005[26]).

* Non-Traditional crops include fruits, vegetables, roots and tubers, herbs and spices.

** Indirect losses include consequential economic losses, for example the inability to replant vegetable crops for several months until flood damaged irrigation and drainage canals and internal field bunds have been rehabilitated and repaired.

acre [27]. These figures compare with the much lower total estimated damage for the sugar cane and rice sectors of G$2.3 billion and G$1.7 billion respectively. The worst flood losses in fruit and vegetables were incurred in the Mahaica-Abary areas of Region 5, accounting for 58% of the overall value of losses (Table 2.2). In 2006, ECLAC reported flood losses in non-traditional crops valued at 1.3% of GDP.

2.74. **Farmers interviewed during the panel discussions in Region 5 identified flooding (2005, 2006 and 2009) as their main climatic risk exposure,** followed by pests and diseases of fruit and vegetables; some farmers at the tail end of the irrigation system also identified lack or irrigation water as a constraint in 2009/2010.

Livestock (Cattle) Risk Assessment

2.75. **The DoL does not maintain any historical records of animal mortality rates either due to natural causes (flood, lightning, accidental death, etc.) or to pests and diseases, and this has severely restricted the ability of the study team to conduct a formal risk assessment for the livestock sector.** The absence of (a) a national database of the numbers of livestock by class of animal and by region and by owner, and (b) any form of national register of animal mortality levels by cause of loss, means that it has not been possible for the World Bank study team to conduct any formal assessment of the risks facing the livestock industry in Guyana. However, some limited loss information is available from secondary sources and from the field visits to the farms and this information is reviewed below.

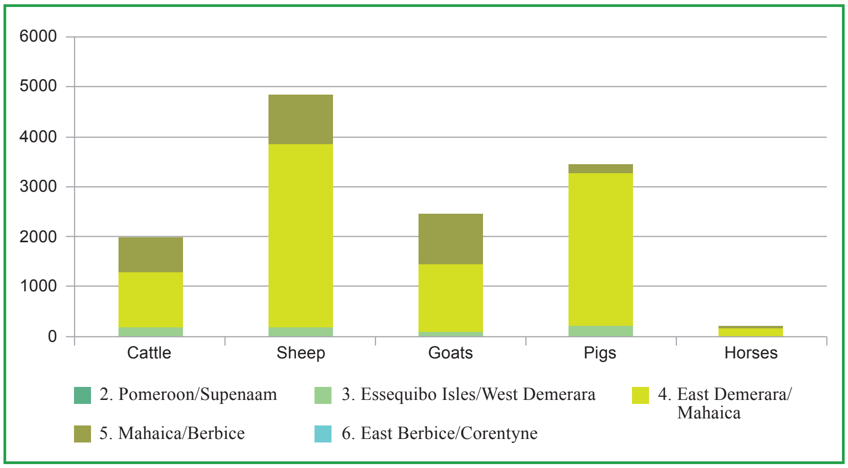
2.76. **During the January 2005 floods, high losses were recorded in livestock and poultry, especially in Region 4, East Demerara/Mahaica.** A total of nearly 13,000 head of cattle, small ruminants, pigs and horses were drowned or died due to starvation and secondary diseases and, in addition, nearly 202,000 birds (poultry) were killed by the January 2005 flood event (Figure 2.9). The total estimated direct and indirect costs to the livestock sector were estimated by UN/ECLAC at G$607.5 million or 6% of the total values of losses to agriculture arising from this flood event. The losses in livestock and poultry were highest in Region 4, East Demerara/Mahaica accounting for 81% of all lost animals/birds and 77% of the total value of losses.

2.77. **Guyana is officially free from Foot and Mouth Disease (FMD), a Class A highly contagious disease of cattle, pigs and small ruminants, and this also applies to a wide range of other highly**

26 UN/ECLAC 2005, Guyana: Socioeconomic assessment of the damages and losses caused by the January-February 2005 Flooding.

27 While recognizing the high value of fruit and vegetables crops, the World Bank queries the extremely high average G$1.35 million per acre damage estimates provided by the UN-ECLAC in 2005.

Figure 2.9. Guyana: January 2005 Flood Losses in Livestock (number of dead animals)



Source: UN/ECLAC (2005).

contagious diseases. Guyana is a member of the World Animal Health Organization (OIE) and, in accordance with international standards, is responsible for notifying outbreaks of all Class A, B and C contagious diseases to the OIE. The OIE records for the period 2005 to 2008 show that Guyana has been free of all Class A highly contagious diseases of cattle, horses, pigs, sheep and goats, and poultry; however, since the start of 2009, no information on the status of these diseases has been provided to the OIE (see Annex 6 for full details). The fact that Guyana is free of FMD and does not practice vaccination against this disease in its national herd gives the country a comparative advantage over several of its neighbors (which have FMD and/or practice vaccination against FMD) as it is able to freely export carcasses and meat. Currently, however, Guyana does not have (a) any abattoirs which meet international food safety standards, and (b) animal pathology/laboratory facilities to certify that export meat is disease-free.

2.78. **The main risks identified by livestock (cattle) producers during the panel discussions include flood, drought, and theft.** The consequences of floods are three fold: first, in case of heavy floods, the animals, particularly the calves, are drowned; second, if the water does not recede within a few days, the lack of pastures may cause the animals to starve; and finally, animals which are weakened by the flooding and lack of grazing are much more susceptible to diseases and possible death. Farmers in Region 5 noted that in 2005 upwards of 40% of their calves were drowned in the severe floods. The main cause of death during a drought is starvation of the animals due to lack of grazing and water. Cattle rustling is a major issue for livestock owners in Region 6 of Guyana. The exposure of animals to contagious diseases was identified as being very low by livestock owners.

2.79. **The panel meetings with livestock producers identified a series of key constraints faced by livestock (mainly cattle) producers** including: (i) lack of access to grazing land is a major constraint for livestock owners in the coastal plains and there are conflicts with rice and vegetable producers; (ii) lack of access to investment capital with which to purchase land and cattle; (iii) lack of veterinary and animal husbandry services, which is a specific problem in Region 6 as the DoL currently does not have any permanent livestock extension or veterinary staff located in the region. The lack of veterinary services and inadequate breeding programs result in low productivity and low quality products. In Region 6 theft was reported as the major problem for cattle owners who complained that they had no legal redress to control this problem. Abattoir facilities are currently inadequate and do not meet the health and safety and certification standards required by international export markets in North America and Europe.

2.80. **Currently, livestock husbandry, management and sanitary standards appear to be very low for much of the cattle herd in Guyana and cattle do not meet the minimum animal health and management standards which are required by livestock insurers.** Many of the smaller cattle owners appear to keep cattle as a wealth asset which can be sold in times of need, for example to pay for hospital fees, funeral costs, education, or for purchasing crop inputs (seeds and fertilizers). In Guyana, law requires that cattle are branded with the owner's initials and registration number and that this number is registered with the Ministry of Home Affairs. However, individual animals are not tagged or registered with either the DoL or the local veterinary services. The lack of local grazing during the rice season means that many cattle are either grazed along the roadsides and/or left unattended to graze in the savannah areas. The low levels of husbandry do not meet the basic management standards which are required by livestock underwriters (see Chapter 3 for further discussion of issues relating to livestock insurance).

Aquaculture Risk Assessment

2.81. **It is not possible to perform a formal risk assessment of the Guyanese aquaculture industry because there are no centralized records for aquaculture production by farm, location and over time; in addition, there are no official records of losses incurred by the industry.** The lack of data and statistics for the aquaculture industry has prevented a formal risk assessment from being carried out. However, various general comments are made in the sections below.

2.82. **Flooding caused by excess rain** overreaching the capacity of the drainage system is the main risk exposure faced by both the fresh-water aquaculture farmers in Regions 2 to 6 and the swamp shrimp producers. In the presence of a major flood event, the fish-stock is likely to be washed out of the ponds, and the ponds and irrigation and drainage infrastructure may be severely damaged. It is notable that the aquaculture farms visited in Region 4 are now being built with very high levels of flood resistance including pond walls which are up to 2 meters higher than the flood plan and which are up to 5 meters in width.

2.83. **During the January 2005 catastrophic flooding in Regions, 3, 4 and 5, damage to the fisheries sub-sector was minimal.** According to the UN-ECLAC 2005 report the floods caused some damage to the Mon-Repos Aquaculture station resulting in losses in red tilapia fingerlings and some marketable hassar, as well as damage to the DoF building in Brickdam, with total flood damage assessed at only G$229,125 (Annex 7).

2.84. **Coastal flooding caused by seawater flooding over the sea wall is also a potential problem for the fresh-water producers of hassar and pacu.** Hassar and pacu are fresh-water species which do not tolerate saline conditions so, in the event of sea flood, the stock would die. Tilapia, however, has demonstrated a wide range of tolerance in Guyana to brackish water and it may be possible to salvage the fish-stock following sea ingress.

2.85. **Pests and diseases are one of the most serious problems faced by the fresh-water and marine aquaculture producers in countries where these sectors are highly developed and which utilize highly intensive production systems.** Ecuador, for example, experienced devastating problems of white-tail disease in its shrimp production industry in the 1990's and, most recently in 2009, the Chilean sea salmon industry has also been devastated by disease. In Guyana pests and diseases are currently not a problem in aquaculture according to Rahaman *et al* 2008[28]. This is due to the fact that, currently, there is very little aquaculture activity in Guyana, the fish-stock are reared under extensive or semi-intensive systems with low stocking densities, and pests and diseases associated with high intensive-high input-high stress systems have not yet had time to emerge in the Guyanese aquaculture industry.

2.86. **A major constraint to the expansion of fresh-water aquaculture in Guyana is the lack of suitable land which is not saline and/or has a high pH.** Rahaman *et al* 2008 note that Class I agricultural land is required for fish farming because the pH of the land is critical: tilapia needs a pH of 6.5-9.0, hassar 5.5-8.0 and only pacu will survive in low pH conditions of 3.5-7.5. In the coastal regions, there is a shortage of low salinity/high pH land for fresh-water aquaculture as this is already allocated to annual cropping.

2.87. **Pollution of fresh-water sources may represent a major exposure to farmers located in the coastal strip and whom rely on drainage water from the national canal/river irrigation system.** The fresh-water aquaculture farms visited during the current mission do not have their own water sources

28 Rahaman, Z, T. Velloza and M. Boyne (2008). The Development of a National Agriculture Sector Adaptation Strategy to Address Climate Change in Guyana: Technical Assessment of the Adaptation Options for the Agricultural Sector to Respond to Climate Change. Draft Report prepared for the Mainstreaming Adaptation for Climate Change (MACC) Project, Development Policy and Management Consultants, Queenstown, Guyana, September, 2008.

(e.g. pumped ground water); they rather rely on canal irrigation water from the conservancies. These fish-farms are located downstream of the sugar cane and rice farms and are exposed to accidental water pollution by agrochemicals which could result in the death of the stock.

2.88. **In Guyana, the absence of industry-level historical databases on aquaculture farming and losses due to natural causes is not an over-riding constraint to developing aquaculture insurance on a facultative or case by case basis.** This is because in the start-up phase of an aquaculture insurance program for Guyana, individual fish-farmers seeking quotes for insurance cover of their fish-stock and or installations and equipment will be subject to a full risk-inspection and management survey by a qualified and internationally recognized aquaculture-insurance specialist and insurance cover will be tailored to the specific farm on this basis. The main drawback is that the costs of an insurance risk survey and report may cost the owner US$10,000 or more if an international specialist has to be flown into Guyana to conduct the survey.

Chapter 3. Agricultural Insurance Opportunities and Challenges for Guyana

3.1. This Chapter provides a technical review of crop, livestock and aquaculture insurance products which are commonly available in international agricultural insurance markets, and their potential suitability to Guyanese farmers. To begin with, aspects of the demand for and supply of agricultural insurance are briefly considered.

Demand for and Supply of Agricultural Insurance in Guyana

3.2. **To date, no commercial insurance company in Guyana has underwritten any crop or livestock insurance policy.** On several occasions in the past, the commercial insurance market in Guyana has been requested to provide crop insurance – e.g. by the rice sector following the 2005 floods. However, no company has marketed any form of farmer crop, livestock or aquaculture insurance in Guyana. Issues relating to the supply of agricultural insurance are reviewed further in Chapter 4.

3.3. **In the absence of any agricultural insurance provision in Guyana, most farmers have no knowledge or awareness of this class of insurance.** Most Guyanese farmers have no knowledge of or experience with crop and livestock insurance and the potential benefits and constraints of such products. In the absence of a functioning agricultural insurance market, it is difficult to quantify objectively farmer's potential demand for these currently hypothetical insurance products.

3.4. **During this pre-feasibility study, some initial demand assessment work was conducted with the panel groups of farmers representing the rice sector, fruit and vegetable producers, livestock breeders and aquaculture producers.** With each group of farmers, a standard format was adopted whereby farmers were invited to identify their three major constraints to production in order of importance, and then asked to identify the key natural, climatic and biological risks they face in their main crop or livestock enterprise. Features of the different types of agricultural insurance products were then explained to farmers and, where appropriate, questions were asked on farmers' interest in/demand for agricultural insurance and willingness/ability to pay for insurance. It is stressed that these discussions were held with small groups of 10 to 20 farmers and the findings cannot be considered to be statistically representative.

3.5. **The findings of these group discussions suggest that, for many farmers, crop insurance is a very low priority compared to finding solutions to their value chain supply constraints.** Chapter 2 showed that Guyanese farmers are exposed to a wide range of production constraints including limited access to working capital, problems with the drainage and irrigation infrastructure, uncertainties along the value chain including high input prices, poor access to commodity markets, uncertain and low output prices, a lack of on-farm storage facilities and poor access to extension and training. For many of these farmers, their priorities are to overcome the supply chain constraints as opposed to purchasing agricultural insurance.

3.6. **Guyanese farmers live with and cope as best they can with the climatic risks of excess rain/ flooding and occasional irrigation water shortages (drought) and some were more concerned with cover for crop pests and diseases rather than climatic perils.** Both rice and fruit and vegetable farmers noted the problems of pests and diseases and the fact that even when they adopted the recommended prevention and control measures, their economic losses could be very high (e.g. paddy bug at milking stage in rice, blast in rice and red rice).

3.7. **Among rice producers, initial findings suggest that some farmers may be interested in purchasing area-yield index crop insurance especially if this guarantees them easier access to institutional production credit.** Between 10% and 20% of rice producers identified an interest in crop insurance, if this gives them access to institutional credit at affordable rates. However, farmers' willingness to pay commercial premium rates of between 5% and possibly as high as 10% for such a cover appears to be low. Issues of willingness to pay for and affordability of crop insurance will need to be studied further under a future full-feasibility study.

3.8. **Cattle breeders were mainly interested in insurance against catastrophic flood events leading to the death of their animals, drought causing a lack of grazing in *El Niño* years and theft of livestock, while fruit and vegetable producers were interested in cover against excess rain/ flood damage and pests and diseases.** These perils are, however, major challenges under a voluntary traditional insurance program: anti-selection is a major issue for flood insurance, namely, the tendency of farmers whose land is located in low-lying flood prone areas along the banks of canals or rivers to purchase flood cover, while those outside the flood prone areas not doing it. Experience shows that where underwriters grant pest and disease cover for crops, this often results in severe moral hazard as farmers do not adopt the often costly pest and disease control measures in the knowledge that they can claim losses under their crop insurance policies. Finally, in the context of Guyana, theft of livestock would be very problematic to insure. These issues are reviewed further in the sections below.

3.9. **Several fish farmers expressed a keen interest in purchasing aquaculture insurance.** The limited number of aquaculture producers met (including tilapia hatcheries and tilapia breeders and shrimp producers), expressed an interest in purchasing catastrophe natural peril/flood insurance cover as this was a precondition required by their lenders (banks). Such a cover was required to protect against loss of their fish-stock and also their major investments (using bank credit) in fish farm infrastructure and equipment (ponds, roads, irrigation and drainage equipment, fish cold stores, fish-feed stocks, etc.).

Crop, Livestock and Aquaculture Insurance Options for Guyana

3.10. Table 3.1 presents a summary of the main internationally available crop insurance, livestock insurance and aquaculture insurance products available and the World Bank's assessment of their potential suitability to the predominantly small-holder farming systems in Guyana in the **start-up phase** of any future market-based agricultural insurance program.

3.11. **While several traditional indemnity-based individual farmer crop insurance products are available, only single-peril or named-peril crop insurance might possibly be suitable for fruit and vegetable crops in Guyana.** Individual grower multiple-peril crop insurance (MPCI) is the most widely underwritten crop insurance product in the World but, in the start-up phase of any new crop insurance program in Guyana, this product cannot be recommended for reasons which are discussed further below. In the US, crop revenue insurance is available for some cereal crops: this sophisticated product provides protection against loss of crop yield and price loss, but cannot be recommended for Guyana because there are no internal commodity markets which can be used to provide price coverage.

3.12. **There is a range of new crop-index products of which area-yield index insurance is identified as a possible product which might be developed for individual rice farmers in Guyana.** Area-yield index insurance is an option for consideration. As there is a good basis for recording rice production and yields at zonal level (and possibly sub-zonal levels), this product might offer potential for Guyana (Table 3.1).

3.13. **Crop weather index insurance (CWII) is a relatively new product which is being offered in some countries as an alternative to traditional indemnity-based crop insurance.** CWII is a flexible product which can be offered at three levels: (i) as a micro-insurance product to protect individual farmers against climatic perils; (ii) as a meso-level insurance product to protect the loan portfolio of a regional bank, MFI or input supplier; and (iii) as a macro-level product which is sold to the government and which is commonly used as an ex-ante food security instrument against catastrophic drought. CWII options are reviewed in this Chapter, but it is stressed that the potential for this product in Guyana currently appears to be very limited (a) because of the lack of suitable weather stations and river-flow gauge stations, and (b) because most agriculture is irrigated and there appear to be very limited opportunities to develop such covers for rain-fed crops.

3.14. **The development of some form of remote sensing (NDVI or rainfall) pasture index to protect livestock against catastrophic drought may offer**

Table 3.1. Agricultural Insurance Products and Potential Suitability for Guyana in a Start-up Phase

Type of Agricultural Insurance Product	Basis of Insurance and Indemnity	Suitability for Guyana in Start-up Phase?
a) Traditional Individual Farmer Crop Insurance		
1. Named-peril (e.g. fire, excess rain)	Percentage damaged	Not suitable in the short term
2. Multiple-peril Crop Insurance (MPCI)	Loss of yield	Not suitable
3. Crop Revenue Insurance	Loss of yield/sale price	Not suitable
b) New Index based Agricultural/Livestock Insurance		
4. Area-yield Index	Area-yield loss	Possibly for the rice sector
5. Crop Weather Index Insurance	Weather index payout scale	Not suitable
6. NDVI (Normalized Difference Vegetative Index) Insurance	NDVI index payout scale	Not suitable
7. Livestock Mortality Index Insurance	Livestock mortality index	Not suitable
c) Traditional Livestock Indemnity Insurance		
8. Mortality Cover for individual animals	Animal accident and mortality	Not suitable in the short term
9. Livestock All-risk Mortality Cover	All-risk mortality/loss of use	Not suitable
10. Livestock Business Interruption Cover	Epidemic diseases in livestock	Not suitable
11. Bloodstock Cover for high-value animals	All-risk mortality/loss of use	Not suitable
d) Aquaculture Insurance		
12. Named-peril cover	Loss of fish-stock	Possibly for fish and shrimps
13. All-risk Cover	Loss of fish-stock	Not suitable

Source: **Authors.**

potential in the future, but cannot be recommended as suitable for Guyana in the short to medium term given the very limited state of market development of the Guyanese livestock sector.

3.15. **There are several traditional livestock indemnity products, the simplest of which is individual animal accidental injury and mortality cover.** This Chapter reviews the preconditions, issues and challenges for operating livestock insurance in Guyana.

3.16. **Aquaculture insurance offers cover against loss of both the fish-stock and the fish-farm infrastructure (ponds and equipment) and appears to offer potential in Guyana.** This Chapter reviews the types of coverage available and the potential for developing aquaculture insurance for fresh-water fin-fish and for brackish water/salt-water shrimps.

Rice Insurance Options for Guyana

3.17. This section reviews two types of cover for individual rice farmers: Individual Grower MPCI and Area-yield Index Insurance.

Individual Farmer MPCI Cover for Rice

3.18. **Traditional individual grower multiple-peril crop insurance (MPCI) is one the most widely practiced forms of crop insurance in the world.** The MPCI policy is an indemnity-based product which insures physical loss of crop production or yields against a wide range of natural, climatic and sometimes biological perils which may impact the crop from the time of sowing or crop emergence through to the final harvest of the crop. MPCI is very popular with farmers because it provides them with very comprehensive protection against yield losses in their own fields and, in some cases, the MPCI policy operates as an "all-risk" yield shortfall guarantee cover. The features, issues and challenges of introducing individual grower MPCI into Guyana for rice are summarized below and further details are contained in Annex 8.

3.19. **In order to design and individual grower MPCI policy it is necessary to have access to time-series, individual grower and field-level crop production and yield data.** The most important consideration in the design and rating of any individual grower MPCI policy is whether the grower can provide his own yield history for at least the last 7 to 10 years as a basis to establish: (i) the farmer's normal or average yield under his given technology and management levels; (ii) an agreed insured yield coverage level which may be set at between 50% and a maximum of 80% of the average yield, according to the level of protection required by the farmer; and (iii) the technical rates which are required to provide the individual farmer with MPCI cover. While farmers in developed countries are usually able to provide their individual crop production and yield history data for insurance purposes, in developing countries very few farmers are able to provide up to 10 years of accurate and independently validated yield data. This is an issue which applies to Guyana and although the GRDB and one private company (Rice Lab) are currently recording the seasonal production and yields of key sampled rice growers, neither source can provide up to 10 years of yield data for the 8,000 registered rice farmers in Guyana.

3.20. **The administrative and operational costs of operating individual grower MPCI are usually very high** because it is usually necessary to conduct pre-inspections on each insured farm and loss assessment requires in-field measurement of actual yield at the time of harvest. In many developing countries, the fixed overhead costs for an insurance company to recruit and train specialist crop-loss inspectors and to then adjust losses on small-farm units of 5 to 10 acres are prohibitively high. This is a very important consideration for Guyana where 60% of rice farmers cultivate less than 10 acres of rice per year.

3.21. **The international experience with individual farmer MPCI is, with few exceptions, extremely poor with problems of low uptake, high levels of anti-selection and moral hazard, high administration and operating costs, and underwriting results are usually negative.** Most voluntary individual grower MPCI programs suffer from very high levels of anti-selection and moral hazard; the programs are usually very exposed to systemic drought, flood and windstorm losses which correlate at the regional and national level; and the premium rates which have to be charged in order to cover the combination of high losses and high administrative costs are often in excess of 10% to 15%. Nearly all individual grower MPCI programs operate at a financial loss (negative underwriting results) and are dependent of government premium subsidies and/or government subsidies on excess claims.

3.22. **Currently, the basic preconditions for the design and implementation of individual grower MPCI do not exist in Guyana and therefore this product cannot be recommended for the rice sector in the short term.** This pre-feasibility study has shown that 10-year time-series individual grower rice production and yield data does not exist and therefore the design of an MPCI product is not technically feasible in Guyana. Moreover, the insurance companies do not have the large teams of trained staff to conduct field-level pre-inspections and yield-based loss adjustment. The issue of offering MPCI including flood cover to individual rice producers on a voluntary basis is also highly problematic in Guyana and it is unlikely that any insurer or reinsurer would be willing to consider this cover because of the problems of anti-selection in areas of a known and regular flood exposure. Finally, preliminary rating calculations applied to GRDB 14-year zonal rice yields show that if individual grower MPCI cover were to be offered in Guyana for a coverage level of 50% of average yields, commercial premium rates would need to be in the order of 9% to 20% of the sum insured, which is totally unaffordable in view of the relatively low gross margin returns to rice production (see Annex 8 for further details).

Area-yield Index Insurance for Individual Rice Farmers

3.23. **Outline proposals are presented below for a prototype Area-yield index program for spring and autumn paddy in Guyana, but it is stressed that further design work will be required if the private commercial insurers and/or the GoG decide to proceed with the pilot testing and implementation of this product.** A major technical exercise has been conducted under this pre-feasibility study to examine the potential to introduce "Area-yield index Insurance" cover for individual rice producers in Guyana, but it is stressed that there are several major issues which will have to be addressed before this can be considered a commercially viable option for Guyana. Full details of the Area-yield index product are contained in Annex 9.

Features, Advantaged and Disadvantages of Area-yield Index Insurance

3.24. **Area-yield index insurance represents an alternative approach to MPCI insurance which aims to overcome many of the drawbacks of traditional individual grower MPCI insurance.** The key feature of this product is that it does not indemnify crop yield losses at the individual field or grower level; rather, an area-yield index product makes indemnity payments to growers according to yield loss or shortfall against an average area yield (the index) in a defined geographical area (e.g. the region or the paddy production zone). An area-yield index policy establishes an insured yield which is expressed as a percentage (termed the "Coverage Level") of the historical average yield for each crop in the defined geographical region which forms the Insured Unit (IU). Farmers whose fields are located within the IU may purchase optional coverage levels which typically vary between a minimum of 50% and a maximum of 90% of historical average yield. The actual average yield for the insured crop is established by sample field measurement (usually involving crop cutting) in the IU and an indemnity is paid according to the amount that the actual average yield falls short of the insured yield coverage level purchased by each grower.

3.25. **The key advantages of the Area-yield approach are that moral hazard and anti-selection are minimized, and as the costs of administering such a policy are less onerous, this offers the potential to market this product at lower premium costs to farmers.** As the policy responds to yield loss at the county or district area-level and not at the level of individual farmer, no farmer can influence the yield indemnity payments and as such anti-selection and moral hazard are minimized. Administration costs are also greatly reduced because there is no need for pre-inspections on individual farms and loss assessment is not conducted on an individual farmer and field by field basis, but rather according to a pre-agreed random sampling of crop yields on plots within the area IU (see Annex 9 for further details).

3.26. **The main drawback of an area-yield index insurance policy is "basis risk" or the potential difference between the insured area-yield outcome and the actual yields achieved by individual insured farmers within the insured area.** Basis risk arises where an individual grower may incur severe crop yield losses due to a localized peril (e.g. hail, or flooding by a nearby stream or drainage canal), but because these localized losses do not impact on the county or district average yield, the grower who has incurred severe crop damage does not receive an indemnity (see Annex 9 for further discussion of basis risk in Guyana).

3.27. **Area-yield index Insurance has been widely adopted for small-holder rice and wheat cropping in India and where crop insurance is linked to seasonal crop credit.** India has operated a public-sector area-yield index insurance program for more than 30 years under its public-sector National Crop Insurance Scheme (NAIS). Crop insurance is compulsory for farmers who borrow seasonal production credit. Currently, this program insures about 20 million Indian farmers each year. Other countries which are operating area-yield crop insurance include the US and Brazil, and this product is being researched in parts of Africa and Asia (see Annex 9 for further details).

Preconditions for the Design of Area-yield Index Insurance for Rice in Guyana

3.28. **There are several preconditions for the operation of area-yield index insurance for rice in Guyana including: (i) homogeneous rice producing regions or zones with low basis risk; (ii) for the defined regions or zones, historical rice production and average yield data as a basis to establish the insured yield and technical rates; and (iii) an independent and statistically accurate system of measuring average rice yields in the defined region or zone and on which basis to trigger claims payments.** In Guyana, the GRDB measures and reports rice sown area, harvested area, production and average yields at a regional and zonal level for both the spring and autumn crops and 14 years of historical rice data from 1994/95 to 2007/08 are available for the purposes of this study.

3.29. **The GBRD reports rice sown and harvested area, production and yields for 9 homogeneous rice-growing "zones" in Regions 2 to 6** including: Region 2 (one zone, Essequibo); Region 3 (three zones, Leguan and Wakenaam Islands, and West Demerara); Region 4 (one zone, Cane Grove); Region 5 (two zones, Mahaica-Abary and West Berbice) and Region 6 (two zones, Black Bush Polder and Frontlands). Each paddy production zone, on average, comprises about 17,500 acres of irrigated paddy per season, ranging from a high of about 32,000 acres in Essequibo zone to a low of only 1,200 acres for spring rice gown in Leguan. For area-yield index insurance purposes a zone (defined as the Insured Unit, IU) of 17,500 acres seems to be an appropriate acreage as long as the farmers' rice production systems within the zone/IU are fairly homogenous (in terms of varieties, sowing dates, input utilization, crop management practices, and production and farm-level yields).

3.30. **A preliminary analysis of individual paddy grower yield performed under this study shows that there is a very high degree of variation in rice yields between individual farmers located within the same paddy production zone.** An analysis of individual farmer paddy yields over the past 5 years in each zone shows that there are major differences in the paddy yields obtained by different farmers situated in the same paddy production zone during the same crop season. The coefficient of variation (CoV) of individual farmer average yields is highest at 26% CoV for the spring paddy crop, compared to 23% CoV for the autumn paddy crop. The farm-level variation in yields is highest in West Berbice (36% CoV for spring paddy) and lowest in West Demerara (16.5% CoV for spring paddy) (see Annex 9, Table 9.1).

3.31. **The variation in paddy yields among different farmers within the same rice-growing zone also tends to increase during catastrophic flood or drought years.** The analysis of spring paddy CoVs between 2003/04 and 2007/08 for Mahaica-Abary, West Berbice, and Cane Grove shows that the analyzed CoVs are higher in 2005/06 than in the other crop seasons as the 2005/06 spring paddy crop was severely affected by floods.

3.32. **The analysis of individual farmer rice yields indicates that there is a high potential for basis risk under an area-yield index insurance program in Guyana that adopts the GRDB rice "zone" as the area IU.** The main way to reduce basis risk is to reduce the area or zone boundaries to a smaller geographical area which hopefully shows a more homogeneous pattern in terms of crop production systems and farmers' rice yields. However, if farmers' cropping practices and drainage and irrigation infrastructure and management are highly heterogeneous, reducing the size of the IU will have little or no impact on reducing basis risk. This issue is a major concern in Guyana where it appears that drainage and irrigation infrastructure and exposure to flood and or water shortages (drought) are highly heterogeneous within each zone and sub-irrigation catchment area.

Rice: Area Yield Coverage Levels, Sums Insured and Calculated Premium Rates

3.33. **Area-yield index insurance policies normally offer optional insured yield coverage levels of between a maximum of 90% and a minimum of 50% of the annual average area-yield.** The 90% down to 50% of zonal average yields for paddy rice are shown by zone and by crop season in Annex 9, Table 9.2. The highest 5-year zonal average yields for spring paddy are found in Essequibo at 28 bags per acre; the lowest average yields for spring paddy are in Leguan zone at 16 bags per acre. Average yields for autumn rice are about 5% to 10% lower than the spring crop.

3.34. **Under an area-yield index insurance, the insured crop yields can be valued either on a costs -of-production basis or on a farm-gate sale price basis.** For the purposes of this exercise, paddy rice was valued at the 2008-09 average prices paid to farmers for the spring and autumn paddy in each region as reported by the GRDB. These prices range from an average of G$2,370 per bag for spring rice, to a slightly higher average of G$2,250 per bag for autumn rice (see Annex 3, Table A.3 for full details).

3.35. **A preliminary estimation of the technical rates for an area-yield index Insurance program for rice is presented in this report, using an internationally accepted crop-rating methodology.** Annexes 3 and 9 present full details of the methodology used in this report for establishing the technical rates for an area-yield index policy for rice using the GRDB's 14-year zonal rice production and yield statistics and for coverage levels from a minimum of 50% up to a maximum of 90% of average zonal rice yields per season.

3.36. **The rating analysis shows that spring paddy yields are usually much more variable and exposed to flood and drought risks than the autumn harvested paddy crop and also that there are major differences in risk exposures between the GRDB's rice zones.** The very much higher spring season risk exposure in paddy is reflected by the higher average technical rate for 80% coverage level of 3.7% for all risk zones compared to an average rate of only 2.5% for the autumn crop. There are major variations in the calculated technical rates across zones with an 80% coverage in spring crops, from a low of 2.4% in Essequibo and Black-Bush Polder where spring rice yields are normally very stable, to a high technical rate for spring rice of 15.7% in Leguan Island where rice production is very marginal on account of the insecure water supply (by and large dependent on rainfall). For autumn rice, calculated technical rates for 80% yield coverage show very much lower variation between zones from a low of 2.16% in Essequibo, Cane Grove, Mahaica-Abary, Black Bush Polder and Frontlands, to a high of only 4.4% in Wakenaam (see Annex 9, Table 9.3).

3.37. **Indicative commercial premium rates are presented in this report, but it is stressed that these rates are purely illustrative and that final rating decisions will be taken by insurers and their reinsurers.** The commercial premium rates have been calculated assuming a target loss ratio of 65%. Under these assumptions, the calculated average commercial premium rate for spring paddy with 80% insured yield coverage level is 5.67% compared to an average of 3.9% for autumn paddy. The corresponding range of commercial premium rates for spring rice is between a low of 3.7% for Essequibo and a high of 21.3% for Leguan (Annex 9, Table 9.4).

3.38. **Some preliminary estimates of the Probable Maximum Losses (PML)** which might be expected under an area-yield index program for rice are presented in Annex 9. For an 80% coverage level, the 1 in 100 year PML for spring rice might be as high as 31% of the spring crop insured values (VAR) and for the autumn rice crop, about 27% of the autumn crop VAR.

Coverage Levels, Affordable Premium Rates and Demand for Rice Insurance

3.39. **Under an area-yield crop insurance program, the coverage level in each paddy crop production zone should be set in accordance with: (a) the underlying risk exposure and frequency, and (b) a commercial premium rate that is affordable to the farmers.** In order for a crop insurance scheme to be both affordable to farmers (no more than 5% to 10%) and sustainable, the insured yield coverage level should be set at a level where maximum payouts are no more frequent than 1 in every 5 to 1 in every 7 years. Commercial premium rates for area-yield index insurance that are set too high discourage farmers from purchasing crop insurance and do not allow the scheme to achieve the economies of scale and premium volume which are necessary for the scheme to be sustainable over time. On the basis of the feedback received from farmers during the focus group meetings, the commercial rates should not exceed 5% of the sum insured for coverage levels of 80%. This means that in the highest risk zones of Leguan, Wakenaam and West Demerara, the maximum coverage level that could be offered for spring rice is 50% of average yield: conversely in the lower risk zones, coverage levels of 80% could be offered for commercial premium rates of less than 5%.

3.40. **Farmer's willingness to purchase voluntary area-yield index insurance is an important issue to take into consideration if area-yield index crop insurance is to be introduced for rice into Guyana.** According to the information obtained from the focus group meetings, most of the paddy farmers in Guyana would not be interested in purchasing area-yield index insurance. The reasons behind farmers' lack of interest in rice crop insurance include: (i) farmers' lack of insurance culture; (ii) low profit margins for paddy cultivation; and (iii) their perceptions that area-yield index insurance is too expensive.

3.41. **In general, paddy farmers perceive area-yield index insurance as being too expensive.** Preliminary exercises indicate that the demand for area-yield index insurance will be low. According to an exercise performed with the farmers during the Frontlands' (Region 6) and Mahaica-Abary's (Region 5) focal group meetings, only a small proportion of between 10% and 20% of the farmers would be willing to purchase area-yield index crop insurance for 80% coverage level assuming that they would have to pay a commercial premium of 5% (see Annex 9 for further details).

3.42. **Some preliminary portfolio estimates have been calculated for area-yield index rice insurance assuming uptake rates of between 5% and 10% of the average sown area of rice.** Under the assumptions of an 80% insured yield coverage level and 5% uptake rate of insurance, the total annual insured area for both the spring and autumn crops might amount to nearly 14,000 acres, with Total Sum Insured (TSI) of G$696 million generating total premium income of G$33.4 million (average rate of 4.8%). With a 10% uptake rate these estimates would be doubled (Annex 9). However, under a voluntary program, it is extremely unlikely that even a 5% uptake rate would be achieved over time. This theme is considered in further detail in Chapter 4.

Conclusions on Area-yield Index Insurance for Rice in Guyana

3.43. **Area-yield index Insurance for rice is technically feasible in Guyana, but basis risk is likely to be a serious drawback of an <u>individual farmer micro-level insurance program</u> operating at a "zonal" level and further research is required before such a cover can be recommended for implementation.** The GRDB is adopting a statistically designed and comprehensive system for seasonal rice-yield measurement which, with minor improvements, would meet international reinsurers' requirements for operating an area-yield index insurance program for rice. However, the preliminary analysis of individual farmer's paddy yields indicates that the variation in individual farmers yields within each GRDB risk zone are often very high and that the element of basis risk due to this high yield variation may pose a serious problem to the successful operation of an area-yield index insurance program.

3.44. **Area-yield index Insurance for rice could also be underwritten in Guyana as a meso-level product designed to protect the season loan portfolio of agencies which are lending to rice producers (banks or MFIs).** There would be two advantages in offering area-yield index insurance at a meso-level or aggregate product: (i) the basis risk would be much less of a concern than under an individual grower program; and (ii) the transaction costs involved in this coverage would be lower than in the **individual farmer micro-level insurance**. This option is reviewed further in Chapter 4.

3.45. **A third option for area-yield index Insurance for rice could also be underwritten in Guyana as a macro-level product designed to protect a governmental contingency fund to assist paddy farmers affected by catastrophic events.** Under this option, the GoG would purchase an area-yield index insurance policy which provides payouts to the government in case that the actual production for paddy in any of the paddy production zones defined as "insured units" falls short of the guaranteed yield established in the policy. **It is recommended that this insurance policy is designed to provide a basic catastrophe coverage** (i.e. to provide coverage for low-frequency but high-severity events) to all the farmers registered in the different paddy production zones along the country. This type of insurance instrument has three main advantages. The first one is that the GoG would get the funds to assist the affected farmers relatively quickly in the event that the actual paddy yields in a certain zone falls short of the guaranteed yield: the GoG would receive the insurance payouts as soon as the determination of the actual yield for the affected zone is done after the crop season. The second advantage for the GoG is that the cost of a contingency fund backed by an aggregate area-yield index-insurance policy would be financed through an annual premium which could be easily included in the annual budget. The third advantage is that the basic coverage provided by the GoG could easily be complemented by whoever is interested in purchasing additional cover in the insurance market. Preliminary estimates indicate that the premium that the GoG would have to pay to offer catastrophe coverage for 278,000 acres of rice at 50% level of coverage for the spring and autumn seasons would be about G$205 million (US$1 million) per year.

3.46. **It is recommended that before any decisions is taken on whether to proceed with the design and implementation of an area-yield index insurance**

program for rice, the local stakeholders should first conduct a more detailed analysis of yield variability and basis risk in the GRDB defined zones. This follow-up study should be conducted on a as large sample as possible of historical GRDB and Rice Lab individual farmer rice yields, and for as many years as possible, and should focus on: (i) quantifying the degree of basis risk, especially in major flood or drought prone areas and years and; (ii) examining whether it is feasible to reduce basis risk by redefining the current GRDB zones and by scaling down to a smaller geographical area unit.

3.47. **Farmers' demand for and willingness to pay for crop insurance for rice will also have to be studied further** before any decisions are made to proceed with the design of an area-yield index insurance program. The pre-feasibility study has identified a low level of voluntary demand for rice crop insurance by the admittedly small sample of farmers met during the focus groups conducted for this study. Prior to investing further time and effort in the design of an area-yield index insurance scheme, it is recommended that a formal crop-insurance demand assessment study be implemented by the interested parties.

Fruit and Vegetables (Named-peril Cover) Insurance for Guyana

Features of Named-peril Damage-based Crop Insurance Policies

3.48. **Fruit and vegetables are, in general, very much more difficult to insure under a traditional indemnity-based or loss-of-growing crop insurance policy than cereal crops because damage by insured climatic perils usually involves both physical yield losses and qualitative losses; furthermore, the fruit and vegetables are often harvested over an extended period of time.** In cereals, physical damage is relatively straightforward to measure during the growing season because the crop is harvested at a single time when grain is mature and ripe, so yield-based loss assessment can be conducted immediately pre-harvest. In fruit and vegetable crops, however, damage or loss to the crop is usually a combination of quantitative or physical damage, and qualitative damage or quality-price downgrading. There are major challenges to design (a) an insurance and indemnity payout system that will cater to both physical loss and quality downgrading in the fruit or vegetables, and then (b) field-based loss assessment procedures for measuring physical damage and qualitative losses. A further complication is that, for many fruit and vegetables, the crop matures and is harvested over a period of weeks or even months and when losses occur it is necessary to adjust the policy for the amount of crop which has already been harvested.

3.49. **Fruit and vegetables are usually insured under a Named-peril damage-based insurance and indemnity policy, rather than under a MPCI loss-of-yield policy.** The MPCI loss-of-yield policy is widely adopted for cereals in many parts of the world, but in the case of fruit and vegetables, a loss-of-yield based insurance and indemnity cover is usually not appropriate. Key reasons include the difficulty of accurately establishing a normal average yield against which yield loss can be measured, and the problem of multiple harvesting of the crop over time. It is therefore conventional to use a percentage damage-based policy and to insure losses due to key named-perils only (further information on the features of named-peril policies are contained in Annex 10).

3.50. **Under a damage-based indemnity system, physical loss or damage to the crop is measured in the field soon after a specific loss event occurs due to an insured peril and the claim is usually settled shortly after the time of loss.** Normally the damage is measured as a percentage loss, and this percentage is applied to the agreed sum insured (i.e. incurred production costs) for the crop. The sum insured may be adjusted downwards if the actual crop is found to be below the normal production potential for uninsured reasons, for example, poor crop establishment. A deductible is usually applied to the loss expressed as a "percentage damage" although this can be a fixed value. This method is most applicable to programs with single or a limited number of discrete event perils (e.g. hail, windstorm, frost).

3.51. **The key advantages of a named-peril damage-based indemnity policy include:** (i) there is no need to collect time-series individual grower production and yield data, on which basis to establish a normal average yield and then an insured yield, because the policy uses a damage-based indemnity procedure rather than loss of yield; (b) the sum insured can be set according to an agreed value per acre, based either on production costs, or production costs plus an element of the expected gross margin profit, or finally a revenue valuation based on the farm-gate sale price of the crop times the expected output; and (c) loss adjustment is based on percentage damage estimation to the crop according to its growth stage, and this procedure is usually easier and cheaper to implement than yield-based loss assessment.

3.52. **The drawbacks of damage-based crop insurance and indemnity policies include:** (i) the product is best suited for specific event perils that cause obvious and easily measured damage to the crop such as hail or wind, and sometimes frost or excess rain, but it is not suitable for progressive perils which impact over time on the crop such as drought and where losses can only be objectively measured in terms of yield reduction or loss; and (ii) the product is not very suitable for other perils such as flood. Indeed flood is not offered by insurers as a single-peril on traditional indemnity-based crop insurance policies because of the problems of anti-selection.

Opportunities and Challenges for Designing Named-peril Crop Insurance for Fruit and Vegetables in Guyana

3.53. **There are major challenges in the design of named-peril damage policies for the huge range of fruit and vegetables grown in Guyana as cover would need to be tailor-made for each crop; in the start-up phase of any crop insurance program it would be necessary to focus on a few key fruit and vegetables.** For each fruit or vegetable type, the indemnity structure will have to be tailor-made and decisions taken as to whether the policy will only protect against physical loss, or physical and qualitative losses (quality price-downgrading), and the damage-based loss assessment procedures which have to be designed accordingly for that crop.

3.54. **Under the pre-feasibility study, the GMC/MoA indicated their focus in any start-up phase for insurance would be on 4 priority crops including plantains, pineapple, peppers and pumpkins.** Although these are identified as priority export crops under the ADP, currently the GMC is only in the process of identifying the farmers who will participate in the cluster groups and the investment projects for these export crops. Furthermore, it was not possible during the field visits to identify any semi-commercial farmers who produce these crops, which also were not grown by many of the farmers met in the focus groups. The information on the production of these crops is very restricted but summary details are given in Table 3.2 for 2008.

3.55. It is apparent from Table 3.2 that currently the scale of production in Guyana of these four priority crops is very restricted, with a total of 98 ha of pineapple production in Regions 2 to 4 and 237 ha of plantains in Regions 2 to 6. As such, the potential scale of a voluntary named-peril crop insurance program for these crops is likely to be very small in the short-term.

3.56. **Fruit and vegetable farmers identified flooding, excess rain, pests and diseases and periodic water shortages (drought) as important constraints, but there are major challenges over the insurability of these perils under a named-peril damage-based indemnity policy.** It was not possible to conduct a formal assessment of the climatic risk faced by plantain, pumpkin, pepper and pineapple producers under this pre-feasibility study. The general list of perils identified by fruit and vegetable producers included flood, excess rain, pests and diseases, and periodic water shortages (drought). The challenges of insuring these perils are identified as follows:

i. **Pests and diseases.** While some MPCI policies extend cover to uncontrollable pests and diseases, the authors are not aware of any named-peril crop insurance program for fruit and vegetables anywhere in the world where underwriters are willing to grant pest and disease cover. The authors do not believe therefore that pests and diseases can be considered in Guyana.

ii. **Water shortages (drought).** Vegetable farmers noted that they experienced irrigation water shortages during *El Niño* years, or about one in every 10 years. Drought impact can, however, only be measured under a loss of yield-based indemnity policy and could not be considered under a named-peril damage-based policy for fruit and vegetables.

Table 3.2. Cultivated Area of Priority Fruit and Vegetables

Cultivated Area by Region (hectares)						
Crop	Region 2	Region 3	Region 4	Region 5	Region 6	Total
Plantain	72.0	79.3	15.6	30.0	40.0	236.9
Pumpkin	20.2	60.0	11.9	15.0	7.6	114.7
Hot Pepper	6.8	36.5	24.3	38.0	42.5	148.1
Pineapple	46.4	42.0	10.1			98.5

Production by Region (metric tons)						
Crop	Region 2	Region 3	Region 4	Region 5	Region 6	Total
Plantain	1,156.0	1,078.5	212.2	408.0	544.0	3,398.6
Pumpkin	275.2	816.0	161.8	204.0	103.4	1,560.4
Hot Pepper	77.7	416.1	277.0	433.2	484.5	1,688.5
Pineapple	788.9	714.0	171.7			1,674.6

Source: National Bureau of Statistics (2008).

iii. **Excess Rain.** For crop insurance purposes, excess rain damage is a separate and distinct peril from flood. Excess rain damage is caused by the direct impact of heavy or prolonged precipitation falling onto the insured crop and which causes a combination of physical and quality damage to the standing crop and, in addition, may cause standing water and water-logging of the soils and secondary damage to the crop due to anaerobic conditions. For specific crops, it might be possible to design a conventional damage-based indemnity product which insures against excess rain damage. In the context of Guyana, the biggest single challenge will be trying to obtain excess rainfall damage data to design and rate such a product, as it appears that this data does not exist. This cover is distinct from flood which is considered below.

iv. **Flood.** Flood is defined as water which originates from off-farm sources such as rivers and reservoirs and irrigation or drainage canals, and which flown into the insured farm causes physical and qualitative damage to the insured crop; this may involve standing flood waters for days or even weeks according to the severity of the flood. Flood is one of the most difficult perils to insure, coverage is very restricted in international crop reinsurance markets, and seldom insurable unless it is part of a MPCI program. In Region 5, vegetable farmers noted that they had experienced 4 severe floods in the past 10 years with a worst-loss year in 2005.

3.57. **In Guyana, flood exposure is both known and predictable in major parts of the coastal plains and the situation is complicated by the fact that flood exposure is highly related to and influenced by the management of the irrigation and drainage system.** Given this complex situation, it is highly unlikely that insurers and their international reinsurers will agree to provide open-ended flood cover for fruit and vegetables grown anywhere in Region 2 to 6. To the contrary, it is likely that flood cover would carry a major series of exclusions and or restrictions.

3.58. **The lack of data and statistics on fruit and vegetable production and, especially historical data on the damage caused to each type of fruit and vegetable by different climatic perils (including excess rain, flood, etc.), is a major constraint to the design and rating of a traditional named-peril damage-based policy for these crops.** In the short to medium term the only way to address this problem would be to try to conduct a farm-level risk assessment survey with key fruit and vegetable producers and to attempt to evaluate their loss histories over the past 5 to 10 years for key selected crops and perils, and then combine these findings with damage severity distributions at different stages of crop growth which would be drawn up in consultation with the GMC/MoA fruit and vegetable production specialists.

3.59. **On the basis of this pre-feasibility study it is concluded that there is little opportunity for the development of named-peril crop insurance for fruit and vegetable crops in the short term.** The main reason for the impossibility of developing named-peril crop insurance is the lack of any detailed vegetable production and yield statistics and gross margin data, as well as a lack of recorded damage data in the country with which to design and rate suitable crop insurance cover for these crops. The second reason is the absence of formal market mechanisms and major price risk exposure for fruit and vegetable producers in Guyana; until these supply-chain issues have been addressed, farmers demand for fruit and vegetable crop insurance appears to be very low. Since 2009, the GMC has started to create a national database of fruit and vegetable growers and it is expected that, in the near future, a more reliable market information system for fruit and vegetables production will be in place in Guyana. Furthermore, it is considered that the role of crop insurance will remain very limited until the ADP project has been able to develop an assured supply of high-quality fruit and vegetables for export from local farmers, and guaranteed export markets have been established. At that stage, it may be appropriate to consider the design and implementation of named-peril fruit and vegetable insurance programs.

Livestock (Cattle) Insurance for Guyana

Main Types of Livestock Insurance Products Available

3.60. **The international insurance market for livestock is much smaller than the crop insurance market** accounting for about 4% of the total global agricultural insurance premiums written in 2008. The classes of animal which can be insured under a livestock insurance policy include cattle and water buffalo, sheep and goats, pigs, horses and donkeys, pets (cats and dogs), poultry, and aquaculture.

3.61. **The types of livestock insurance policy available are listed in Box 3.1.** The most common form of livestock cover is **individual animal mortality** cover which insures losses arising from death and accidental injury due to natural causes such as fire, lightning, flood, etc. Additional coverage can sometimes be purchased for veterinary expenses, transport and non-epidemic/non-contagious diseases. Exclusions usually include all epidemic diseases, theft, and loss of economic use of the animal. The sum insured is usually based on the market value of the animal and this decreases over time according to its age. For individual animal insurance, premium rates range from 1.5% to 10% of the sum insured based on the type of animal, its age, location and the tasks it performs. For individual animal cover, deductibles range from no deductible to a coinsurance on the value of the claim of between 10% and 20%.

3.62. **In some markets, All-risk Livestock Mortality Insurance is available, and in a few countries specialized Business Interruption Cover is available for Class A epidemic diseases** of cattle and poultry, albeit on a very selective basis.

3.63. **Livestock mortality index insurance is a very new form of livestock insurance** that has only been piloted in Mongolia to date. It may have potential for development in countries where livestock production is exposed to catastrophic losses and where national livestock census data and catastrophe mortality data can be readily collected and at low cost.

Opportunities and Challenges for Livestock (Cattle) Insurance in Guyana

3.64. **This study has shown that livestock (cattle) breeders in Guyana face a series of mainly supply chain constraints** including a lack of access to grazing, as most irrigated land in the coastal regions is cultivated with sugar cane, rice and other crops; a lack of domestic demand for livestock products (beef and milk) and therefore very low prices for these products; a lack of access to institutional credit with which to invest in their livestock enterprises; high costs of animal feeds and vaccines; theft, which is a major problem in some regions; and finally, a lack of access to livestock husbandry and extension services.

3.65. **The natural perils faced by livestock (cattle) breeders include, in order of priority, flood causing**

Box 3.1. Typology of Livestock Insurance Products

A. Traditional Indemnity-based Products:

Range of Products	There are a number of livestock insurance products, which range from basic animal mortality and accidental injury covers, to comprehensive all-risk insurance including epidemic diseases. In addition, specialized policies are available to cover loss of animals in transit or at exhibitions, carcass rejection at the slaughterhouse, loss of use, and pet insurance.
Mortality Cover	The most common form of livestock insurance cover is named-peril animal mortality cover. Mortality cover commonly insures against death or accidental injury requiring slaughter because of suffocation due to machinery breakdown; poisoning and pollution; fire, lightning and explosion; flood and windstorm; subsidence and landslide; riot, strike and malicious damage. Standard mortality cover generally excludes: diseases and especially epidemic disease and all forms of consequential loss and legal liability.
All-risk Cover	In some countries, all-risk mortality cover is extended to cover named diseases or epidemic diseases, with an accompanying high deductible and/or high rates (e.g. Germany, Czech Republic, Hungary).
Consequential Loss/Business Interruption Cover for Epidemic Diseases	Specialized policies which are designed to indemnify both loss of animals following an epidemic, and also the reduction or loss of income arising out of the ban on sales of animals or animal products (milk, eggs, etc.) for up to 12 months post-event (e.g. Germany since 1990 and Mexico since 2005).
Bloodstock Insurance	Insurance for high-value animals (e.g. race horses, semen bulls and prize cows). The insured perils commonly include mortality, disability, infertility, medical treatment and surgery.

B. New Livestock Index Products:

Livestock Mortality Index Cover	Mongolia is currently the only country offering livestock breeders a catastrophic winter-freeze mortality index policy for their livestock.
Livestock Pasture-grazing Index Cover	Several countries including US, Canada, Spain and Mexico have developed remote sensing (satellite) based NDVI (normalized difference vegetative index) pasture-grazing indexes for livestock producers which are designed to respond to drought-induced degradation of the natural grazing/pasture during the season and to cover the additional costs of purchased feed incurred by the livestock producer.

Source: **Authors.**

death of their cattle, theft, and drought/lack of grazing in *El Niño* years which increases their working costs for the purchase of supplementary feeds. Standard livestock mortality insurance is unlikely to be able to meet these identified needs with the possible exception of flood cover. From a livestock insurance viewpoint, flood may be very difficult to insure in areas of known and predictable flood exposure in much of Regions 2 to 6, and it is extremely unlikely that underwriters will accept to insure against theft of livestock for the reasons discussed below. Finally drought does not usually result in the death of the animals from starvation and a standard livestock mortality insurance policy does not cover additional costs when supplementary animal feeds have to be purchased.

3.66. **There are a series of standard preconditions for the operation of livestock insurance, but currently few of these preconditions are met in Guyana.** Box 3.2 lists the main preconditions for the operation of a livestock insurance scheme including key conditions such as the tagging of individual animals for identification purposes and registration of all animals. This is a precondition for offering theft cover in livestock. Currently, however, in Guyana legislation only requires for that the animal be branded with the owners herd number and there is no system for identifying individual animals; under these circumstances, underwriters will not grant theft cover. A major requirement for the operation of livestock insurance is the presence of qualified veterinarians who can conduct pre-inspections of each insured animal to certify the animal is in sound health and then, in the event of loss, to inspect the carcass and to confirm that the cause of death is due to an insured peril. Currently the DoL is constrained by a lack of financial resources and a shortage of veterinary staff. Furthermore, in the absence of a functioning pathology laboratory, the DoL staff can only conduct visual diagnoses of the cause of animal death. From an insurance viewpoint, if insurance covers named-livestock diseases, this is conditional on having disease diagnostic capabilities in the country. Finally, in the absence of a formal livestock mortality database, it is very difficult to design and rate a livestock insurance product(s) in Guyana.

3.67. **In conclusion the possibility of developing livestock (cattle) insurance in Guyana is very limited in the short term.** There are several reasons for this conclusion. First, most small-scale livestock production in Guyana is performed for subsistence purposes and is not suited for livestock mortality insurance. Second, most of the livestock production systems in Guyana are free-grazing (roadside and savannah); livestock insurers would not accept the risk under these conditions. Third, animal registration and tagging are preconditions for livestock insurance; in Guyana, there is currently no system of individual animal registration or identification. Fourth, the country lacks a formal livestock mortality reporting system and database; thus, it is not possible to perform any rating exercise for livestock insurance purposes. Last, but not least, the livestock veterinary service is stretched and there are very limited animal disease pathology/laboratory services in Guyana.

3.68. **Opportunities for developing remote sensing NDVI pasture/grazing indexes for livestock owners are currently very limited in Guyana** for a number of reasons. NDVI indexes are most applicable in territories with large-scale homogeneous pasture and grazing areas such the ones found in Canada, the US and parts of Spain, and where changes in grazing quality due to drought stress can readily be indexed using remote sensing technology. Conversely, in Regions 2 to 6 of Guyana, grazing land is very fragmented and interspersed with irrigated annual cropping, and variations in soil type and salinity, etc. may complicate any attempts to develop a NDVI pasture index. Furthermore, until the livestock industry in Guyana moves onto a commercial footing with improved grazing and pasture management, there is little role for a NDVI index cover.

3.69. **The ADP intends to overcome many of these constraints** by the introduction of improved cattle

Box 3.2. Preconditions for the Operation of Livestock Insurance in Guyana

Key Preconditions for Livestock Insurance	Key Findings from Field Surveys (Regions 2-6)
Commercially managed beef and dairy enterprises.	Many small herds are raised purely for subsistence purposes and are uninsurable.
Individual animal identification (tagging) and registration.	No system of individual animal tagging or livestock registration system exists in Guyana.
Veterinary pre-inspections to certify animal is in sound health.	The DoL livestock veterinary and extension services are very under-resourced and there are no permanent staff in Region 6.
Animals must be contained within farm boundaries and free-range grazing is not permitted.	There is a lack of suitable grazing land in much of the coastal region. Many animal are free-grazing (road-side and savannah).
Loss notification and inspection procedures must be in place and animal pathology services available.	There are limited veterinary pathology/laboratory services in Guyana and restricted number of veterinarians to perform loss inspections.
Mortality data is essential for rating purposes.	No formal livestock mortality databases exist in Guyana.

breeding stock, investment in the development of improved livestock husbandry and veterinary services, including a national animal pathology laboratory and investment in a new abattoir which meets international export stands. **Once these improvements are in place and a commercial beef production and export industry has been established, there may be demand from cattle farmers for some form of livestock mortality insurance cover.**

Aquaculture Insurance for Guyana

Features of Aquaculture Insurance Policies

3.70. **Aquaculture is a small and highly specialized class of livestock insurance** which ranges from on-shore fresh-water fish insurance (e.g. trout, tilapia, carp, which are raised in ponds or tanks); brackish-water or estuarine insurance for shrimps and shellfish, to off-shore deep seawater insurance for fish (most commonly salmon and sea bass, which are contained in floating cages).

3.71. **Aquaculture insurance policies typically cover mortality of the fish-stock as well as protection against physical loss or damage to the insured ponds, cages, installations and equipment. There are two types of policy coverage: (a) Named-peril or (b) All-risk insurance.** Insured perils typically include natural meteorological events, such as storm and flood damage. However, aquaculture breeders may elect, on a case by case basis, to request insurance against diseases in their fish-stock, pollution, predator attacks, collision, oxygen depletion, changes in pH and salinity, theft and escape. Underwriters will only grant these additional perils if the owner has high-management, loss-prevention and control systems in place. The sum insured is usually set in accordance with the value of the fish-stock each month and it is customary to set a maximum aggregate limit per site. Premium rates range between 3% and 10% of the sum insured and deductibles range between 15% and 30% for each and every loss, both depending on the species, location and the conditions in which the stocks are kept. Further details of the insurance coverage offered by aquaculture policies are contained in Annex 11.

3.72. **The international aquaculture market is dominated by a small number of international reinsurers** including SwissRe and MunichRe and, to a lesser extent, SCOR, HannoverRe, PartnerRe, Sunderland Marine and various syndicates at Lloyd's. In well established aquaculture insurance markets such as Chile, Norway, Scotland, Canada and parts of Asia, these reinsurers are willing to grant treaty reinsurance capacity to local insurers. However, most of the international insurance and reinsurance market for aquaculture is placed on a facultative or case by case basis and is subject to pre-inspections and risk surveys by international aquaculture specialists. Also, reinsurers usually insist on appointing their own independent loss adjusters to attend and assess losses.

Opportunities and Challenges for Aquaculture Insurance in Guyana

3.73. **On the basis of this pre-feasibility study there would appear to be a demand for aquaculture insurance by the medium-sized producers who are investing large capital sums in new tilapia and shrimp farms in the coastal regions and who require insurance as a precondition by their lenders/investors.** The capital investment costs in establishing a new semi-intensive on-shore fish farm vary from about US$15,000 to $20,000 per acre, including all costs of land acquisition, leveling, pond construction and irrigation, and drainage investment. Following several recent years of severe floods in the coastal regions, banks are now reluctant to lend to aquaculture producers unless they have flood and natural peril insurance cover. To date, several companies have made enquiries to the local brokers[29]/local insurers about the possibility of purchasing aquaculture insurance from international markets, but no company has actually placed such a cover.

3.74. **In principle, there are no technical constraints to individual fish farmers in Guyana from seeking quotations from international aquaculture insurance and reinsurance markets on a facultative or case by case basis.** Specialized reinsurers may be willing to analyze aquaculture insurance proposals from commercial aquaculture

29 Abdool & Abdool Inc. Insurance Brokers & Financial Consultants, based in Georgetown, is a leading insurance intermediary which is actively working with the aquaculture industry to identify its risk transfer requirements.

companies in Guyana and to offer restricted cover against natural perils including flood; however, as a precondition for their support, they will require full pre-inspection and risk surveys of the fish farms to be carried out by designated international aquaculture risk surveyors and to appoint their own loss adjusters These two factors will add significantly to the costs of aquaculture insurance in the start-up phase.

3.75. **There is no aquaculture underwriting expertise in Guyana and it will be necessary to develop local expertise in this class of business over time.** Currently there is no local expertise in Guyana to underwrite or to adjust losses in aquaculture insurance; therefore, in the short term, this expertise will have to be contracted from overseas markets. In the short term, the contracting of international aquaculture underwriting and loss adjustment expertise will add significantly to the premiums that will be charged to the aquaculture farmers. In the medium term, as the demand for aquaculture insurance increases, it is hoped that local underwriting expertise can be developed in Guyana and the costs of coverage reduced.

Crop Weather Index Insurance

3.76. **Crop weather index insurance (CWII), is a simplified form of insurance where payouts are based on a weather index rather than the measurement of crop losses in the field.** The index is selected to represent as closely as possible, the crop yield loss likely to be experienced by the farmer. The major difference between a CWII policy and a traditional indemnity-based crop insurance policy is that the index does not insure the individual farmer's crop against physical damage or yield loss; rather it uses a proxy weather variable such as too much or too little rainfall, or relative humidity or temperature, to approximate as closely as possible the actual damage that could be incurred to the farmer's crop in the event of an extreme weather event.

3.77. **To date, the most common application of micro-level (farmer) CWII is against rainfall deficit (drought) in rain fed crops grown in arid and semi arid climates and where the rainfall measurements are made at a reference weather station,** during a defined period and insurance payouts are made based on a pre-established scale according to the amount of rainfall deficit during the cover period, as set out in the insurance policy. The sum insured is normally based on the production costs for the selected crop and indemnity payments are made when actual rainfall in the current cropping season, as measured at the selected weather station, fall below pre-defined threshold levels. Further information on CWII products is contained in Annex 13.

3.78. **The key advantages and disadvantages of CWII are listed in Box 3.3.** Key advantages include: (i) elimination of adverse selection and moral hazard because individual farmers cannot influence the outcome of the weather index; (ii) reduced administrative costs because there is no requirement for in-field crop pre-inspections, or field-based loss assessment; (iii) cost savings can be passed on to farmers in terms of reduced premium charges; and (iv) indexation usually brings increased objectivity and transparency to the insurance contract.

3.79. **The major drawback of Crop weather index insurance is the basis risk or the potential mismatch between losses as measured/triggered by the index weather station and the actual crop losses occurring on individual farmer's fields.** The effectiveness of a weather index insurance contract depends on how closely actual crop losses at the farm-level within the defined command area of the designated weather trigger station correlate with the losses as measured by the weather index at that station. Basis risk can be minimized by a careful design of the index, by ensuring that only extreme weather events are covered, and by reducing the size of the geographical area that each weather station represents (for example, in the case of a rainfall deficit product, if topography is highly variable and there is evidence that precipitation varies significantly over short distances, it may be necessary to reduce the maximum distance served by each station from say, a 20 km radius, to between 10 km and 15 km radius). Other drawbacks of weather index insurance include: (i) the product can only operate where there is a high density of weather stations and at least 20 to 25 years of uninterrupted data to construct and rate the index; (ii) introduction of the product must be accompanied by farmer awareness and education and training programs; (iii) the product only insurers specific named-perils unlike an All-risk MPCI cover (Box 3.3).

Opportunities and Challenges for Crop Weather Index Insurance in Guyana

3.80. **Chapter 2 identified the very low number of "usable" weather stations with an uninterrupted time-series rainfall data as a major constraint to the development of weather index insurance in Guyana.** Under this study, a review was conducted of daily rainfall data for 32 HYDROMET weather stations, out of which only 4 stations met the international requirements for the design of CWII contracts in terms of an uninterrupted time series of at least 20 to 25 years of daily rainfall data.

3.81. **Although the most common application of micro-level weather index insurance to date has been for rainfall deficit (drought), this product is not appropriate in the coastal regions of Guyana,**

Box 3.3. Summary of Advantages and Challenges of Weather Index Insurance

Advantages	Challenges
Less moral hazard The indemnity does not depend on the individual producer's realized yield.	***Basis risk (Note 1)*** Without sufficient correlation between the index and actual losses, index insurance is not an effective risk management tool. This is mitigated by self-insurance of smaller basis risk by the farmer; supplemental products underwritten by private insurers; blending index insurance and rural finance; and offering coverage only for extreme events.
Less adverse selection The indemnity is based on widely available information, so there are few informational asymmetries to be exploited.	***Precise actuarial modeling*** Insurers must understand the statistical properties of the underlying index.
Lower administrative costs Does not require underwriting and inspections of individual farms.	***Education*** Required by users to assess whether index insurance will provide effective risk management.
Standardized and transparent structure Uniform structure of contracts.	***Market size*** The market is still in its infancy in developing countries and has some start-up costs.
Availability and negotiability Standardized and transparent, could be traded in secondary markets.	***Weather cycles*** Actuarial soundness of the premium could be undermined by weather cycles that change the probability of the insured events (i.e. *El Niño* events).
Reinsurance function Index insurance can be used to more easily transfer the risk of widespread correlated agricultural production losses.	***Microclimates*** Makes rainfall or area-yield index based contracts difficult for more frequent and localized events.
Versatility Can be easily bundled with other financial services, facilitating basis risk management.	***Forecasts*** Asymmetric information about the likelihood of an event in the near future will create the potential for intertemporal adverse selection.

Source: **World Bank (2005).**

Note 1: **Basis Risk:** Since index-insurance indemnities are triggered by exogenous random variables, such as area yields or weather events, an index-insurance policyholder can experience a yield or revenue loss and not receive an indemnity. The policyholder may also experience no yield or revenue loss and still receive an indemnity. The effectiveness of index insurance as a risk management tool depends on how positively correlated farm yield losses are with the underlying index.

where nearly all cropping is irrigated. A rainfall deficit index is appropriate for rain fed crops in arid or semi-arid areas. Under irrigated cropping, a rainfall index is invalidated because there is no direct relationship between the amount of rainfall measured at the weather station and the amount of irrigation water plus rainfall received by the crops.

3.82. **In Guyana, rice production is vulnerable to catastrophic excess rainfall at the time of harvest.** In the case of the spring rice crop, catastrophic excess rain at the time of harvest in April may lead to major losses in the rice crop through a combination of (i) water logging of the soil and prevention of access by combined harvesters, (ii) grain shedding, and (iii) lodging of the ripe paddy and germination and rotting of the rice panicles and grains. Similar problems might occur in the autumn harvested paddy crop in the event of unseasonable or excess rain at the time of harvest. Although, there could be a potential interest on behalf of farmers to purchase a micro-level farmer "excess rainfall" CWII product for rice, the design of such a product seems to be unfeasible in the short and middle terms due to the lack of a sufficient density of weather stations with uninterrupted rainfall data in the rice-growing regions.

3.83. **Flood has been identified as the major cause of loss to agriculture (rice, other crops, and livestock) in the coastal regions of Guyana, but this peril is very challenging to insure** either under a conventional indemnity-based crop insurance product or under a crop weather index insurance (CWII) product. **Flood** indices are more complex to design than drought crop weather indexes because a combination of different sources of information (i.e. river gauge, water tables records at the conservancies, rainfall data, flood plain modeling, agro-meteorological modeling, remote sensing and related geo-information technology) is needed in order to accurately design a flood contract that can act as a proxy for crop losses. To date, there are no commercial crop flood index schemes in implementation around the world. In Guyana, it appears that historical daily and peak season river and drainage canal flow gauge data is lacking[30] and this is a major constraint to designing a flood index cover. Annex 13 presents a review of the issues and challenges surrounding the design of flood indexes policies for agriculture.

3.84. **In Guyana it is likely that traditional crop insurers and crop index insurers will be reluctant to consider catastrophe flood insurance for agriculture until the NDIA/GoG has completed the major task of investment in upgrading and rehabilitating the drainage and irrigation canal systems in Regions 2 to 6.** The GoG is extremely committed to upgrading and improving the drainage and irrigation systems in the coastal regions of Guyana and since 2005 has significantly increased its budgetary allocation to the NDIA for drainage and irrigation capital investment and improvement projects. The international donor community is also contributing to this effort. However, until this work is completed, it would be very difficult for crop insurers and their reinsurers to decide which areas within each region represent an insurable flood risk and which areas are deemed uninsurable.

3.85. **The conclusion of this review is that, in the short to medium term, it will not be technically feasible to design and implement a flood CWII product for crop producers in the coastal regions of Guyana.** This conclusion is based on the limited available hydrological recording equipment and historical information for each river catchment area which could be used to design and rate a flood index cover, the fact that the river flood exposure is modified by the drainage and irrigation systems in the coastal regions, and the fact that flooding is directly influenced by the state of repair and management of the drainage and irrigation system (see Annex 13 for full details).

30 MacDonald, M. 2004. Guyana Drainage and Irrigation Systems Rehabilitation Project: Hydrology and Water Resources. Final Report. Ministry of Agriculture, Guyana.

Chapter 4. Institutional Framework for Agricultural Insurance

4.1. This Chapter presents a review of the potential roles that the private insurance companies, the banking and MFI sector, and other service organizations in Guyana might play in implementing market-oriented agricultural crop, livestock and aquaculture insurance in the future. It is also recognized that the GoG and its rural line departments (Agriculture, Livestock and Fisheries) are likely to have a very important role in promoting and supporting the introduction of private-sector-led agricultural insurance under some form of Private-Public Partnership (PPP). Therefore, this Chapter also reviews the potential roles that the government may play under an agricultural insurance PPP for Guyana.

4.2. To being with, however, the Chapter briefly reviews the current government natural disaster relief compensation scheme for farmers and the future of this scheme if formal agricultural insurance programs are introduced.

Ex-post Disaster Relief Programs versus Ex-ante Agricultural Insurance

4.3. **In the absence of any formal crop or livestock risk transfer and insurance mechanisms, the GoG currently allocates considerable financial resources to ex-post disaster relief payments to farmers who have suffered losses to their crops and livestock under natural calamities.** The GoG's assistance to rice farmers affected by the 2005 floods amounted to G$400 million (US$2 million). These payments were finalized in 2009 and, in this case, all registered rice growers received a compensation payment equivalent to G$2,200 per acre, subject to a maximum payment per grower of G$22,000. The assistance was mainly based on vouchers to purchase fertilizers. Payments were also made to livestock producers and vegetable growers who incurred severe flood losses in 2009. Payments to vegetable growers amounted to distribution of free seeds to enable them to replant their flood damaged crops. In 2010, the GoG is also making major financial efforts to mitigate the effect of the current drought affecting crop and livestock producers. According to the Minister of Agriculture, in 2010 the GoG has allocated G$342 million to the implementation of drought relief and recovery projects including the supply and distribution of fertilizers, seed paddy, planting materials and agrochemicals to farmers of both crops and livestock, as well as the support to drainage and irrigation works across the country. Funding for the rice sector amounts to G$100 million and for livestock to G$10 million. For livestock, interventions have included provision of supplemental feeds and the digging of water holes[31]. So far the GoG's expenditures in providing irrigation pumps and hay to farmers amounts to G$54 million and it is expected that this assistance will increase over the next month or so until the drought cedes.

4.4. **If agricultural insurance is introduced into Guyana, the Government will need to reassess the role of post-disaster compensation payments.** If rice insurance cover is to be introduced into Guyana in the future, it will be necessary for the GoG to reconsider its strategy of providing ex-post financial disaster compensation (e.g. in the form of fertilizer vouchers) to this group of farmers for the following reasons: (a) if insurance and disaster relief payments are made to farmers, this would amount to a double indemnity; and (b) international experience shows that where free public-sector disaster relief is provided, this acts as a major disincentive for farmers to purchase crop insurance.

4.5. **Options for the GoG to consider in the future include phasing out public-sector disaster relief once crop and livestock insurance is established,** or to continue to offer disaster compensation only for those crops and classes of livestock and perils which are not covered by private-sector agricultural insurance. In terms of international experience, Spain continues to provide natural disaster compensation only for those crops and perils which are **not** insurable under the national agricultural insurance scheme: agricultural insurance is voluntary, but in order to encourage all farmers to purchase ex-ante agricultural insurance, the government offers very high premium subsides. In the US, the federal government continues to provide both natural disaster relief assistance and subsidized crop insurance and, in many cases, farmers are eligible for double indemnities under both programs (Glauber, 2007).

31 GINA April 22, 2010. Guyana: Agricultural sector in full recovery.

Framework for a Private-Public Partnership for Agricultural Insurance in Guyana

4.6. **It is likely that the development of any market-based agricultural insurance products and programs in Guyana will require the active collaboration of the private and public sectors under some form of Private-Public Partnership agreement (PPP).** Figure 4.1 presents an illustrative institutional framework showing the relationship between key stakeholders under such a PPP.

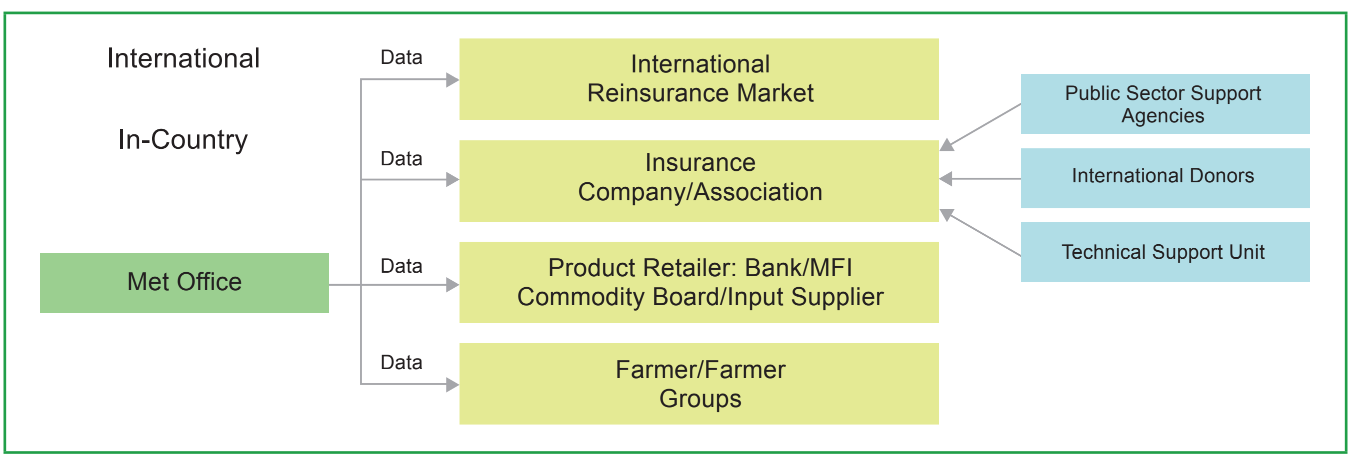
4.7. **Wherever possible, agricultural insurance should be implemented and underwritten by the private commercial insurance companies.** In the context of Guyana, the insurance companies will need to consider whether they intend to underwrite agricultural insurance individually, with the implied high start-up costs for establishing and staffing an internal agricultural underwriting, marketing and claims administration department, or to collaborate through the Insurance Association to form some kind of Coinsurance Agreement or Pool Agricultural Insurance Program to share the costs.

4.8. **The Guyanese insurance companies do not have retail branch networks in rural areas to market and administer policies to individual farmers and, therefore, they need to consider cost-effective distribution channels through existing rural organizations.** In the context of Guyana, if an area-yield index insurance product is developed for rice, potential distribution channels include (a) the Guyana Rice Development Board (GRDP) working in association with the Guyana Rice Producers Association (GRPA), and (b) the banking and MFI sectors financing rice production. The IPED, which is the main micro finance institution financing rice growers in Guyana, has already indicated its interest in protecting its seasonal lending to rice growers with an area-yield index insurance product if issues of basis risk associated with this product can be resolved.

4.9. **International experience shows that new pilot crop or livestock insurance schemes are generally most successful and sustainable where insurance is linked to a wider agricultural development program aimed at providing improved technology, products and services to farmers.** The bundling of agricultural insurance with agricultural credit and input supply including seeds and fertilizers appears to offer a win-win situation to farmers, rural banks, and input suppliers and should be promoted in Guyana wherever possible. This concept fits well with the ADP project which is designed to provide a packaged approach of new technology, credit, extension and training services, and output marketing assistance to the fruit and vegetables, livestock (cattle) and aquaculture sectors. Key organizations which may become involved in this initiative would therefore include the GMC for fruit and vegetables, the regional Livestock Producer Associations for livestock and the NAAG for the aquaculture sector.

4.10. **The role of international reinsurance is likely to be crucial in any agricultural insurance initiative**

Figure 4.1. Illustrative Institutional Framework for Private-Public Partnership for Agricultural Insurance in Guyana



Source: Authors adapted from CRMG, World Bank.

for Guyana both in the provision of technical design assistance and in providing reinsurance capacity. The reinsurance sector is a major source of specialized technical expertise in the design and rating of agricultural insurance products so it is recommended that Guyanese insurance companies seek the involvement of lead agricultural reinsurance companies at the earliest opportunity. In addition, given the catastrophic nature of flood and drought climatic risk exposures in Guyana, the local insurers will be very reliant on reinsurance capacity support from reinsurers.

4.11. **Public sector support for the PPP is likely to involve a wide range of Ministries and Departments** including the Insurance Commission, the Ministry of Finance, the Ministry of Agriculture, the GRDB, HYDROMET (as the provider of meteorological data), the Departments of Livestock and Fisheries, and the Bureau of Statistics. The GoG's specific roles in supporting any PPP initiative through these public-sector institutions are discussed further at the end of this Chapter.

4.12. **International development agencies and donors are likely to play an important role on the start-up phase of any agricultural insurance initiative for Guyana** including the provision of technical assistance in the design and rating of traditional and index crop insurance products and programs, and in the provision of specialized training.

4.13. **The formation of a Technical Support Unit (TSU) is also recommended in the start-up of a new agricultural insurance program.** The TSU would be comprised of a small team of agricultural insurance specialists whom would provide technical design, rating and implementation services to the insurance companies and key stakeholders involved in the PPP. The TSU would be funded by all stakeholders.

4.14. In the sections below, the potential roles of each stakeholder are considered in more detail.

Role of Private Insurance Companies

Structure of the Guyanese Non-life Insurance Industry

4.15. **The general or non-life insurance sector in Guyana is very small. Currently, six insurance companies, six registered brokers, and 193 insurance agents are involved in the general insurance market.** The total premium volume for the Guyanese general insurance market amounts to, approximately, US$20 million. The general insurance liability retained in the local market accounts for approximately 7% of the total liability; the remaining liability is ceded to the international reinsurance market (mainly Lloyds of London) mostly on an excess of loss basis, either under facultative or treaty reinsurance agreements.

4.16. **The insurance industry is organized under the umbrella of the Insurance Association of Guyana.** The Insurance Association is the forum in which the insurance industry discusses specific topics regarding this field, and it is also the vehicle for capacity building and information exchange.

4.17. **The insurance industry is regulated by the Office of the Commissioner of Insurance (OCI), which falls under the Central Bank of Guyana.** The OCI, among other duties, is responsible for approving and registering new insurance policies and for the management of the statutory deposits (minimum capital reserves) that the insurance companies must make in order to operate each particular line of insurance.

Insurance Company Interest in Agricultural Insurance

4.18. **The general perception among the five interviewed insurance companies is that agricultural insurance is a risky business.** These companies also mentioned that they have no experience in agricultural insurance. However, under certain preconditions including: (i) the existence of an accurate risk assessment for the agricultural sector; (ii) the existence of a training program for their underwriters on agricultural insurance; and (iii) full reinsurance protection, they may consider entering into the agricultural insurance business on a pilot basis.

Coinsurance Pools in Agricultural Insurance

4.19. **In Guyana, the commercial insurance companies may wish to consider the benefits of forming a coinsurance pool to underwrite agricultural insurance.** In developing countries, where insurance markets are often poorly developed and there is no tradition of crop or livestock insurance or rural insurance infrastructure, a pool coinsurance program may be a much more attractive and cost-effective proposition for commercial insurance companies, as opposed to trying to operate independently. The potential benefits of an insurance pool include: (i) the ability to underwrite a much broader and larger range of businesses, and the potential to achieve a better geographical spread of risk, than if each company was operating independently; (ii) economies of scale in the costs of developing new products and programs, and in underwriting risks and adjusting claims where a single lead coinsurer is appointed (or a separate Technical Support Unit is created) to administer the business on behalf of the pool members; and (iii) the potential major cost savings in the purchasing of reinsurance protection for a pooled coinsurance program. Further details on the benefits and limitations of Pools are contained in Box 4.1.

4.20. **Coinsurance pools for agricultural insurance have proved to be very popular with private and mutual insurers in many countries** including most notably, the Agroseguro Pool in Spain, the Tarsim Pool in Turkey, the Philippines Livestock Insurance Pool, the Austrian Hail Insurance Pool and various other pool arrangements in China, Argentina, Malawi, Mongolia and Ukraine.

4.21. **Currently there are no market pools in Guyana** (AXCO, 2006). According to the OCI, there are no restrictions in Guyana for the operation of coinsurance pools.

Agricultural Insurance Delivery Models for Small Farmers in Guyana

4.22. **The Guyanese insurance companies need to identify cost-effective ways of marketing, underwriting, administering and settling claims on potentially large numbers of individual agricultural insurance policies issued to predominantly small farmers in Regions 2 to 6.** As noted previously, the insurance companies do not have rural distribution networks or any experience in underwriting small-scale agricultural risks. They will therefore need to identify cost-effective distribution channels.

4.23. **There are several ways in which insurance companies can deliver insurance products and services to small rural households and farmers**, which are listed in Box 4.2. Under the traditional method termed the "Full-service Model", the insurance company assumes full responsibility for all insurance functions including insurance awareness and education, as well as policy sales and marketing (either through its own network of sales agents or commission brokers) and relies predominantly on individual client sales. Premiums are collected individually by the company from the insured and claims notifications and settlements are managed directly by the insurer. This model would be prohibitively expensive for Guyanese

Box 4.1. Benefits and Limitations of Coinsurance Pool Arrangements

Benefits

Economies of scale through operating as a single entity with shared (pooled) administration and operating functions leading to costs savings due to:

* Reduced staffing requirements (fixed costs);
* Shared costs of product research and development, actuarial and rating;
* Reduced costs of underwriting and claims control and loss adjustment.

Cost advantages in purchasing common account (pooled) reinsurance protection rather than each company trying to place its own reinsurance program. Advantages due to:

* Stronger negotiating position with reinsurers;
* Larger and more balanced portfolio and better spread of risk;
* Reduced costs of reinsurance due to pooled risk exposure;
* Reduced transaction costs (reinsurance brokerage, etc.).

No competition on rates in a soft market and ability to maintain technically set rates. Most pools operate as the sole insurance provider or monopoly (e.g. Austria, Senegal, Spain, Turkey), and there is therefore no competition on pricing.

Box 4.1. (cont.)...

Ability to maintain underwriting and loss adjustment standards. Under a pool monopoly arrangement, the pool manager can ensure that common and high standards are maintained in the underwriting of crop and livestock insurance and in the adjusting of claims. Where companies are competing against each other for standard crop insurance business, there is often a problem of varying loss adjustment standards between companies.

Limitations

Pool may act as the sole agricultural insurer, resulting in lack of competition in the market in terms of:
* Range of products and services offered by the monopoly pool underwriter;
* Restrictions on the range of perils which are insured;
* Restrictions on the regions where agricultural insurance is offered and/or the type of farmer insured;
* Lack of competitiveness in premium rates charged by the pool.

Source: ***Authors*.**

insurers to try to operate for smallholder agricultural insurance.

4.24. **In Guyana there may be considerable potential for commercial insurers to enter into a Partner-Agent relationship with rural organizations (e.g. the GRDB/GRPA, rural banks and MFIs such as the IPED) which have an existing rural distribution network and a large farmer membership.** Under a Partner-Agent Model, the insurance company enters into a formal contractual agreement with the agent under which the agent assumes responsibility for marketing and promoting the insurer's policies to its membership, for collecting premiums from the insureds and paying these over to the insurer, for notifying claims to the insurer and, finally, in some cases, for distributing claims settlement payments to the Insureds. Usually, the insurer will agree to pay the agent a commission for its services. In Guyana, the IPED is already acting as an agent for one of the insurance companies: it is marketing a homeowners' fire insurance cover to its network of borrowers and receives a commission from the insurer.

4.25. **The Partner-Agent approach has been successfully promoted for smallholder agricultural insurance in recent years in Africa, Asia and Latin America** and offers a potential win-win situation for both parties. For the insurance company, the distribution of its products through a rural institution offers the potential to reach large number of small farmers at low cost; for the rural institutions, the agreement enables them to expand the range of products and services they

Box 4.2. Distributional Models for Small Farmer Insurance (Micro-insurance)

- **Full-service Model:** Commercial or public insurers provide the full range of insurance services from initial development of the product, through distribution, to absorbing risk.
- **Partner-Agent Model:** Commercial or public insurers, together with micro finance institutions or nongovernmental and other organizations, collaboratively develop the product. The insurer absorbs the risk and the agent markets the product through its established distribution network. This lowers the cost of distribution and thus promotes affordability.
- **Community-based Model:** Local communities, MFIs, NGOs, and/or cooperatives develop and distribute the product, manage the risk pool, and absorb the risk. As with insurance mutuals, there is no involvement on the part of commercial insurers.
- **Provider Model:** Banks and other providers of micro finance can directly offer or require insurance contracts. These are usually coupled with credit, for example, to insure against the risk of default.

Source: **ProVention 2006 (Cohen and McCord, 2003).**

offer to their membership and, where the organization is involved in agricultural credit provision, the potential to protect their loan portfolio with crop and livestock insurance (the bundling of crop insurance with credit and other services is discussed further in the next sections). **Other insurance delivery models include the Community-based Model and the Provider Model.** In Guyana, the IPED operates its own internal credit-life insurance scheme to protect its loan portfolio: borrowers are not aware that they are insured. The IPED allocates a share of the interest paid by its borrowers to a credit life-fund. The risks up to certain value limit are retained and managed within the IPED life-fund. For those risks which exceed the limit and cannot be managed within the IPED fund, the excess liability is transferred to an insurance company through an excess-of-loss life insurance policy. In the event of death of the borrower, the IPED receives an indemnity, either from the fund or from the insurer, equal to the amount of the loan the deceased had with the IPED.

Role of Commercial Banks and MFIs as Distribution Channels for Insurance

Access to Rural Finance in Guyana (Banks and MFIs)

4.26 **Although most of the banks currently operating in Guyana are lending to the rural sector, the amount of rural credit available and the accessibility by the farmers is very limited and expensive.** Currently, agricultural lending in Guyana accounts for approximately 6.1% of the total banks' finance portfolio. Loan maturity periods are no longer than 6 months and the interest rates for rural lending are extremely high ranging from 15% to 26%. Additionally, collateral requirements to access rural credit are extremely high (see further details in Annex 14).

4.27. **In Guyana, bank lending to the agricultural sector has declined over the last decade.** Total bank lending to the agricultural sector in Guyana has declined from G$8.7 billion in 2000 to only G$3.9 billion in 2008. As a percentage of total bank financing, agriculture accounted for 6.1% in 2008 relative to 16% in 2000. In 2008, bank lending for rice farming was G$1.1 billion with another $1.7 billion lent to rice millers; back in 2000, rice farmers received loans valued at G$5.7 billion with an additional $5.9 billion lent to millers. Lending to the livestock sub-sector was G$741 million in 2008 compared to G$890 million in 2000. Finally, lending to the shrimp and fishing sub-sector has actually increased over time from G$975 million in 2000 to G$1.2 billion in 2008.

4.28. **Several factors have contributed to reduced bank lending to the agricultural sector over the last decade.** From the banking sector side: (i) banks have become more urban oriented in their lending; (ii) banks became more bottom-line focused over time; (iii) banks distribute their assets in favor of investment, rather than in lending; (iv) banks are not adequately staffed for lending to agriculture; (v) bank lending policies became inflexible enough to accommodate long-term loans to the agriculture sector (securing a loan takes 3-6 months, while realizing security can take up to ten years); (vi) lack of a structure of contracts for both internal and external transactions, which impedes access to pre- and post-crop financing based on the assigning of proceeds; and (vii) agriculture assets lack adequate resale value – since they are of a specialized nature, and entry for new players is restrictive. From the agricultural sector side, the main causes which contributed to reduced financing were the erosion of the margins obtained by agricultural producers (resulting from a combination of decreasing commodity prices and increased input prices), and land tenure problems.

4.29. **Micro finance Institutions play a key role in financing the rural farmers in Guyana.** The Institute for Private Enterprise Development (IPED) is leading the process of lending to rural farmers. The IPED has a revolving fund of US$7 million which is used to lend to small entrepreneurs operating in potentially successful sectors of the economy. Currently, much of its lending is to the agricultural sector, about half of which is to rice farmers. The IPED is the main financial institution providing seasonal production credit to Guyana's rice farmers. In 2008, the IPED provided G$600 million seasonal loans to 1,173 rice farmers, representing 15.38% of the total credit to the agricultural sector and 55% of the total rural lending to rice farmers.

Banks and MFIs Interest in Agricultural Insurance

4.30. **In general, the banking and MFI sectors welcomed the possibility of implementation of**

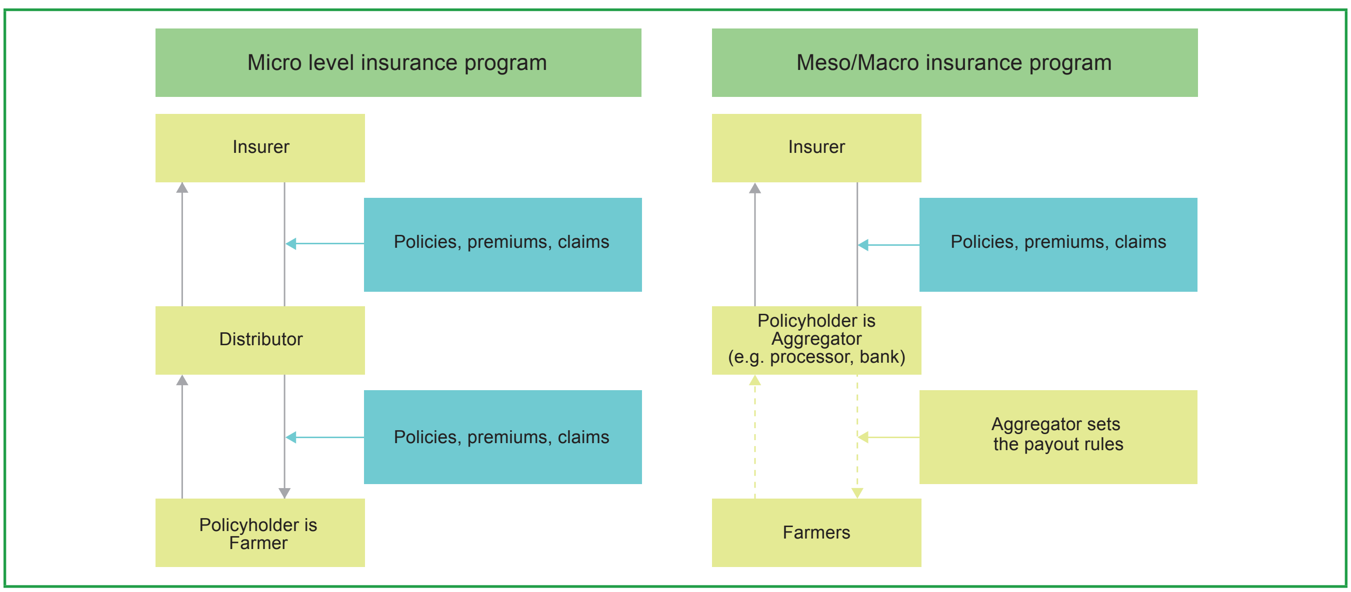
agricultural insurance in Guyana. Many of the banks perceive that agricultural insurance, although it will not provide a full guarantee over the loans given to farmers, can be used as a partial collateral for the securitization of the climatic-induced default risk faced by the banks in rural lending. Most of the banks interviewed during this mission mentioned that, in cases where the farmers have good collateral on the production risks, they would analyze the possibility of sharing part of the cost of the insurance by reducing the interest rates they are requesting for rural lending.

4.31. **The IPED, as the largest provider of seasonal production credit to the rice sector in Guyana, has expressed interest in purchasing area-yield index Insurance to protect its loans against climatic-induced crop failure and inability of farmers to repay their loans.** The IPED is interested in bundling its crop loan portfolio to rice producers with area-yield crop insurance for rice, and would consider reducing its fixed interest rate for rice of 20% per year to reflect the transfer of climatic risk exposure to the insurance policy. In other words, all rice loan beneficiaries would automatically be insured.

4.32. **There are two insurance options which might be considered by financial institutions lending to the agricultural sector and which are illustrated in Figure 4.2.** Under the first option (micro-level insurance), the financial institution (e.g. a bank or MFI) would act as an Agent (Distributor) and a conventional individual farmer crop insurance program would operate. In this case, the bank/MFI would require that each individual crop-credit recipient be automatically insured under the crop insurance product. The bank/MFI would need to decide how much of the premium it would finance itself and how much premium it would charge to/collect from the insured farmers. In the event of a claim on the crop insurance policy, each grower would receive a claims settlement according to their insured yield coverage option and insured acreage.

4.33. **Under the second option, a meso-level insurance program, a financial institution lending to the agricultural sector would be the insured policyholder and would purchase agricultural insurance to protect its agricultural loan portfolio against catastrophic climatic losses (Figure 4.2).** Under this option, the bank/MFI would declare its total agricultural-loan acreage in each region and the coverage level it wishes to insure under the crop insurance policy in each region. The bank/MFI lending to the agricultural sector would purchase a single aggregate policy to protect its loans and would be responsible for premium payment. In the event of a claim in any or all insured regions, the losses would be computed and the bank/MFI would receive an aggregate claims indemnity. The bank or MFI would then decide whether it wishes to pass on any of this indemnity payment to its crop borrowing

Figure 4.2. Comparison of Organizational Structure for Micro and Meso-level Agricultural Insurance



Source: Dick, W. (2009).

members or not. The major advantage from an insurance viewpoint is that the bank/MFI would be able to accept a higher degree of basis risk associated with the area-yield index product than individual farmers.

Bundling Crop Insurance with Crop Credit and Input Supplies

4.34. **The bundling of agricultural insurance with credit provision through commercial banks and/or MFIs, including most notably the IPED, needs to be considered carefully.** The role of seasonal production credit in Guyana appears to be critical to enabling farmers to invest in improved seeds and fertilizers and to raise their production and yields. Similarly, few livestock producers can afford to purchase cattle with which to establish beef and dairy production enterprises without livestock investment loans.

4.35. **In many parts of the world, public or private sector credit to agriculture is protected by a compulsory insurance cover.** From an insurer's viewpoint there are major advantages of automatic or compulsory crop-credit insurance in that (a) anti-selection is reduced, (b) there is less need for pre-inspections, (c) the costs of promoting and marketing the agricultural insurance program are reduced, and (d) the insurance uptake and spread of risk and premium volume is generally much higher than under a purely voluntary program. Examples of compulsory crop-credit insurance schemes include the major crop insurance programs in India, the Philippines and Brazil (compulsory for those loans given through *Banco do Brasil*, a state owned bank).

4.36. **There are advantages for a scheme involving small farmers to be compulsory rather than voluntary, unless other circumstances allow the insurer to avoid adverse selection and high administrative costs.** Even with a compulsory scheme there must be worthwhile incentives built-in to counter moral hazard. Clearly, operating an insurance scheme together with a credit program can offer the level of control required by insurers reflecting the common interests of banks and insurers – if insurance is not taken out by the farmer then he will not be eligible for a loan. Loan applicants would also normally go through an initial appraisal procedure which will assist in evaluating the management potential of the farmer (Dick, 1999).

4.37. **Where agricultural credit and insurance are linked there is a potential for the bank or MFI to reduce its interest rates to the extent that climatic or natural risk exposures have been transferred to the insurance policy.** The Malawi weather-based crop insurance program and the Mongolia livestock index-based insurance program are examples where the lending banks have reduced their interest rates to those producers who agree to purchase drought index insurance. This is a subject which will require further discussion between the Guyanese banks/MFIs and agricultural insurers.

Risk Financing and Role of Reinsurers

4.38. **This section presents some preliminary insurance uptake estimates for the area-yield index Insurance in terms of the insured area, sums insured and premium, and then considers the need for risk financing and reinsurance in relation to the estimated PMLs for rice production.** It is stressed that, in the absence of any formal demand assessment studies to date, these portfolio estimates are purely illustrative. The portfolio estimates are based on the assumptions of the spring and autumn rice crops being insured at 2 insured yield coverage levels, 70% and a maximum of 80%, and then two insurance uptake scenarios, 5% of rice cultivated area and 10% of rice area with uptake proportional to the cultivated area of rice in each of the Regions 2 to 6.

4.39. At the 70% coverage level and lowest insurance uptake rate of 5%, the total insured area of spring and autumn crops in all the paddy production zones in Guyana would be 13,917 acres with a total sum insured (TSI) of G$609 million (US$3 million), with an estimated premium of G$22 million (US$110,000) and expected loss ratio of 65%. At the highest 80% coverage level with 10% insurance uptake, the TSI would rise to G$1.392 billion (US$6.9 million), with a premium of G$66.9 million (US$334,000) and expected loss ratio of 65% (Table 4.1).

4.40. **The 1 in 100 year PML estimations vary from a low of G$138 million (US$0.7 million) or 23% of TSI for 70% coverage level and 5% uptake rate** to a high of G$406 million (US$2.2 million) or 29% of TSI for the 80% coverage option and 10% insurance uptake rate. The PML claims value is a useful guide to an insurer as to the minimum amount of capital that it should prudently reserve to pay for claims in a worst case scenario assuming it has no reinsurance protection

Table 4.1. Area-yield Index Insurance Portfolio Projections and 1 in 100 Year PML

Annual Paddy Portfolio (Spring + Autumn Harvest Crops): Insurance Uptake Scenarios	Insured Area (acres)	Sum Insured (G$ million)	Premium (G$ million)	Average Premium Rate	Estimated PML (G$ million)
1) 70% Coverage level: 5% uptake	13,917	609	22.0	3.6%	138 (23%)
2) 80% Coverage level: 5% uptake	13,917	696	33.4	4.8%	203 (29%)
3) 70% Coverage level: 10% uptake	27,834	1,218	43.9	3.6%	275 (23%)
4) 80% Coverage level: 10% uptake	27,834	1,392	66.9	4.8%	406 (29%)

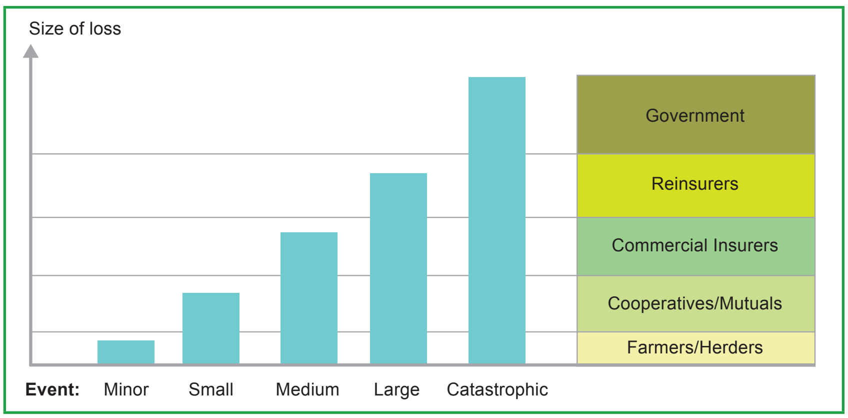
Source: **Authors from the CRAM. Full details presented in Annex 9.**

in place. However, the very high 1 in 100 year PML levels for area-yield index insurance for paddy (rice) in Guyana suggest that no local insurer would underwrite this risk without reinsurance protection.

4.41. **The international agricultural reinsurance market for traditional and new CWII insurance is dominated by a handful of specialist agricultural reinsurers** including SwissRe, MunichRe, PartnerRe, HannoverRe and SCOR. In addition to providing reinsurance capacity, several of these reinsurers also play an active role in the technical design and rating and implementation of CWII products. It is important to involve a lead reinsurer(s) at an early stage in the planning and design stages of any new agricultural insurance program.

4.42. **There are many options for structuring risk financing and reinsurance programs including both proportional and non-proportional reinsurance.** Figure 4.3 provides an example of a non-proportional insurance and reinsurance structure involving both mutual and private commercial insurers with reinsurance for catastrophic events being provided by international reinsurers and possibly the local government.

Figure 4.3. Illustration of Agricultural Risk Layering and Financing



Role of Government

4.43. **International experience tends to suggests that implementation of agricultural insurance is most efficient and effectively managed by the private commercial crop insurance sector[32].** However, where insurance markets and infrastructure are poorly developed, governments may have important roles to play in promoting agricultural insurance, particularly in the start-up phases of new private commercial agricultural insurance programs. This section reviews some of the roles for government under a public-private partnership and specifically the roles that the GoG may wish to consider in order to promote agricultural crop and livestock insurance in Guyana.

4.44. **Box 4.3 presents a summary of some of the ways in which governments can assist private insurance companies by enhancing insurance market infrastructure in the start-up phase of a new agricultural insurance programs.** Features of these interventions are considered further below in the context of Guyana.

Legal and Regulatory

4.45. **In Guyana the Insurance Commission will need to decide whether the introduction of agricultural insurance will require any changes to**

32 See for example, Hazell, 1992; and Mahul and Stutley, 2010.

the existing insurance legislation. The Commissioner of Insurance has suggested that the introduction of agricultural insurance may require changes in the existing insurance law or, at least, the authorization of agriculture as a new class of approved non-life business. Conversely, the insurance industry believes that there is no need to amend the insurance law or to create a new line of business in order to offer agricultural insurance. Instead, insurers propose to place agricultural insurance under the existing general fire-risk and all-risk property policies that are currently in place in the market. The insurers believe that if modifications to the insurance law are required, this will lead to major delays in the introduction of agricultural insurance in Guyana and they also argue against the additional statutory deposits which would be needed if a new line of agricultural insurance has to be created. The Commissioner of Insurance has agreed to analyze these issues carefully and to provide legal opinion.

Enhancing Data and Information Systems

4.46. **There appears to be important roles for the GoG to further enhance and strengthen the national database systems for crops other than sugar cane and rice, for livestock and livestock mortality rates**

Box 4.3. Roles for Government in Supporting Agricultural Insurance

Legal and Regulatory Framework. One of the most important functions for government in facilitating agricultural insurance markets is the establishment of an appropriate legal and regulatory framework and, where necessary, to enact specific agricultural insurance legislation.

Enhancing Data and Information Systems. Time-series data and information on crop production and yields and climate are essential for the design and rating of any traditional crop insurance product or new weather index product. Governments can provide an invaluable service by creating national databases and making these databases available to all interested private commercial insurers either free of cost, or at concessionary rates.

Product Research and Development. Among the major start-up costs for any new crop or livestock insurance program is the design (including the design of loss assessment procedures) and rating of new products, and then the pilot testing of the new products and programs. Such costs may be prohibitive for individual private commercial insurers, especially in developing countries. In such situations there is justification for the government to provide financial support to product design and rating, especially where the products and rates are then made available to all interested insurers.

Education, Training and Capacity Building. Governments can play an important role on new agricultural insurance programs by supporting (a) farmer awareness and education programs, and (b) capacity building and workshops, and technical training programs for key agricultural insurance staff.

Catastrophe Risk Financing. Agricultural insurance often has to protect against catastrophic perils of flood, drought, wind and storms in crops, and epidemic disease outbreaks in livestock. Most insurance companies do not have adequate capital to retain their catastrophe risk exposures and they typically purchase some form of contingency financing and/or reinsurance protection. For new companies, which do not have large amounts of capital and have not yet built up claims reserves, the ability to retain risk is usually low and they typically need to purchase quota share treaty reinsurance and to then seek non-proportional reinsurance protection on their retention. In start-up situations where the insurance company does not have an established track record and loss history, the costs of reinsurance protection may be very high. In such situations, government support to the reinsurance program may be highly cost-effective.

Public Sector Premium Subsidies. Premium subsidies are the most widely practiced form of government support to agricultural insurance, practiced by over two thirds of countries which have some form of agricultural insurance. Governments justify the provision of agricultural insurance premium subsidies on the grounds that they make insurance more affordable for farmers, particularly small and marginal farmers, thereby increasing the rate of adoption and uptake of agricultural insurance. There are, however, major drawbacks of premium subsidies including that they disproportionately benefit larger farmers to the detriment of small and marginal farmers; they tend to promote moral hazard, namely to encourage crop production in high-risk regions; once premium subsidies are introduced they are very difficult to reduce or to withdraw and they represent a major cost to government. This report only advocates premium subsidies where a clear social need is identified and where the premium subsidies are targeted to special-needs groups and are provided for a specific period of time and which can be withdrawn once the program has attained a critical mass.

Source: Authors.

and to invest in upgrading the meteorological weather station network. This review has identified major gaps in the national systems and procedures for recording, reporting and storing of data and statistics for (a) non-traditional crop (fruit and vegetables) production and crop losses, and (b) the livestock sector, including livestock numbers by region and livestock mortality rates by cause of loss. The GoG can play a major role in funding the creation of new database systems and procedures for these sectors and this is already envisaged under the ADP. While the GoG is already investing heavily in upgrading the HYDROMET climatic service, for example through the investment in Doppler Radar, further investment is required to upgrade the national network of synoptic weather stations and rain-gauge stations and to strengthen data recording and transfer.

Product Research and Development

4.47. **The Guyanese insurance industry has no experience with the design and rating** of traditional or new index crop, livestock and aquaculture insurance products. The GoG could usefully support the provision of specialized technical assistance from international sources to assist the Guyanese Insurance Association and the Insurance Commission to design, rate and prepare policy wordings for these new agricultural insurance products.

Education, Training and Capacity Building

4.48. **Governments can play a key role in supporting farmer awareness and education programs,** as well as capacity building and workshops and technical training programs for key agricultural insurance staff. Given the fact that there is no agricultural insurance tradition in Guyana, high priority will need to be given to financial and insurance literacy programs for farmers, and to specific training in the role and benefits of the different crop and livestock and aquaculture insurance products. Insurance Companies' staff will also need specialized training in product design, actuarial and rating, underwriting and claims administration, and loss assessment systems and procedures. Similar training also needs to be provided to staff in the banks, MFIs and input suppliers if these organizations get involved as delivery channels/agents.

Catastrophe Risk Financing

4.49. **In many countries, the government is involved in the reinsurance of agriculture.** Key territories where government acts as a catastrophe reinsurer (either directly or indirectly through a national reinsurance company) include the US, Canada, Spain, Brazil, India, South Korea and China. In Guyana, it is too early to consider the role of the government, if any, as a reinsurer of last resort for agriculture. It is recommended that private insurers should first seek to place their reinsurance requirements with international reinsurers and only revert to government in the unlikely case that they cannot place their reinsurance programs.

Premium Subsidies

4.50. **Premium subsidies are the most widely practiced form of government support to agricultural insurance** practiced by over two thirds of countries which have some form of agricultural insurance. Typically, premium subsidies are in the order of 50% of the full premium charge, but in some countries governments provide subsidies as high as 75% to 80% of the premium. Premium subsidies are, however, very controversial for a number of reasons. The provision of non-discriminatory premium subsidies is regressive, as they disproportionately benefit larger farmers to the detriment of small and marginal farmers. Also, subsidies that cover a large part of the overall premium tend to promote moral hazard whereby farmers grow high-risk crops which attract high-premium subsidies in regions which are not technically suited to the crop. Once premium subsidies have been introduced by governments, it is politically very difficult to reduce or to withdraw these subsidies and in many of the countries which operate non-discriminatory premium subsidies the fiscal costs to the government are extremely high. It is not known whether the GoG is considering providing agricultural insurance premium subsidies. However, the World Bank only advocates progressive premium subsidies where a clear social need is identified and where the premium subsidies are targeted to special-needs groups for a limited time period.

Chapter 5. Discussion, Conclusions and Next Steps

5.1. This final Chapter highlights the key outcomes and conclusions of the pre-feasibility study, and identifies the key crop and aquaculture products which merit further investigation and which might be developed into commercial insurance programs in the near future.

Discussion and Conclusions

5.2. **The design of an agricultural insurance risk transfer solution for Guyana should consider the features of agricultural production in the country.** Agricultural production in Guyana relies on drainage and irrigation; thus, its performance is affected by weather factors and man-made factors. Drainage and irrigation infrastructure and water management issues are as important as the effect of weather on the agricultural sector performance. While the losses caused by weather factors on agricultural production are considered unpredictable and unforeseen, the agricultural losses caused by failures of an inadequate drainage and irrigation infrastructure or water mismanagement, are considered predictable and foreseen. Insurance is a financial tool which covers unpredictable and unforeseen losses; thus, losses derived from water management or drainage and irrigation infrastructure issues should not be the object of insurance. It is also important to consider that, in an eventual crop insurance program for Guyana, the insurers/reinsurers will take all the precautions in order to avoid insuring any man-made aspect influencing agricultural production. High levels of insurance deductibles and specific provisions in this regard on the insurance policy wording should be expected.

5.3. **There is no one-size-fits-all solution in agricultural insurance.** For this agricultural insurance pre-feasibility study, several agricultural insurance products were analyzed in order to identify which of them were more suited according to the risk faced by each of the main agricultural activities and the predominant farmer typology in each region of the country. The findings and results of this analysis are concluded in the sections below.

5.4. **There appear to be opportunities to develop area-yield index crop insurance for the rice sector in the short term, but issues of basis risk must first be addressed.** It is technically feasible to design and implement area-yield index insurance for the rice sector in Guyana with minor strengthening of the procedures for measuring zonal average yields. However, the basis risk issues associated with this product in the context of Guyanese irrigated rice production must be studied in detail under any future feasibility study stage. Likewise, it is probable that some amendments to the current insurance regulation are needed in order to authorize index products as insurance products. In view of the very low demand for a purely voluntary area-yield insurance cover, it is unlikely this product will be commercially attractive to local insurers and international reinsurers on a purely voluntary basis. However, in view of the interest shown by one MFI in a bundled credit and crop insurance package, this may offer an opportunity of interest to insurers. An additional opportunity for area-yield index insurance which might be of interest to the GoG is to purchase area-yield index insurance in order to finance a contingency fund to provide assistance to rice farmers affected by catastrophic events.

5.5. **There are opportunities for the development of aquaculture insurance in Guyana in the short and medium term.** Although this industry is in its initial stages and the sources of risk are high, the industry seems to be well organized and most of the risk management measures are in place. Specialized reinsurers may be willing to analyze aquaculture insurance proposals on a facultative case by case basis to cover against natural perils; nevertheless, it is important to take into consideration that, as a precondition to write these risks, they will perform risk surveys by designated risk surveyors and designate their own loss adjusters. These two factors may increase the premium costs for the coverage; however, the survey cost can be partially reduced if the farmers organize themselves and request the risk surveys as a group. In the short term, there is no possibility that international reinsurers will be willing to grant local companies an aquaculture reinsurance treaty facility, but this should be a medium term goal for the industry once it has gained experience in underwriting aquaculture risks and demonstrated a profitable and expanding portfolio.

5.6. **Currently, the basic preconditions for the development of individual grower multiple-peril crop insurance (MPCI) coverage cannot be met in Guyana; therefore, this product is not recommended in the short term.** Guyana lacks individual grower long-term yield history data which is a precondition for the design of an MPCI policy. Moreover, the country lacks the required trained staff to perform crop pre-inspections and crop loss adjustment activities required by any MPCI program. The preliminary MPCI rating estimates for rice presented in this report indicate that such a type of agricultural insurance product would be unaffordable by the farmers. Indicative rates for individual grower MPCI and a 50% coverage level would range from 9% to 20% of the sum insured.

5.7. **There are very limited opportunities in the short term to develop weather index crop insurance for rice producers.** Basis risk and lack of reliable weather data are among the main constraints to the development of weather index insurance in Guyana. Under irrigated cropping, a rainfall index is invalidated because there is no direct relationship between the amount of rainfall measured at the weather station and the amount of irrigation water plus rainfall received by the crops. The estimated missing values on almost all historical data series confirm the need to reconstruct rainfall data in order conduct future analysis regarding risks identification and quantification on areas of interest. The weather station network is comprised mostly by ordinary hydrometeorological stations (approximately 66 out of 140); however, there is no homogeneity on the rain-gauges instruments installed across the coastal plain and most of them are in poor physical conditions due to the lack of maintenance and field supervision.

5.8. **Named-peril crop insurance coverage for fruit and vegetable crops is not technically feasible for Guyana in the short term.** Currently, it would be very difficult to design named-peril crop insurance for fruit and vegetables because of the lack of vegetable production and yield statistics and gross margin data in the country with which to design and rate suitable crop insurance cover for these crops. Another reason is the absence of formal market mechanisms and major price risk exposure for fruit and vegetable producers in Guyana; until these supply chain issues have been addressed, farmers' demand for fruit and vegetable crop insurance appears to be very low. The World Bank recommends that only when export markets have been developed, and an assured supply of high quality export fruit and vegetables has been secured from local farmers, it may be appropriate to consider the design and implementation of named-peril fruit and vegetable insurance programs.

5.9. **Livestock insurance covering cattle mortality is not a feasible insurance option for Guyana in the short term.** There are several reasons supporting this statement. The first one is that most small-scale livestock production is performed for subsistence purposes and is not suited for livestock mortality insurance. Secondly, most of the livestock production systems are free-grazing (roadside and savannah); livestock insurers would not accept the risk under these conditions. The third reason is that in Guyana there is currently no system for animal registration or identification. Fourth, the country lacks a formal livestock mortality database; thus, it is not possible to perform any rating analyses for livestock insurance purposes. Last, but not least, the livestock veterinary service is under-resourced and there are very limited animal disease pathology/laboratory services in Guyana. Once the investments in the development of improved livestock husbandry and veterinary services, and the investment in a new abattoir which meets international export standards have been implemented, and if there is suitable demand from cattle farmers, it may then be feasible to design and rate some form of livestock mortality insurance cover.

5.10. **Preliminary findings indicate that most farmers have a low financial capacity to afford agricultural insurance.** An initial area-yield crop insurance demand survey was initiated during the mission through the focus groups with some rice farmers. The results show that, assuming no government intervention, around 10% to 20% of the farmers will be willing to purchase coverage of 80% of the actual production history at zone level at the current prices. This finding is supported by the fact that the gross margins that the farmers are obtaining for their rice crops are very modest.

5.11. **The bundling of agricultural insurance with credit and other services received by the farmers should be considered for Guyana.** The voluntary demand by farmers for agricultural insurance appears to be very low in Guyana and farmers' main constraint in many cases appears to centre on a lack of access to seasonal crop production credit or medium-term loans for investment in livestock and aquaculture. International experience shows that agricultural insurance, when linked to credit provision, can be a very successful tool in increasing bank lending to small and medium farmers.

5.12. **The Guyanese insurance companies lack rural branch networks to deliver agricultural insurance to small and medium farmers and rural distribution channels need to be identified.** In order to diminish the cost of insurance for farmers, delivery mechanisms through banks, input suppliers and rural extension services must be analyzed in detail.

5.13. **If agricultural insurance is introduced into Guyana, the Government will need to reassess the role of post-disaster compensation payments.** If rice insurance cover is to be introduced into Guyana in the future, it will be necessary for the GoG to reconsider its strategy of providing ex-post financial disaster compensation (e.g. in the form of fertilizer vouchers) to this group of farmers for the following reasons: (a) if insurance and disaster relief payments are made to farmers, this would amount to a double indemnity, and (b) international experience shows that, where free public-sector disaster relief is provided, this acts as a major disincentive for farmers to purchase crop insurance.

5.14. **In Guyana it is likely that the development of any market-based agricultural insurance products and programs will require the active collaboration by the private and public sectors under some form of Private-Public Partnership (PPP) agreement.** The private commercial insurance sector in Guyana is relatively small and, by itself, does not have the financial resources, let alone the technical knowledge and expertise, to plan, design, rate and implement new crop and livestock insurance programs for the predominantly small-scale farm sector in Guyana. It is therefore likely that, if agricultural insurance is to become a reality in Guyana, the government will need to provide technical, legal and financial support to the private commercial insurers at least in the start-up phase in order to create agricultural market insurance infrastructure. In other words, it is likely that there will be a need for some form of Private-Public Partnership for agricultural insurance.

5.15. **There are many ways in which governments can support and promote the introduction of market-based agricultural crop, livestock and aquaculture insurance through the private sector,** including the creation of the necessary legal and regulatory framework; enhancing data and information systems and making data freely available to the insurance industry; supporting the technical design and rating of new agricultural insurance products; and especially, through involvement in farmer education and training and capacity building for insurance company underwriters and field loss adjustment staff. Under some circumstances, there may be a role for the government in risk financing reinsurance. If the government intends to provide premium subsidies, this decision should be very carefully evaluated: it is recommended that premium subsidies should only be targeted to special-needs farmers and, in this case, for a limited period of time.

Next Steps

5.16. The pre-feasibility study was produced for the Ministry of Agriculture and the GoG but will also be made available to other interested potential stakeholders including the Guyana Private Insurance Association and its members, the banking and MFI sectors and key commodity and producer organizations such as the GRBB and the GRPA.

5.17. Depending on the outcomes of the GoG's review of this report, the next stage could be to implement a full **feasibility study for agricultural insurance** which would be designed to address some of the key outstanding issues identified by this initial study including:

i. To further investigate the potential to develop a **public-private partnership** for agricultural insurance in Guyana and the respective roles of government and the private commercial insurance companies;

ii. To conduct a formal individual **crop insurance demand study** with rice farmers and possibly with other sectors including the fruit and vegetables and livestock sectors;

iii. To conduct a more detailed study into the issues of **basis risk** associated with an area-yield index insurance program for individual farmers (micro-level insurance) and potential ways of overcoming this problem, for example by scaling down to a smaller insured unit than the zone;

iv. In order to further investigate the opportunities for **meso-level rice area-yield index insurance** for the financial sector, to conduct a more detailed study of the historical lending patterns of commercial banks (and rural banks and MFIs) to the rice sector, their recovery rates and reasons for default and potential interest in an aggregate crop insurance cover designed to protect their seasonal lending portfolios to rice farmers.

5.18. If on the basis of the feasibility study there appears to be sufficient demand for area-yield index insurance for rice (either at micro, meso or macro-levels) in Guyana, and the other outstanding issues listed above can be resolved, then at that stage, subject to approval by the GoG and the private commercial insurers, decisions may be taken to move to a planning and design phase for the implementation of a pilot rice crops insurance program(s).

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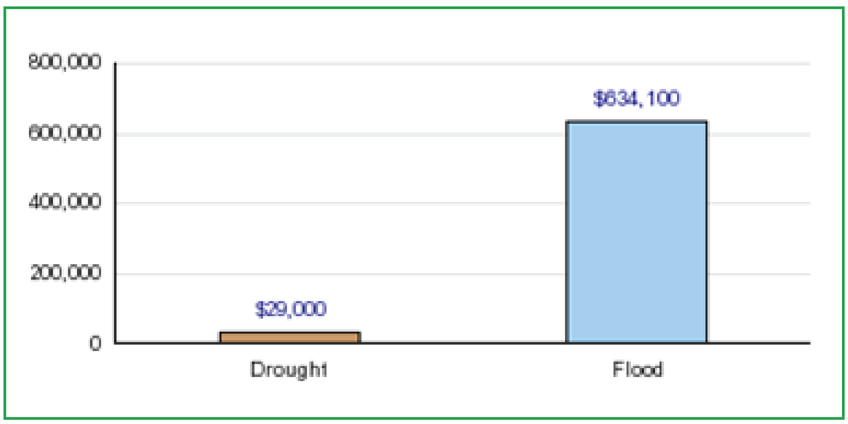
Annex 1. Overview of Climatic Risk Exposures of Agriculture in Guyana

1. **Agricultural production in Guyana is exposed to natural disasters.** Flooding and drought are the two main recurrent events that have caused millions of economic losses in the past in Guyana. In the period between 1988 and 2006[33], 7 natural disasters have caused major losses in the economy, of which 2 correspond to drought, 4 to flooding, and 1 to mass movement due to wet conditions. The total economic damage caused due to natural hazards for the period above-mentioned was US$663.1 million (US$34.9 million per year) and a total of 954,974 people were affected. Figure 1.1 shows the reported economic damages by disaster type in Guyana from 1988 to 2006.

Figure 1.1. Reported Economic Damages by Disaster Type (US$ thousands), 1988 to 2006



Source: EM-DAT (2008).

2. **Agricultural production suffers recurrent droughts.** In 1997, persistent drought conditions between September 1997 and February 1998, where average rainfall was about 25% of normal precipitation over the coastal areas, forced the Government of Guyana (GoG) to declare a state of emergency due to water shortages in almost all of the lakes, reservoirs and other irrigation sources for agricultural production. According to national estimates, about 145,000 acres of rice were sown in 1998, of which about 25,000 acres were lost and overall yields were reduced by 5% because of lack or irrigation water. Approximately, 1,300 small rice cultivators lost their entire crop[34], and about US$20 million on export earnings were lost by farmers and millers. On the other hand, the sugar sector reported a reduction on sugar production by about 13 tons of the targeted spring season output (approximately, US$7 million in lost export earnings). Similar to the rice sector, the number of farmers who suffered crop losses was estimated at about 1,000, most of them small sugar cane growers. Regarding other crops, in many coastal areas with access to potable water, residents resorted to using it for watering their crops and avoiding total losses.

3. **In August, 2009, a national task force led by the Ministry of Agriculture's National Drainage and Irrigation Authority (NDIA) was established to deal with irrigation issues** due to drought conditions cause by the recent *El Niño* phenomenon. In Region 2, the government allocated about G$149 million to excavate critical irrigation canals and to operate irrigation pumps in Dawa and to support farmers who were pumping water. In Region 3, it invested in the conditioning of irrigation canals to meet the irrigation needs of farmers and in excavating 33 holding ponds to provide water for cattle. In Region 4, water is being provided to the East Demerara Water Conservancy (EDWC) by pumping water from the Mahaica River. In Region 5, about G$15 million have been invested to provide farmers with fresh water coming from upstream of the Mahaica River. Additional work on canals has also been reported to be part of the Government's assistance to provide water for cattle. In Region 6, a number of irrigation pumps has been in operation at key areas (Sandaka, Manarbsi and Black Bush Polder), and two pumps are used to re-circulate and cover the irrigation needs of farmers. Additional expenses have been allocated by the GoG to target water scarcity problems in the country's interior communities[35].

4. **Flood is a recurrent phenomenon affecting agricultural production, in particular in recent**

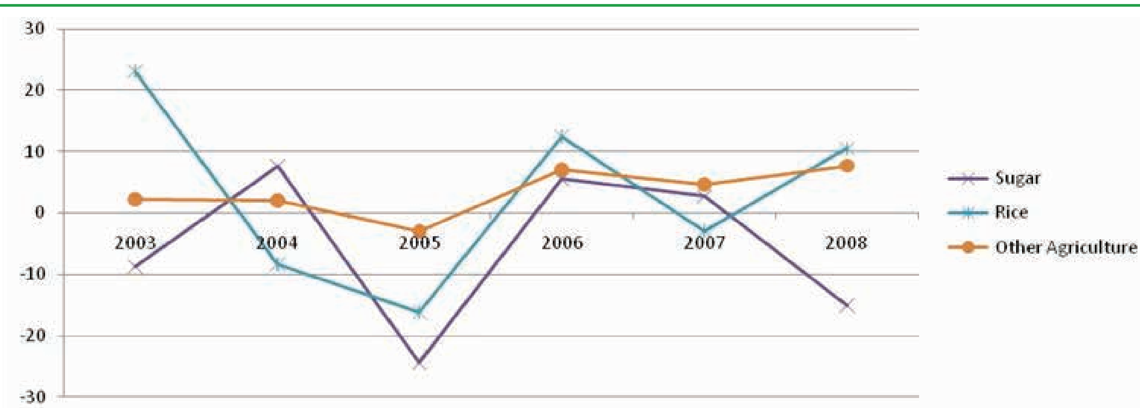
33 OFDA/CRED International Disaster Database.

34 World Bank, 1998.

35 Guyana Chronicle Online, 2010.

years. Extreme rainfall experienced between December 2005 and February 2006, caused one of the largest natural disasters in Guyana. The most important productive sector of Guyana's economy is agriculture, which accounts for approximately 32% of GDP, 40% of export earnings and 30% of employment. Rice and non-traditional sectors grew at an average of 3% per year during the 2000's. However, the prolonged and high-intensity rainfall caused a disaster which resulted in losses of G$55.1 billion, equivalent to 59% of Guyana's GDP, and affected nearly 37% of the total Guyanese population (72% of the population in Region, 41% of the population in Region 3 and 20% of the population in Region 5). Figure 1.2 shows the evolution of the agricultural GDP from 2003 up to and including 2008.

Figure 1.2. Agricultural Sector GDP Growth Rates (Real GDP)



Source: FAO, Guyana Rural Sector Review (2008).

5. **Due to its geographic position on the north-eastern area of South America, Guyana is not impacted directly by hurricanes like the rest of the CARICOM states.** Although it has enough warm water for hurricanes to develop, the country's proximity to the equator diminishes the likelihood of tropical systems hitting its shores. Near the equator, the Coriolis force, which is an apparent force caused by the Earth's rotation, is insignificant in the area so there is not enough spin to initiate hurricane development. However, Guyana does face high deviation in rainfall patterns associated with the ENSO phenomenon, which cause most of the flooding and water shortages, and the consequent economic disruption with negative effects on agriculture.

6. **The recurrent phenomenon of *El Niño-La Niña* Southern Oscillation (ENSO), causes inter-annual variations in weather and climate in Guyana.** The ENSO has a cycle, with the *El Niño* (warm phase) manifesting in one extreme, and the *La Niña* (cold phase) in the opposite one. *El Niño* and *La Niña* events are defined as periods when the sea surface temperature measured in the region located between 5° north and 5° south and between 120° and 170° west, varies an average of –/+ 0.4°C for six months or more. Anomalous patterns caused by the ENSO phenomenon result in climatic impacts in several continental areas located in the tropics and extra-tropics. Guyana is one of the countries whose annual rainfall is directly influenced by the ENSO cycle. During *El Niño*, Guyana, like the rest of the countries located in the north-eastern part of South America (Suriname, French Guyana and north-eastern parts of Brazil), experiences less rain than normal. Meanwhile, during *La Niña* events, more rain than normal is commonly registered in the same area. Mean annual rainfall (1974-2008) has been analyzed for seven weather stations in Guyana (02MCNABB, 02ODENMG, 03BAGLEG, 03LNORAF, 03UIVLBK, 04CGROVF, and 06NO73VL)[36], located in Regions 2, 3, 4 and 6, indicating – in average – variations between 8.33% and 25.31% below the long-term average on *El*

36 The selection criterion of these weather stations was based on length of historical information, data completeness (less than 10% of missing values), and data quality and data consistency. Data visual inspection and comparison with correlated data from neighboring weather stations; double mass curve method and statistic analysis was conducted to determine data consistency. The use of a larger number of weather stations with a complete historical data series should be considered with the aim of covering a larger area across the coastal plain and improving estimations regarding rainfall spatial and geographic distribution.

Niño years, and between 12.82% and 38.76% above the long-term average on *La Niña* years. Table 1.1 shows the monthly average rainfall for selected weather stations in Regions 2, 3, 4, and 6 in Guyana. Figure 1.3 shows the cumulative 3-month (quarter) rainfall for a selected station (1991 to 2007).

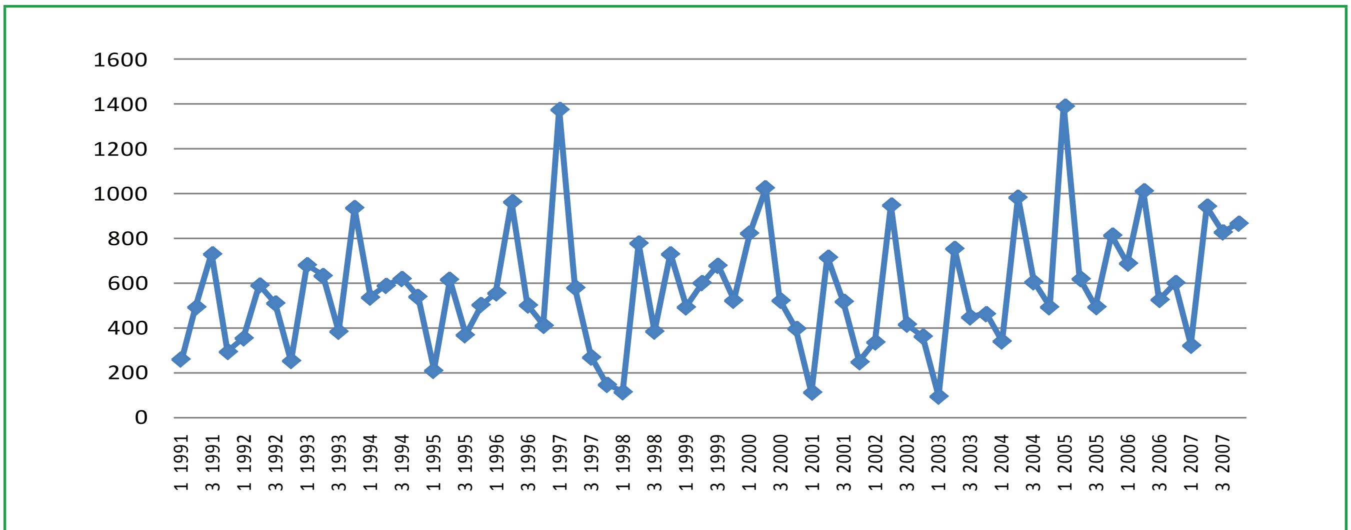
experienced warm sea surface temperature conditions, including the years of 2009 and early months of 2010. In February 2009, the sea surface temperature (SST) anomaly in the region was sufficient to be classified as a moderate *El Niño* condition. The anomaly increased from 1.23°C in February 2009 to 1.54°C for the period

Table 1.1. Monthly Average Rainfall (mm) in Regions 2, 3, 4 and 6 (1974-2009)

Region	Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2	Mc Nabb Back	228.6	97.3	110.6	135.2	296.0	306.3	258.2	164.7	104.4	118.8	180.1	250.7	**2250.9**
2	Ondemeeming	212.4	87.4	72.8	142.8	263.2	280.3	191.3	130.2	93.1	93.6	150.5	237.8	**1955.4**
3	La Bagatelle Leguan	193.7	56.7	71.6	108.9	221.9	238.0	186.0	125.7	67.1	78.8	123.9	195.4	**1667.6**
3	Leonora Front	235.9	107.3	108.4	160.9	302.7	356.0	300.1	198.9	91.6	108.8	159.7	251.9	**2382.0**
3	Uitvlugt Back	257.3	112.4	126.6	169.1	337.7	397.0	308.6	196.2	113.3	127.6	160.5	270.8	**2577.0**
4	Cane Grove Front	191.8	107.4	105.9	147.3	242.9	273.3	234.0	159.3	65.5	69.2	120.4	206.2	**1923.3**
6	No. 73 Village	173.3	108.6	105.1	157.9	249.1	253.6	199.8	151.1	67.3	73.6	97.2	170.8	**1807.4**

Source: HYDROMET.

Figure 1.3. Cumulative 3-month Rainfall (mm) for the Period between 1991 and 2007

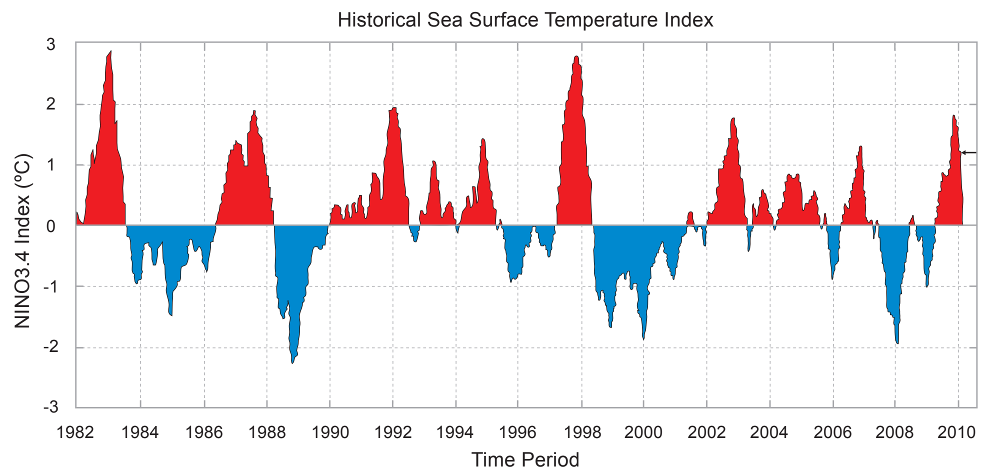


Source: HYDROMET (Guyana Rural Sector Review, 2008).

7. **The *El Niño* event was evidenced 31% of the time and *La Niña* another 31% of the time from 1950 to 1997.** According with the World Meteorological Organization (WMO), there have been five *El Niño* events from 1970 to 2000 (1972-73, 1982-83, 1986-88, 1991-95 and 1997-98), two of which were considered as the most significant of the century (1972-73 and 1997-98), and one as the longest of the century (1991-1995). In the 2000's, several years (i.e. 2002 and 2004) have between December, 2009 and January-February 2010 (see Figure 1.4). According with recent *El Niño* forecasts, moderate conditions of the current event seem to persist at least though April 2010, and it could endure though early or middle May because of the still moderately strong sub-surface anomalies.

8. **The southern "movement" of the Inter Tropical Converge Zone (ITCZ), tropical waves,**

Figure 1.4. Historical Sea Surface Temperature Index, 1982 to 2010

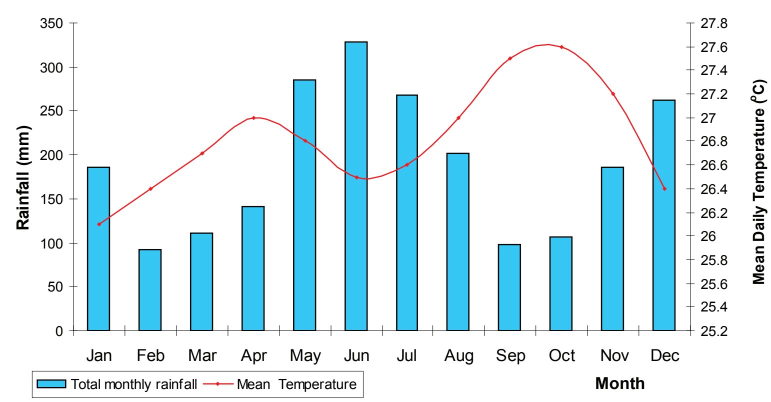


Source: The International Research Institute for Climate and Society.

squall lines and troughs are responsible for the annual cycle observed in Guyana's climatology. Tropical climate is characteristic of Guyana, where the annual rainfall ranges between 1,700 and 2,800 mm, distributed in two rainy seasons. The first wet season, which concentrates around 50% of total rainfall per year, occurs between mid April and the ending of July; meanwhile, the second wet season takes place between November and the end of January. Annual precipitation decreases slightly from west to east, with ranges that go from 2,200 to 1,800 mm. Sunshine averages range from 5 to 7 hours per day during the rainy and dry seasons, respectively. The average daily temperature ranges from 22°C to 31°C, and 80% of relative humidity in the coastal area. Average weather patterns are favorable for crop production; however, extreme weather events including long dry periods, excessive rainfall during the crop cycle, and highly intense rainfall which causes flooding in productive areas, are the main causes of crop losses or yield reduction. The monthly average rainfall distribution and the rainfall and mean daily temperatures patterns for Guyana are presented in Figure 1.5 and Figure 1.6, respectively.

9. **According with recent climate change forecasts, significant impacts of sea level rise, driven by an increase in global temperatures, are expected to occur in the low-lying coastal areas of Guyana during the period between 2050 and 2080.** Guyana's low-lying coasts (about 1.4 meters below the sea level at high tide), like several other Latin American countries[37], are among the most vulnerable to climate variability. The coastal plain, where most of the agricultural production takes place and the majority of the Guyanese population lives, is exposed to recurrent flooding damages. According to USACE (1998), short-

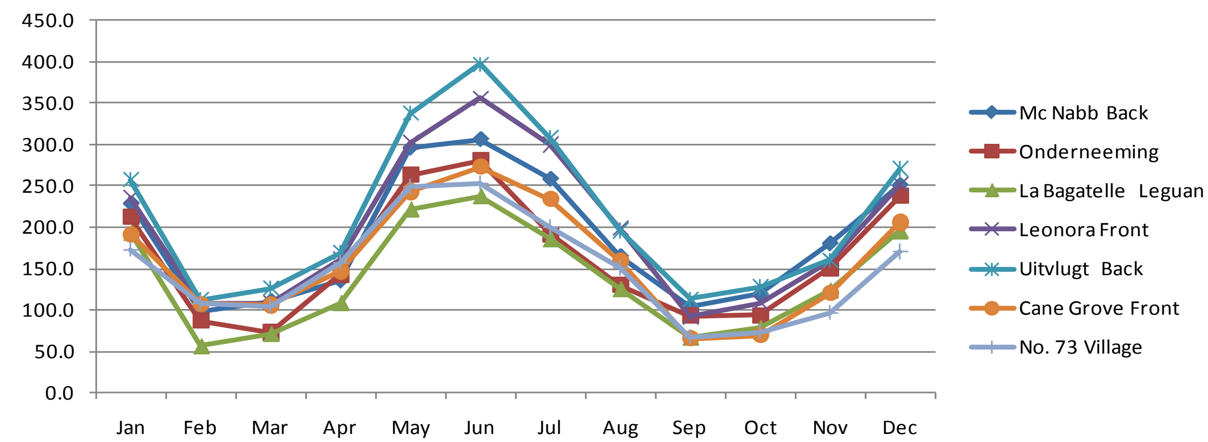
Figure 1.5. Rainfall and Mean Daily Temperature Pattern for Guyana



Source: HYDROMET.

37 The Latin American countries with low-lying coasts which are vulnerable to climate variability are: part of Argentina, Belize, Colombia, Costa Rica, Ecuador, Mexico, Panama, El Salvador, Uruguay and Venezuela.

Figure 1.6. Monthly Average Rainfall (mm) for Seven Weather Stations Located in Regions 2, 3, 4 and 6



Source: HYDROMET.

duration localized flooding is common on those occasions where heavy rains coincide with high tides. Although the current Sea Level Rise (SLR) rate, which has increased from 1 to 2-3 mm/year in south-eastern South America, is not a main problem yet, acceleration of SLR rates (up to 2-3 mm/year) over the past decade suggest an increase in the country's vulnerability and puts the current coastland protection system (i.e. sea wall) and the land-use planning and zoning norms for infrastructure, under severe strain and imminent need for revision.

10. **Scenarios of future climate change indicate that precipitation in Guyana will be reduced (5% to 10%), especially between June and December.** Therefore, water availability – not only for agricultural purposes but also for home consumption and industry – is likely to be compromised during the dry season (September to November), given that less rainfall may lead to a reduction of water levels on the conservancies. Evaporation levels are expected to increase about 5% by the 2040's, if temperature rises 1° to 1.5°C and other parameters remain unchanged. Although it is likely for the country to expect a decrease in the number of rainy days in a year, it could also be possible to experience an increase in the daily intensity of rainfall, affecting the frequency of both droughts and floods in the future. Weather parameters are correlated with crop phenological stages and their variability could compromise the cultivation of specific crops. For example, recent studies indicate that, if there wasn't any change on cultivation techniques, increased temperature levels due to climate change could reduce rice crop production owing to a raise of CO_2 levels, increase on rice water demands for land preparation, and the need for the use of more pesticides[38].

Conclusions

11. **Although Guyana has been less affected by weather events in comparison with its neighbors in the Caribbean area, extreme rainfall and drought events are becoming more intense and frequent in the country.** However, the magnitude of the economic damage that a weather event can cause to the economy, thus to the agricultural sector, depends on both human and climatic factors. For example, the increase in the frequency and severity of flood losses on rice could be explained due to: (i) the increased intensity of daily rainfall; (ii) the outdated drainage and irrigation systems; and (iii) drainage and irrigation issues.

12. **A preliminary conclusion from the climatic risk exposure analysis in Guyana is that, given the technical complexities that exist due to the presence of irrigation facilities for crop cultivation (mainly on sugar cane and rice crops) and crops diversity, there**

38 Pests and diseases are more likely to outbreak and weeds tend to spread more easily at higher levels of temperature (Backlund, Janetos and Schimel, 2009; Cline, 2007).

is no single solution to single-handedly reduce climatic risks impacts on the agricultural sector. Therefore, it is relevant to implement in parallel both (a) climate adaptation measures such as the identification of exposed and vulnerable areas, improvement of drainage, cultivation of crops that could better adapt, for example, to extended drought periods or an increase on average daily temperatures; and (b) try to interlink these types of risk management issues with risk transfer instruments designed to provide coverage against weather and natural disasters.

Annex 2. Agricultural Production Systems in Guyana

Importance of the Agricultural Sector in Guyana

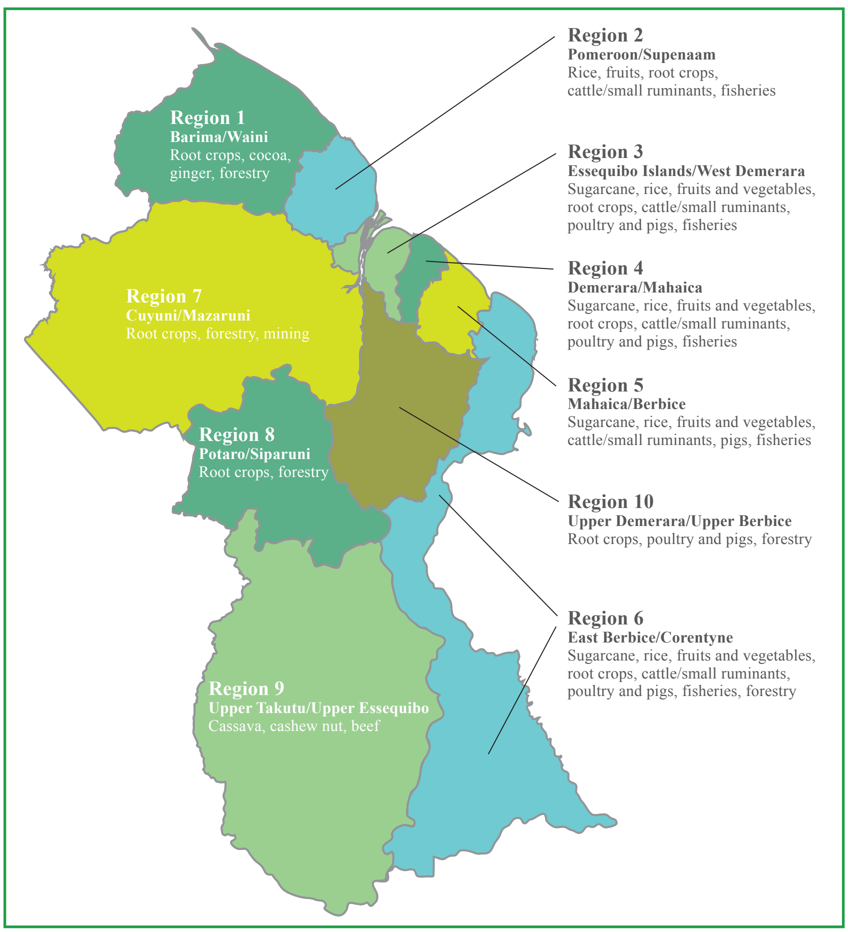
1. **Agriculture is the most important sector of Guyana's economy, as It accounts for approximately 30% of GDP, 40% of export earnings and, best estimates indicate, more than 50 % of employment.** About 400,000 acres of agricultural land is irrigated, of which about 130,000 acres are planted with sugar cane, 200,000 acres are under rice cultivation and 70,000 acres are allocated to other crops and livestock. Sugar and rice are the most important crops in terms of area, value of production, employment creation, and contribution to export earnings. However, it is observed that, in recent times, other agriculture activities have been increasing in importance as sugar and rice markets have become more difficult to access. These agricultural activities comprise livestock, aquaculture production, grain crops, oil seeds, root and tuber crops, vegetables/"greens", spices and seasonings, and a wide variety of fruits. Map 2.1, shows the distribution of the main agricultural activities on each of the ten administrative regions in which the country is divided.

Resources for Agricultural Production in Guyana

2. **Most of the agricultural production, as well as other economic activities, takes place along the coastal plain.** The coastal plain is a fertile flat strip of 5 to 7 km wide along the seashore. The coastal plain lies about 1.4 meters below the 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. The annual rainfall averages about 2,300 mm and is distributed in two rainy seasons, which occur from May to July and from November to January. During the rainy seasons, sunshine averages about five hours per day, but during the dry seasons, seven hours or more are common. Temperatures rarely rise above 31°C or fall below 22°C and relative humidity is high with 80% or more on the coastal zone. A summary of the land use in the coastal areas of Guyana is presented on Map 2.2. The rainfall and mean daily temperatures patterns for Guyana are presented in Figure 2.1.

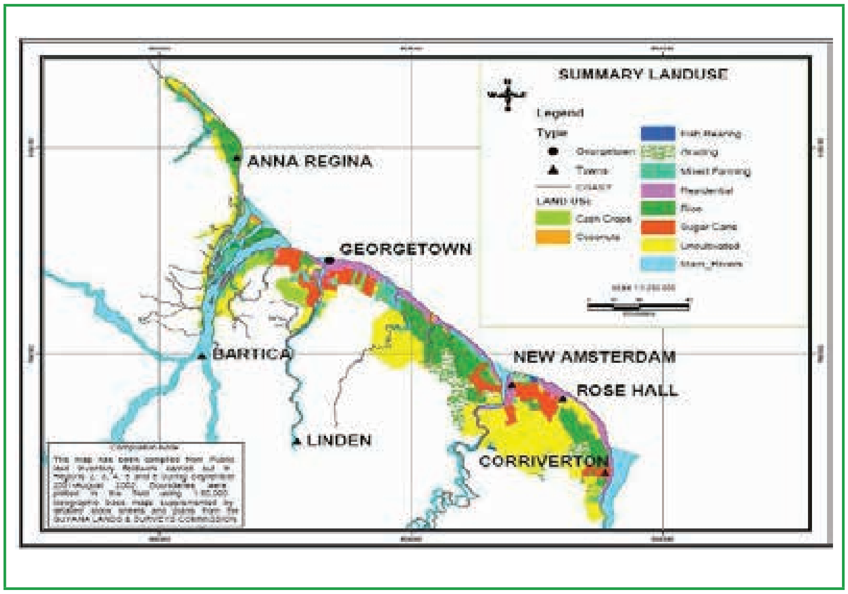
3. **Agricultural production in Guyana has always been tied to the defense against water intrusion from the sea and from rainwater runoff.** The fact that the vast majority of agricultural activities take place in the coastal plain,

Map 2.1. Distribution of the Main Agricultural Activities per Administrative Region in Guyana



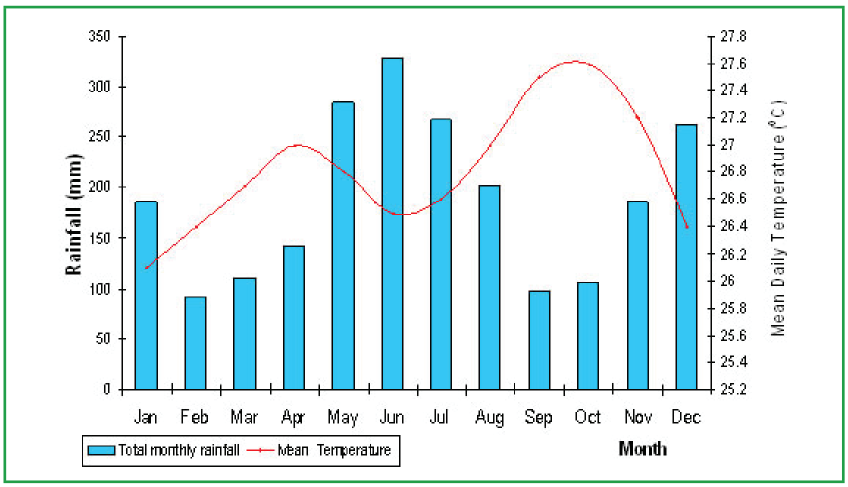
Source: Guyana Rural Sector Review, World Bank/FAO.

Map 2.2. Summary of Land Use in Coastal Areas of Guyana



Source: Guyana Lands and Surveys Commission (2008).

Figure 2.1. Rainfall and Mean Daily Temperature Patterns for Guyana



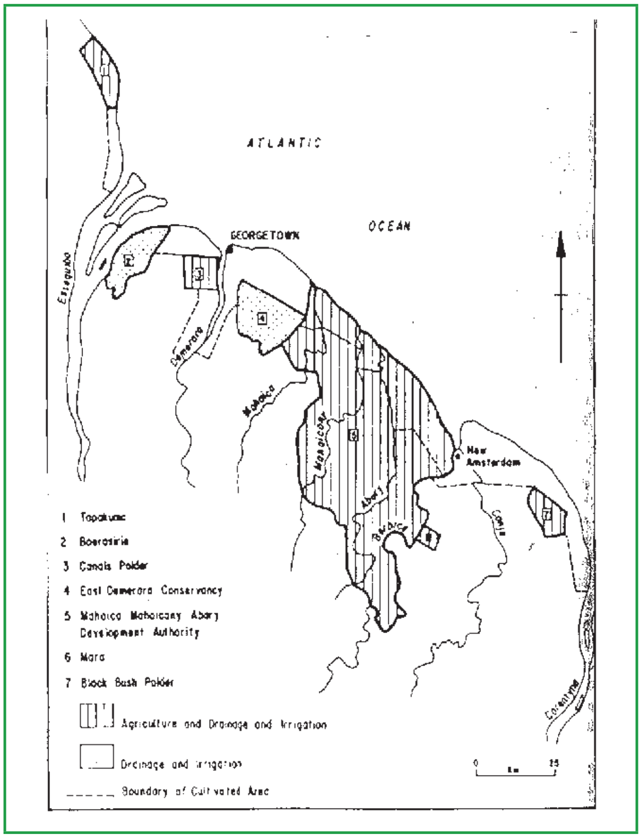
Source: HYDROMET.

which lies below the sea level at high tide, means that agricultural production has to rely heavily on drainage and irrigation systems. A comprehensive drainage and irrigation (D&I) system was constructed more than 100 years ago by the Dutch, back when sugar cane was the principle crop grown under irrigation. However, In 2010 the D&I system is in need of major rehabilitation. Currently, drainage throughout most of Guyana is poor and river flow sluggish because the average gradient of the main rivers is only 0.2 0/00. Drainage by gravity is possible only when the tide is low, and this form of drainage is affected by the ever-changing levels of the foreshore outside the sea defenses. The total length of the irrigation canals in Guyana is 485 km of main canals and 1,100 km of secondary canals. Similarly, the main drainage infrastructure is about 500 km in length, while the length of the secondary drainage system is 1,500 km.

4. **Crop production in Guyana is also tied to irrigation.** About 400,000 acres of agricultural land is irrigated. The irrigated areas are concentrated in Regions 2, 3, 4, 5 and 6 (between the mouths of the Pomeroon River and the Corentyne River). The water supply is derived from water conservancies (reservoirs) in Regions 2, 3, 4 and 5, and from the rivers, through pumping, in Region 6. Very few control structures exist along the main canals and distributor canals. Water flow in the secondary canals is controlled by head gates, and farmers derive water from secondary canals normally by gravity. Minor drains are interspersed with secondary canals that drain directly to the sea through sluice gates (some are associated with pumping stations) or to a façade drain, which drains to the sea at regular intervals. Sluice gates are open twice a day at low tides. Irrigation canals within the sugar estates have no gradient and are often used for cane transportation. Map 2.3 shows the drainage and irrigation system in place in Guyana as well as the main irrigated areas.

5. **The drainage and irrigation infrastructure in Guyana needs extensive rehabilitation as well improved management efficiency.** Although the GoG (with assistance from donors) is currently investing in the rehabilitation of the drainage and irrigation system, the systems' current state of disrepair and maintenance contributes significantly to lowering Guyana's efficient use of water and its capability to manage rainwater runoff. Another important cause of poor water efficiency and water runoff capability is the insufficient management of the drainage and irrigation system.

Map 2.3. Drainage and Irrigation System, Guyana



Source: **Ministry of Agriculture, National Drainage and Irrigation Authority, Guyana.**

Features of Agricultural Production in Guyana

6. **The agricultural sector in Guyana consists of a diverse set of agricultural activities.** Sugar cane production, which accounts for 40.6% of the agricultural GDP of Guyana, is the main agricultural activity in the country; sugar production and processing also takes place within the coastal regions except in Region 2. Rice production, accounting for 11.8% of the agricultural GDP, is the second agricultural activity in order of importance in the country. Rice production is concentrated in the five coastal regions (i.e. Regions 2, 3, 4, 5 and 6). These five regions are also the major producing areas for fruit and vegetables, as well as shrimp and tilapia. Root crops are the most widely cultivated crops in Guyana as they are common to all regions, except for Region 5 where much smaller quantities are produced. Cattle, sheep and goat production is more prevalent in all of the coastal regions; while pigs and poultry production are more common in Region 10 and the coastal regions except Region 2. Finally, forestry (accounting for 10.4% of the agricultural GDP) is an economic activity that is found in all of the interior regions and in Region 6.

7. **With the exception of the sugar sector, in which GuySuCo (the state owned sugar mill) owns two thirds of the land cultivated with sugar cane, the remaining agricultural sub-sectors in Guyana are characterized by the predominance of small farms.** According to the last farm household survey available for the county, farms of less than 6 ha accounted for about 75% of the country's 24,000 farms. Many of these small farms combine their crop production with some milk production and small-scale fruit and vegetable production. There are, however, several larger agricultural operations that include private rice growers, as well as some medium and large-sized forest and aquaculture operations.

8. **Several constraints are affecting the development of the Guyanese agricultural sector.** The key constraints limiting agricultural sector development are the absence of multi-annual commodity and sectoral policies, and the accompanying investment plans and programs; inadequate human and institutional resources; poor quality of research and extension services (the main exceptions are the rice and sugar sectors); high cost of inputs; poor maintenance of drainage and irrigation systems; poor farm-to market roads; and farmers lack of access to rural credit at adequate terms and conditions. The ineffective granting of land titles and the inadequate establishment of mechanisms to effectively address praedial larceny are also major limitations to investment in the agricultural sector. Box 2.1 summarizes the main institutional, infrastructural, and market constraints faced by the agricultural sector in Guyana.

Main Agriculture Sub-sectors in Guyana

Sugar Sub-sector

9. **The sugar sector in Guyana is the mainstay of the economy.** The sugar sector is the most important agricultural activity in Guyana accounting for 40% of agricultural GDP[39]. During the period

39 Value as of 2008.

Box 2.1. Main Constraints affecting Agricultural Production in Guyana

Institutional Related Constraints

Research, Technology Development and Extension Services

The Crops and Livestock Department (CLD) of the MoA is responsible for the provision of technical and extension services to the livestock, and fruit and vegetables sub-sectors. However, the unit in charge of providing agricultural information and training farmers and extension personnel is, perhaps, its weakest unit. Similarly, the Veterinary Diagnostic and Plant Health Laboratories, which were intended to provide diagnostic support to the agriculture and livestock sectors, hardly function. These Departments have limited operational funding and staff shortages.

Land Tenure and Land Management

The Guyana Lands and Surveys Commission is in charge of addressing land tenure issues. These include rationalizing the status of lands both legally held through temporary leases and those where settlement is permitted but no legal documents have been issued. There is a major issue related to farmers who are seeking to possess lands for agricultural. These farmers are deterred by cost factors and a laborious administrative process to obtain their land titles and invest on those lands.

Weak Legal and Regulatory Framework

A weak legal and regulatory framework results in many critical policies and regulations being unclear, outdated, or simply not in place. The judicial system, on which economic transactions depend, is slow and in need of reform to be effective and independent. This weak legal framework has also contributed to the lack of development of effective and efficient capital and land markets, as well as the inadequate access to credit by farmers.

Infrastructure Related Constraints

Drainage and Irrigation

The poor state of the drainage and irrigation systems contributes to severe flooding and acute droughts throughout the agriculture belt, resulting in destruction of many farms and livestock. These problems arose from poor management, low levels of maintenance, and sea defense breaches. The GoG has already started to address these challenges through: (a) implementing the Conservancy Adaptation Project (CAP), which would see significant improvement in the operation and implementation of the flood structures within the East Demerara Water Conservancy; (b) the construction of additional drainage outlets and rehabilitation of pumping stations; and (c) major rehabilitation of canals and drains including pump stations, structures and drainage outlets.

Roads and Transport

The state of the farm roads is inadequate. In many instances, there is poor maintenance of roads and bridges, some of which are impassable in the rainy season, causing many farmers to lose substantial income. The inadequacy of river and sea transport and of external transport links are also significant impediments to business development. The entities which are able to meet export market stipulations often find that inadequate refrigeration facilities, insufficient cargo space, and irregular shipping schedules negatively impact the efficiency and quality of exports.

Market Related Constraints

The most immediate demand-side challenge is adjusting to trading in a more competitive marketplace for sugar and rice. The marketing of non-traditional crops, livestock, forestry and fishery products is constrained by the inadequate technical support services related to standards, quality, inspection and regulation. These essential areas are prerequisites to addressing other market related issues such as storage, packaging and transportation.

Source: **Authors.**

between 1997 and 2007, Guyana's sugar production ranged between 246,000 and 325,000 tons of raw sugar output, and export volume ranged between 230,000 and 312,000 tons. Sugar cane production is typically organized on a fairly extensive large-estate basis in over 125,000 acres of harvested area. There are currently nine sugar factories in Guyana, all of which are operated by one corporation, GuySuCo.

Farmer-produced cane is estimated at less than 20% of the total cane output.

10. **The sugar sector also contributes immensely to Guyana's socioeconomic development.** Sugar is the largest net earner of foreign exchange for the country and it is the biggest corporate contributor to public revenue. Moreover, it directly employs 25,000 people or about 10% of Guyana's labour force. Indirectly, it provides employment for another 20% of the country's citizens. The European Union (EU) preferential sugar market regime, known as the European Union Sugar Protocol, has traditionally provided high prices for ACP countries and allows Guyana to market the majority of its sugar. Challenges to this regime in the WTO have led to major changes, including a scheduled price decline of 37%, which will reflect in large export losses. This will impact Guyana's economy very negatively and, especially, it's many sugar producing areas.

11. **The sugar farming sub-sector in Guyana is constrained by several factors.** The major constraints identified for the sugar sub-sector are inadequate managerial and technical skills, high cost of transportation, inadequate bulk loading facilities, disorganized cooperatives and relatively high employment costs.

Rice Sub-sector

12. **Guyana's rice sub-sector contributes significantly to the well-being of a large number of farming communities in Guyana.** The rice sector is the second most important agricultural activity in Guyana accounting for 11.8% of agricultural GDP (in addition, the rice industry as a whole contributes with 20% of the agricultural GDP and 12% of export earnings for the country). Additionally, the rice sector is the largest user of agricultural lands, and it absorbs and influences more of the working population than any other industry in Guyana. About 8,000 farmers are directly involved in rice production but the industry supports at least 20% of Guyana's population directly, and many more indirectly. Rice is the major source of employment in rural areas.

13. **The rice sector has traditionally been mainly a small-farmer sector; however, there is an ongoing process of land consolidation.** Currently, out of approximately 8,000 rice farmers in Guyana, 59% of the farmers who possess or rent under 10 acres cultivate 14% of the total rice acreage, while those farmers who posses above 10 acres under rice cultivation, cultivate the remaining 86% of the total rice acreage in the country.

14. **Paddy production in Guyana is fully market oriented.** In spite of the fact that the majority of rice farmers in Guyana are small farmers, this does not mean that rice production is a subsistence crop. Rice farmers in Guyana are selling their rice production to the market and, most of them, have saving accounts and are receiving or have received some sort of financial support from MFIs, banks, millers or input suppliers.

15. **In Guyana, the rice sector is highly organized, with centralized coordination provided by the Guyana Rice Development Board (GRDB).** The GRDB's mission is to efficiently utilize the resources of Guyana to produce high-quality rice and rice by-products as a staple food for local and international markets. The GRDB has several functions. Among other responsibilities, it is responsible for performing the quality control of rice production, conducting rice research and extension services in the country, and providing certified rice seeds to the farmers.

16. **Farmers associations also play an active role in supporting rice farmers in Guyana.** The Guyana Rice Producers Association (GRPA) represents about 70% of the rice farmers in Guyana. Its main objectives are: (i) to protect, promote and enhance the interests of rice producers; (ii) to promote associative mechanisms in the rice farming sector; and (iii) to represent the rice farming sector on the discussions about any matter affecting rice production. The GRPA has twelve Field Officers who are in charge of the follow-up of paddy crops during the crop season, and of collecting production data and stock data in the mills. The GRPA also certifies seed fields and assists in the mobilization of farmers to attend meetings and seminars.

17. **The rice sector in Guyana needs to consolidate itself and further develop into one that is sustainable and profitable.** This is a major challenge given that average yields of paddy are below the comparative yields of other rice-producing countries with which Guyana competes in the region. Average

current yield per crop is estimated by the GRDB to be 26 bags (1.7 tons) per acre. In comparison, US paddy yields are about 43 bags (140 pounds) per acre in Arkansas and 39 bags per acre in Texas/Louisiana per crop. In Guyana only a few fully mechanized and larger high-technology rice producers achieve average yields of 40 to 45 bags per acre.

18. **Paddy prices in Guyana are highly volatile within a particular harvesting season.** Usually, at the start of the harvest period, paddy prices are high on account of the uncertainty over supplies during the harvest period. However, as soon as the main harvest begins and there are certainties about its volume, paddy prices usually fall. The differences between the paddy prices at the beginning of one crop season can be, in average,130% higher than the paddy prices at the peak of the crop season.

19. **Owing to the low yields obtained by rice farmers and the volatile rice prices, the financial margins for paddy production in Guyana are low.** The production cost of paddy, ranges from G$50,000 to G$70,000[40] per acre, depending on the region and whether or not the farmer is renting or owning the land. Assuming, similar paddy prices to 2008/09[41], with an average of G$2,500 per bag, the break-even yield that rice farmers must obtain to cover the cost of production should be between 20 and 24 bags per acre. Under similar situations, in terms of paddy prices, only those farmers, who are able to harvest over 40 bags per acre, would obtain high profits from paddy crops.

20. **The rice farming sector in Guyana faces several constraints.** These constraints include: (i) inadequate drainage and irrigation facilities; (ii) pervasive influence of natural perils, like flood and drought, in paddy production; (iii) high cost of inputs; (iv) high paddy price volatility; and (v) difficulties to access credit.

40 It is expected that the production cost for paddy during the 2009/10 spring crop season will rise due to the additional costs assumed by the farmers in order to pump water to mitigate the current effects of the *El Niño* phenomenon.

41 Paddy prices for 2009/10 spring crop season as of March 2010 were from G$3,500/bag to G$4,000/bag. However, it is expected that this price would fall at the peak of the crop season, when the millers will have more certainties about the evolution of the harvest season.

Fruit and Vegetables Sub-sector

21. **The fruit and vegetables sub-sector has increased in importance as the protected markets for the traditional export crops of rice and sugar have eroded.** This sector comprises grain crops (corn, black-eye and minica), oil seeds (peanut and coconut), root and tuber crops (cassava, sweet potato, eddo, yam, tannia/dasheen and plantain), vegetables/"greens" (bora, boulanger, tomato, ochro, pumpkin, cabbage, peppers, etc.), spices and seasonings (eschallot, celery, thyme, etc.), a wide variety of fruits (mango, pineapple, citrus, passion fruit, cherry, watermelon, papaya, etc.), and other crops such as cocoa and coffee.

22. **There are at least 80 non-traditional crops exported from Guyana, and except for copra, these crops are mainly produced by small farmers (less than 2.5 acres).** In 2006, 5,219 tons valued at US$7.2 million of non-traditional agricultural produce (fresh and processed) were exported from Guyana. Major regional destinations for the produce exported in 2006 were CARICOM markets, while major extra-regional destinations were France and Canada. In 2006, the main non-traditional exports were heart of palm chunks, copra, coconut oil, plantain, pumpkin, watermelon and mango.

23. **In general, fruit and vegetable farmers in Guyana are not specialized; significant investment in capacity building and technology is needed in order to reconvert this sector to an export oriented one.** Currently, fruit and vegetable production in Guyana takes place, mostly, in an open air environment, on an extensive form, and as a complement to rice or sugar cane production. Inadequate storage and transportation result in a high incidence of harvest/post-harvest losses. However, in recent times, some specialized export oriented fruit and vegetable farmers have begun their activities in the country. These specialized producers are investing in greenhouses and drip irrigation technologies.

24. **The commercial arrangements along the fruit and vegetable value chain in Guyana are still very informal; significant efforts on capacity building, infrastructure and market information are needed in order to substantially improve the current mechanisms that farmers have to market**

their products. In general, farmers face difficulties marketing their produce. In most of the cases, farmers sell their produce at low prices to farm-gate wholesalers/truckers (hucksters) rather than having to pay for transport, landing fees, etc., as they feel that they would not recover these additional costs through direct sale of their produce. Some farmers, however, take their produce to Georgetown, but spend much of the night waiting around Stabroek Market before they can sell their merchandise. Fruit and vegetable farmers complain about the very low average prices they receive from wholesalers for their produce, a problem which is compounded by over-production and limited demand at a local level. Farmers also argue for the need to develop export markets and the establishment of up-to-date storage and packing facilities. It must be noted that, cognizant of this constraint, the MoA has already upgraded the GMC packaging facility at Sophia and has constructed a new one at Parika, East Bank Essequibo, Region 3.

25. **The development of the non-traditional agricultural sector is seen as essential to maintaining an increasing the level of development in rural areas.** Fruit and vegetables have been identified as a priority sector under the ADP (Agricultural Export Diversification Program) funded by the IADB. Major challenges related to levels of investment, access to credit, productivity of operations, marketing, and enterprise management capacity, continue to characterize the sub-sector.

26. **Guyana enjoys a number of competitive advantages in the production of fruit and vegetables for export; however, in spite of these apparent comparative advantages, the country has not been able – so far – to build an export oriented fruit and vegetables sub-sector.** The availability of suitable land, adequate water, isolated areas that lend themselves to organic production systems, the plant health status of the country (which is free of fruit fly) and its preferential position as a potential exporter, especially to the CARICOM and European Union markets, gives Guyana incommensurable comparative advantages for fruit and vegetable production. However, while there are clear weaknesses at the production end that need to be addressed, the failures in marketing are often cited as being more binding.

27. **In order to exploit the country's comparative advantages for fruit and vegetable production, several constraints must be overcome.** Constraints to the production, marketing and trade of fruit and vegetable production include: (i) inadequate selection of cultivars and scarcity of planting material; (ii) lack of extension services; (iii) high cost of inputs; (iv) lack of farmers' access to credit; (v) insufficient/inadequate market information; (vi) the virtual absence of formal contract farming arrangements; (vii) the lack of organization and associations by the farmers; and (viii) the poor condition of the drainage and irrigation main infrastructure.

Livestock Sector

28. **The livestock industry is an important contributor to rural incomes and employment in Guyana.** The livestock industry represented about 2% of the agricultural GDP in 2008.

29. **Although there are no accurate statistics available for Guyana, best estimates indicate that the total cattle head count in the country is between 280,000 and over 350,000 head of beef and dairy cattle.** The herds are generally dual-purpose, being managed for both beef and milk. Milk production takes place on small farms with herds of less than 10 head on average, and is concentrated in three coastal sub-regions. Several milk production systems are used by farmers in Guyana, the low input system being the one that is most widespread. It is generally known that dairy productivity in the country is poor: the average milk production per cow per day is often 4-5 pints, the average lactation length between 120 and 180 days, and the average calving interval often more than 400 days. Cattle ownership in Guyana is characterized by a large number of about 16,000 small farmers owning a few head of cattle which are held as assets to be sold in times of need, and a relatively small number of medium and larger commercial beef producers. The beef production system competes for land with rice production and, when rice prices are low, beef cattle are grazed on rice lands. When rice prices are high, cattle are placed on lands farther away from the coast and the farmers homesteads. Beef production is estimated at 1.4 million kg per year and milk production at 6-8 million gallons per year.

30. **Livestock production is well below its potential capacity and the largely subsistence level systems face numerous constraints.** Inadequate feeding programs, both pasture and supplement related; lack of veterinary services; and inadequate breeding programs result in low productivity and low quality products. Systems for controlling cattle movement within the country are lacking and competition with crops for land leads to community conflict: lack of access to grazing land is a major constraint for livestock producers in the coastal plains. Outdated legal frameworks undermine institutionalization of progressive systems for planning and managing the sector. Abattoir facilities are currently inadequate and do not meet the health, safety and certification standards required by international export markets in North America and Europe. There is limited knowledge on meeting Good Manufacturing Practices (GMP) and Good Agricultural Practices (GAP) in the livestock chain.

31. **The development of the livestock sector requires transforming herders from being low-productivity and low-quality product producers to commercial entrepreneurs.** To develop high-valued high-quality livestock products, the provision of adequate support services through upgraded technical and regulatory institutions, especially in the areas of animal health and sanitary services, traceability, quality control and standards, will be necessary.

32. **The GoG is currently working on enabling an environment for the development of the livestock sector in the country.** The livestock sector has been identified as a priority one under the ADP (Agricultural Export Diversification Program) funded by the IADB. The GoG's strategies for improving the livestock include: (i) the development of a master plan for the sector; (ii) the establishment of a livestock working group; (iii) the construction of a state-of-the-art abattoir; (iv) the improvement of grading standards for beef; (v) the improvement of land use planning and tenure arrangements; and (vi) an increase in extension and veterinary services for livestock production in the country.

Aquaculture Sector

33. **Aquaculture is a small but rapidly innovating and growing private sector-led industry.** In aquaculture, besides the New Line Aqua Farm of Region 3, which is already producing red and Nile tilapia, hassar and fresh-water pacu, and the Sankar's Tilapia Farm of Region 2 which has recently been established, there were at least six other smaller projects which were at the pre-operation phase. The development of the aquaculture industry is benefitting from collaboration between the Department of Fisheries of the MoA, the USAID-funded GTIS, the DFID and the NAAG.

34. **The GoG's policy on the fisheries sub-sector is one of an expanded and more diverse production base.** This goal is to be promoted through increased production of aquaculture, shell-fish and fin-fish, using environmentally friendly methods (industrial trawling of marine fish and small-scale artisanal fishing), and the expansion of inland fishing for food and ornamental fish, including fresh-water and brackish water aquaculture for tilapia and shrimp. The DoF/MoA estimate that up to 40,000 acres of low-lying saline land located in the coastal plain between the sea wall and the agricultural lands might be suitable for fish farming, but the development of this land will require major investment in seawater pumping and drainage systems.

35. **Aquaculture producers are organized and nucleated in the National Aquaculture Association of Guyana (NAAG).** The NAAG was formed in February 2006, with members that include aquaculture farmers, feed producers, processors, loan agencies and donor agencies. Technical support in the areas of feed production, training, equipment and brood stock procurement and farm management was provided by the GTIS and the Mon-Repos Aquaculture Station (MRAS). The MRAS collaborated with the IPED in fingerling acquisition, joint research and training activities and sharing of technical information on aquaculture, including cage culture. Significant research for the period under review included research on polyculture. Data obtained was presented to farmers in the training courses held at the Mon-Repos facility. Several species were identified locally for use in brackish water aquaculture.

36. **The aquaculture sector in Guyana faces several constraints for its development.** First, the sector faces difficulties to access investment capital

to construct fish farms and install the necessary equipment for fish production. Second, the availability of electricity and its cost is a serious issue. Third, there is a lack of availability of locally produced quality feed-stock for aquaculture production: imported fish-feed from the US is expensive and, to date, locally produced fish pellets are of poor quality and dissolve on contact with the water leading to major waste and pollution of the water. Last, but not least, the cost of international air freight from Guyana to the target markets is a serious drawback for the Guyanese aquaculture production. So far, no major disease outbreaks have occurred, either in the tilapia or the shrimp farms in Guyana.

Poultry Sector

37. **The poultry sector is a growing private sector-led industry in Guyana.** The production of poultry products is largely oriented toward the domestic market. Chicken is the second main food staple, demonstrating the importance of the product to the Guyanese diet. Recently, there has been a considerable expansion of the poultry industry with investments in large-scale operations. For example, local poultry meat production increased by 100% to 13.7 million kg between 1997 and 2003. By 2007, poultry meat production was approximately 25 million kg. Unlike meat production, the data show that egg production had the opposite trend falling from an all-time high of 30 million eggs in 2000 to 9.8 million in 2007.

38. **The industry remains an important source of income and employment for a number of low-income families, mainly in the rural areas of Guyana.** In 2002, it was estimated that the industry provided formal employment to more than 6,000 persons (CPEC, 2002) with 60% employed in the small broiler farms and an additional 20% in live bird sales. The commercial broiler farms employ 6% of all workers in the industry.

Forestry Sector

39. **The forestry sector has been a key export sector in Guyana and it is being expanded.** Currently, about 65,000 square miles (168,000 km^2) or more than 75% of Guyana's total land area is forested. Exports of timber were the fifth largest contributor to export earnings in 2002. This sub-sector employs approximately 20,000 people (GoG, 2003). The forestry sector has contributed, over the 1997-2007 period, between 3 and 5% to total GDP. As a percentage, the forestry sector accounts for 11% of the total agricultural output.

Annex 3. Rice Crop Yield Risk Assessment

1. **This Annex presents the main findings of the rice crop risk assessment performed for Guyana.** The Annex aims to provide a description of how climate is influencing the rice sector in Guyana. The Annex is based on the findings obtained with the use of the CRAM, which is a Crop Risk Assessment Model that was specially designed to assess crop risk for major crops in Guyana. The risk assessment for rice production in Guyana was performed using GRDB historical time-series rice production and yield data at zonal level, which is the lowest level of disaggregation of rice production information available in Guyana.

2. **The Annex provides a comprehensive assessment of the climatic risk faced by the rice sector in Guyana.** The first section of the Annex starts with the description of the influence of climate and the drainage and irrigation infrastructure on paddy cropping patterns. Next, it analyses the evolution of crop production and yields for paddy crops in the country starting with the 1994/95 crop year up to and including 2007/08. Then, it assesses the key risk exposures and their impact on paddy crop production. After this, the Annex describes the crop portfolio risk model used for the risk assessment and explains the main findings of this analysis, including the calculations of the average loss cost and the maximum probable losses.

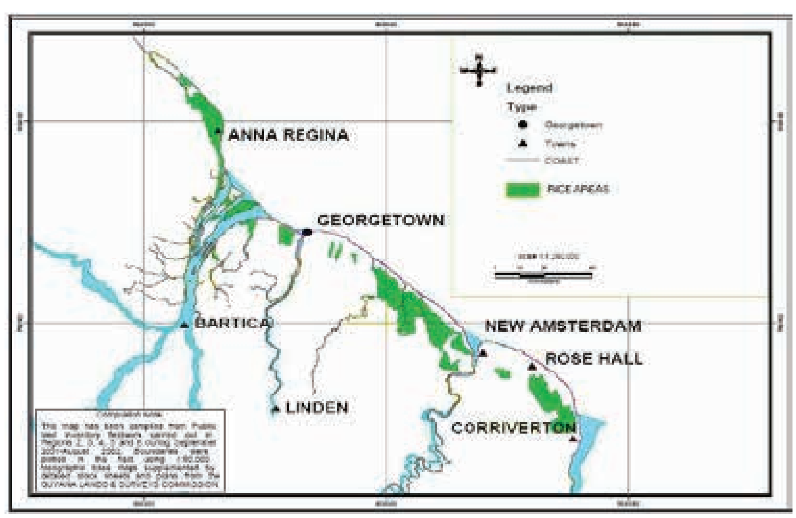
Features of Paddy Crop Production in Guyana

3. **Paddy production takes place along the coastal plain in Guyana.** The coastal plain is a fertile flat strip, 5 to 7 km wide, along the seashore. The coastal plain lies about 1.4 meters 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. The 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. During the rainy seasons, sunshine averages about five hours per day but during the dry seasons, seven hours or more are common. Temperatures rarely rise above 31°C or fall below 22°C and relative humidity is high, with 80% or more in the coastal zone. Map 3.1 shows the main rice production areas in Guyana.

4. **Paddy is cultivated in Guyana during two crop seasons, namely the spring crop season and the autumn crop season.** The spring crop is generally cultivated during the months of November and December and harvested during the months of March and 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. Figure 3.1 overlays the crop calendar for both paddy crop seasons in Guyana and the monthly rainfall and mean daily temperature pattern.

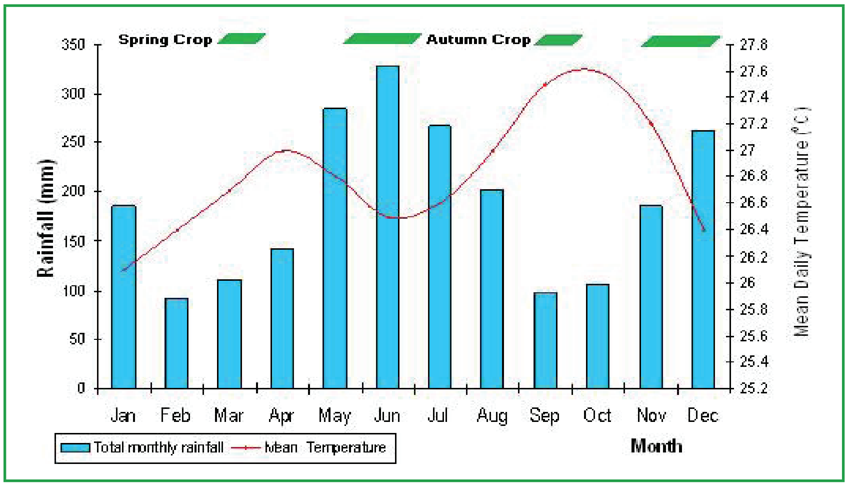
5. **Paddy production in Guyana is tied to the defense against water intrusion from the sea and depends on a comprehensive drainage and irrigation (D&I) system.** The fact that the vast majority of agricultural activities take place in the coastal plain, which lies below sea level at high tide, means that agricultural production has to rely heavily on drainage

Map 3.1. Main Rice Production Areas in Guyana



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

Figure 3.1. Monthly Rainfall and Mean Daily Temperature Pattern for Guyana



Source: HYDROMET and GRDB.

systems. A comprehensive drainage and irrigation (D&I) system was constructed more than 100 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 0.2 0/00. Drainage by gravity is possible only when the tide is low and this form of 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. In addition to its dependence on a complex drainage system, paddy production also relies on irrigation. The irrigation areas are concentrated in Regions 2, 3, 4, 5 and 6 (between the mouths of the Pomeroon River and the Corentyne River). **The variable occurrence of rainfall has led to the creation of conservancies**, which supply water in Regions 2, 3, 4 and 5, while water in Region 6 is extracted from the rivers through pumping. The conservancies are: Tapakuma in Region 2, Boeraserie in Region 3, East Demerara and the Mahaica-Mahaicony-Abary/Agriculture Development Authority (MMA/ADA) in Regions 4 and 5. All of them serve the dual purpose of flood control and storage of irrigation water for their respective areas, based on the agricultural sector's water needs. The description of the characteristics of each of these conservancies is provided in Box 3.1.

6. **As of 2009, despite of the efforts by the GoG to rehabilitate the system, the D&I infrastructure needs extensive rehabilitation as well as an increase in the efficiency of its management.** Although the GoG (with assistance from donors) is investing in rehabilitating the drainage and irrigation system, the current state of disrepair and poor maintenance of the system significantly contributes to lowering Guyana's water use efficiency and capability to disperse rainwater runoff. Projections of future climate scenarios, resulting in water deficits and increase on rainfall intensity, mean that these conservancies will have to be efficiently maintained.

Paddy Crop Yields in Guyana

7. **According to the Guyana Rice Development Board (GRDB), during the 2007/2008 crop year, the paddy gross cultivated area in Guyana almost reached 305,000 acres.** Out of this total of 305,000 acres sown in 2007/08, it is estimated that more than 97% were irrigated. During this year, the spring crop season paddy accounted for 147,786 acres or 49% of total cropped area and the autumn crop season paddy accounted for 155,051 acres or 51% of total cropped area. Table 3.1 shows the main figures for paddy production in Guyana for the 2007/2008 crop year.

8. **The yield performance of paddy crop in Guyana is currently very low.** The annual average yield of paddy for the period 1994/95-2007/08 is 25 bags (140 pounds) per acre. This yield performance for paddy ranks the country in the 11th position in terms of paddy yield performance among the other countries of Latin America and the Caribbean region. Furthermore, if this comparison is made with countries that compete against Guyana in rice exports to the CARICOM market, like the US, the situation is even worse. The paddy yield performance in the US, almost 50 bags per acre, almost doubles the paddy crop productivity in Guyana. Multiple reasons justify this gap in terms of paddy productivity and, all of them, are related with the constraints faced by the rice farming sector in Guyana. Beyond the issue mentioned before, regarding the inadequate infrastructure of the drainage and irrigation system in Guyana that – often – affects paddy yields and could enable the country to reach higher standards

Box 3.1. Description of the Water Conservancies in Guyana

Tapakuma Conservancy

This is a storage area that links several lakes in Region 2, such as the Itirubisi, Capoey, Mainstay and Tapakuma, and is surrounded by an earthen dam with associated outlets. The current supply flow to the irrigated areas is by gravity, hence it is necessary to maintain a high water level to ensure that all agricultural plots are adequately serviced. The Dawa pump station is able to irrigate over 13,000 ha of rice and other crops in this Region on the Essequibo coast. The pump discharges water into the Tapakuma River when the conservancy is too full and extracts water from the Tapakuma River to replenish water whenever the storage level is low.

Boeraserie Conservancy

This conservancy in Region 3 was specifically built to serve the agricultural needs. The catchment area is 256 km^2 but at spill level the area is 182 km^2. High intense rainfall often causes the earthen embankment to overflow. Its main discharge is via a 244 m long weir and sluices at Waramia into the Essequibo River to the West, and several outlets leading to the coast, and along the West Bank towards the Demerara River. Along these outlets, agricultural farms and sugar cane fields are fed by gravity drainage. Hence, there is a need to maintain high levels to allow for flow to the farms and fields. Maximum storage level is 18.84 m GD. Usable bottom is 16.31 m GD. Storage level is usually 2 meters above the surrounding land level.

East Demerara Conservancy

The East Demerara Water Conservancy in Region 4, which was constructed in the 18th Century, serves several purposes: flood control, irrigation, and potable water supply to the Georgetown area. Its catchment area is 333 km^2. Maximum water level is 17.68 m GD, usable bottom is 16.31 m GD (MacDonald, 2004). It is a very important contributor to maintaining occupancy on the coast, where all the main rivers are brackish to saline as the seasons change from wet to dry. All supply is through gravity flow by maintaining higher heads above field level. During dry events the water level is maintained by pumping water from the Mahaica River to increase the supply within the conservancy. Its storage capacity can be easily exceeded, which can place pressure on the earthen embankment resulting in failures, or erosion and gullying by overtopping. In the past years, its infrastructure has been improving and a number of outlets have been reactivated.

Mahaica-Mahaicony-Abary Agricultural Development Authority (MMA/ADA)

The section of impoldering the Abary watershed of the MMA/ADA was completed in the 1980's. The conservancy was constructed to serve two purposes, flood control and irrigation supply to the front lands that were being cultivated, this by gravity flow. It has been maintained to a level that allows for the supply of irrigation water to farmers; however, it has not been able to control the flooding in the Mahaicony and Mahaica riverain areas. The flood control of the conservancy is assisted with a mile long spill weir, which discharges into the Berbice River, several structures discharging into the Abary, and other high level irrigation canals.

Irrigation infrastructure in Region 6

There is no man made conservancy in Region 6. The Ikuruwa Lake in the Canje River and the swamps, along with the numerous lakes on the Berbice River, flow outwards and provide irrigation supply, by pumping abstraction, for some 52,700 he of cropland. Abstraction from the Canje is through a number of pumped intakes located on the river's right bank. Since there is no man made storage in place, the flow is subject to the variations and volume of rainfall received by the respective watershed. Saline intrusion up the Canje River during periods of low flow is a constraint to abstraction. There have been also many episodes during which pumps have had to be shut down, particularly during the 1997-1998 ENSO event.

Source: **GNVSLR (2002).**

on paddy productivity, there are other financial and technical constraints to farmers' investment on their paddy crops; and thus, to increase the productivity of the country's paddy farming sector. During the farmers focal groups performed for this pre-feasibility study, the farmers identified, from top priority to low priority, that the inadequate drainage and irrigation infrastructure, the low prices they are receiving for their production, the uncertainties they use to have about prices they will receive for their production at

Table 3.1. Guyana Paddy Crop Production 2007/2008

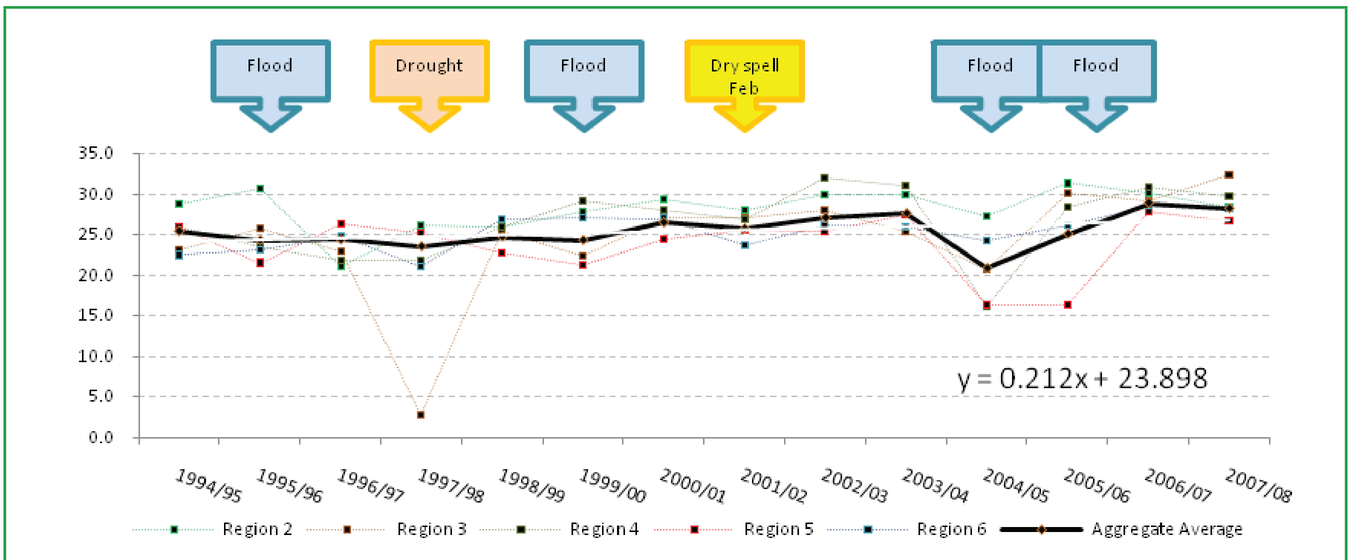
Crop	Area (acres)	% of Area	Production (metric tons)	Average Yield (bags/acre)
Spring Season Paddy Crop	147,786	49%	265,063	28.2
Autumn Season Paddy Crop	155,051	51%	227,774	23.3
Total Paddy	**305,837**	**100%**	**492,837**	**1,051**

Source: GRDB Annual Report 2008.

harvest, the high cost for the inputs, the lack of access to credit, the adverse weather, the presence of red rice (which is believed to cause 50% of losses every year on the paddy crop potential yield), and the presence of high infestations of pests and diseases, are the major constraints that affect their decision regarding the application of technology to paddy crops. The analysis of the historic paddy yield tendency performed for this study for spring and autumn paddy in the period between 1994/95 and 2007/08 confirms the low application of technology on paddy crops. According to this analysis, the paddy yields in Guyana for both, the spring and autumn season, have increased at an annual rate of 1/3 of a bag per year in the period under analysis. Figures 3.3 and 3.4 describe the regional average yields (in bags per acre) and the known natural calamities affecting spring and autumn paddy crops in the period between 1994/95 and 2007/08 in Guyana.

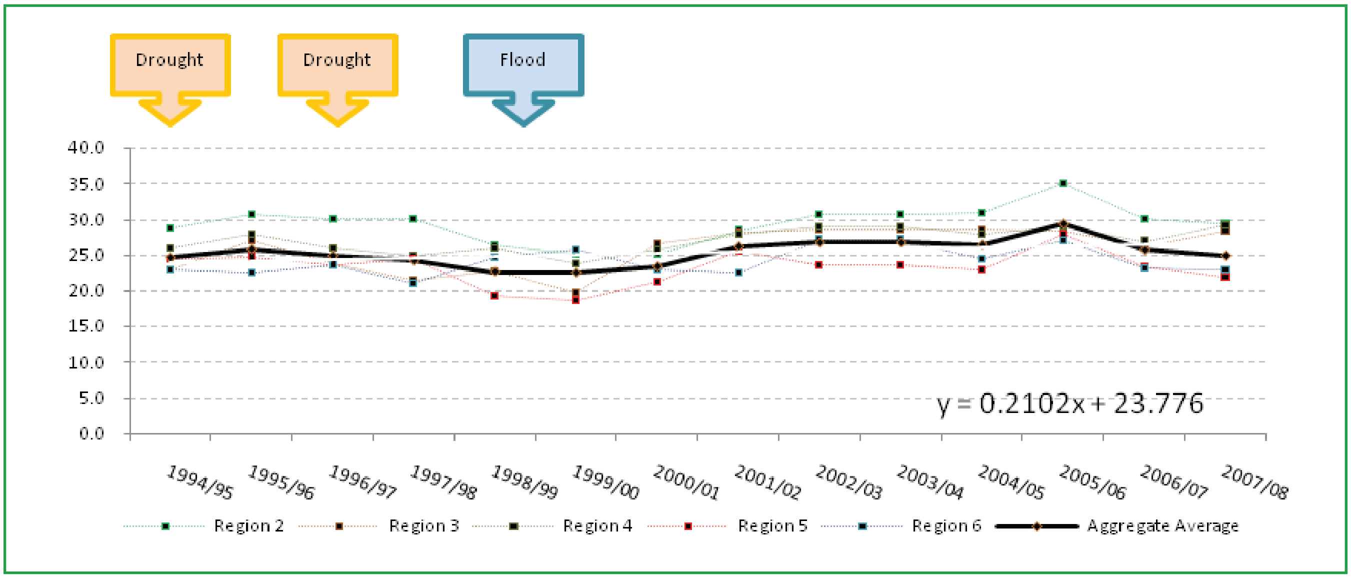
9. **Paddy yields in Guyana depend on the crop season and region and show moderate to high yield variability.** The analysis of the paddy yield coefficient of variation (CoV) for the spring and autumn paddy crop seasons at the national level shows that the spring paddy crop season, which has a CoV of 8.8%, has a slightly higher yield variability than the autumn paddy crop season, which has a CoV of 7.4%. The analysis of paddy yield CoV for the spring and autumn paddy crop seasons at the regional level shows that Region 3 – with CoVs of 28.7% and 11.8% for the spring and autumn paddy crops, respectively – has the highest regional paddy yield variability in Guyana. Region 5 – with CoVs of 15.7% and 10.4% for the spring and autumn paddy crops, respectively – follows Region 3 in the ranking of regions with high paddy yield in Guyana. In third place comes Region 4, which has CoVs of 16.7% for the spring paddy – slightly higher than Region 5 – and 6.3% for the autumn paddy, respectively. Region 2 and Region 6, which show

Figure 3.3. Guyana. Spring Season Paddy Crop. Historic Average Yields in Bags per Acre at Regional Level (1994/95 – 2007/08)



Source: Authors from GRDB Annual Reports 1995-1998.

Figure 3.4. Guyana. Autumn Season Paddy Crop. Historic Average Yields in Bags per Acre at Regional Level (1994/95 – 2007/08)



Source: Authors from GRDB Annual Reports 1995-1998.

the best maintained drainage and irrigation systems in the country, are in the last position in terms of paddy crop yield variability. Both regions show quite similar CoVs for the spring and autumn crops. While Region 2 shows CoVs of 9.2% for the spring paddy and 8.8% for the autumn paddy, the CoVs at Region 6 are 8.8% for the spring paddy and 8.1% for the autumn paddy, slightly less variable in terms of output than Region 2.

10. **The impact of weather related calamities on paddy productivity is not distributed evenly across the different regions of Guyana.** Although all the regions on which paddy production takes place are situated relatively close, the historic analysis of yield variability due to weather events on each of the regions show that their impact on paddy yields is different. Almost all the weather events that historically affected paddy production in the country during the period between 1994/95 and 2007/08 have had the same pattern along the country; however, their consequences on paddy crop yields were not the same among the different regions. For instance, the analysis of historic yield variability shows that Region 3, despite experiencing the same magnitude of rain shortfall during the 1997/98 spring crop season, has much worse performance in terms of paddy yield than the other regions, when referenced to the historic average – which was approximately 70% of the historic rainfall average comprising the months from December to March. Concomitantly, during the floods of 2005/06, the spring paddy in Region 5, in spite that excess of rain during the crop season referenced to the historic average rainfall from December to March, was similar to the other paddy crop-producer regions – which was approximately 70% in excess of the historic average – had a worse yield performance than the other regions. This fact is evidencing that there are factors, other than the rain, that explain the different paddy yield performances on different regions, even under the same weather event. Coincidentally, Region 3 – which has the weakest irrigation system in the country – has had the worst spring paddy yield performance during the *El Niño* 1997/98 drought. Also, as expected, Region 5 – whose drainage system has a lot of limitations to deal with floods – has produced the worst spring paddy yield performances during the flood events of 2004/05 and 2005/06. Figures 3.3 summarizes the historic performance of spring paddy crops in Guyana at the regional level for the period 1994/95 -2007/08, identifying the main adverse weather phenomena affecting the paddy during this period. Figure 3.4 does the same as Figure 3.3 for autumn paddy crops. Appendix B presents a detailed analysis of paddy production, paddy sown and harvested areas, annual average yields, seasonal aggregate rainfall records, and main perils affecting the crop for each of the regions and paddy crop seasons in Guyana.

11. **Contrary to what can be expected for a small country like Guyana, zonal annual aggregate paddy yields are weakly correlated between the spring and autumn crop seasons and are moderately correlated among the different paddy production zones within the same crop season.** The correlation analysis on historic actual annual average yields for different paddy production zones and crop seasons performed for this study shows the existence of a weak relation between the average yield performances for the spring and autumn paddy crops. The coefficient of correlation between spring paddy historic average yields and autumn paddy historic average yields is – in average for all the paddy production zones – 0.10, which indicates that the paddy yield performance on each of these crop seasons is relatively independent. The correlation analysis on historic actual annual average yields for different paddy production zones within the spring and autumn crop seasons performed for this study shows, for both the spring and autumn paddy crop seasons, the existence of a moderate relation between the average yield performances among the different paddy production zones. The coefficient of correlation of paddy historic average yields for the different productions zones within the same crop season is – in average for all the paddy production zones – 0.5 for both the spring and autumn crop seasons. That means that there is relatively high intra-seasonal covariant risk on annual average yields for the different zones compounding the risk portfolio. The results of the paddy yield correlation exercise performed for paddy production in Guyana are presented in Appendix A, Table A.5.

Key Risk Exposures and their Impact on Paddy Crop Production

12. **Natural calamities have a strong impact on paddy production in Guyana.** The major natural calamities affecting paddy production in Guyana are the occurrences of flood, droughts, saline intrusion, excess of rain at harvest and, potentially, tidal impacts. As it was noted, floods in Guyana are associated with events of high rainfall intensity but also with the incapability of the current drainage infrastructure to run off the excess of water. Droughts, in the Guyanese context, are mostly associated with shortages of water for irrigation and related to *El Niño* events. Saline intrusions are a risk in connection with, either, droughts or tidal impacts. A detailed description of each of the risks affecting paddy production is presented below.

Flood

13. **The geographical setting of paddy production areas in Guyana makes rice production vulnerable to floods.** As previously noted, paddy production in Guyana takes place on the coastal plain, which lies below sea level at high tide. Therefore, production has always been tied to the defense against water intrusion from the sea and from rainwater runoff. As also previously noted, paddy production is reliant on the operation of drainage systems as well as a complex network of canals and secondary canals that are outdated and require major rehabilitation work. Furthermore, the country is experiencing an increase on the frequency and severity of rainfall events that exceed the current capacity of the drainage system, which has been designed to accommodate 38.1 mm of rainfall over a 24 hour period, to effectively run off the excess of water.

14. **Flood is reported to be one of the main causes of paddy crop losses in the country.** In all the focus groups performed for this study, the interviewed farmers in Regions 2, 3, 5 and 6 have identified flood as one of the three most pervasive perils that they face on their agricultural production. A survey based on farmers' focus groups performed by GuySuCo[42] in Mahaica-Abary (Region 5), Leguan Island (Region 3), and Walles (Region 3) has arrived at the same conclusion. Flood events usually affect more the spring paddy crop season, which goes from November to April; however, some flood events, like the one which took place in July of 1996, also affect the autumn paddy crop season, which goes from June to October.

15. **The paddy production areas in Guyana have been historically affected by several 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. During the period between 1974/75 and 2007/08, the

42 GuySuCo. Vulnerability and Capacity Assessment. Impacts of Climate Change on Guyana's Agricultural Sector. March, 2009.

evolution of the Paddy Rainfall Index[43] shows that there were seven excess of rain events[44] during the paddy spring crop season. During the same period of time, the evolution of the Paddy Rainfall Index shows that there were three excess of rain events during the autumn paddy crop season. Figures 3.5 and 3.6 show the historic evolution of the Paddy Rainfall Index and highlights the main excess of rain events along the period between the 1974/75 crop year and the 2007/08 crop year for the spring and autumn crop seasons, respectively.

16. **There is evidence that the paddy production areas in Guyana have been affected on several occasions by flood events during recent history.** According to the records obtained from the Dartmouth Flood Observatory[45] and EM-DAT[46], the paddy production areas in the country were affected by floods in January 1975, July 1989, January 1990, November 1990, July 1996, January 2000, January 2005, January 2006 and December 2008. The historical data on flood events[47] point to the fact that their frequency is increasing in Guyana. From one single event reported during the 1970's and the 1980's, the number of flood events has risen to three during the 1990's, and four during the first decade of the 2000's. This tendency in the increase on the frequency of flood events is also evidenced on the historic evolution of excess of rainfall events presented on Figures 3.5 and 3.6 for the spring and autumn crops, respectively.

17. **Paddy farmers in Guyana have suffered severe losses[48] due to the occurrence of flood events.** In the period between the 1994/95 and 2007/08 crop years, paddy farmers in Guyana suffered significant crop losses on eight occasions. During the 1995/96 crop year a flood event affected Region 5 and Region 6 during the autumn crop season. While the total loss on paddy crops production due to the autumn 1995/96 flood amounted to 4,600 metric tons, Region 6 was the most severe affected with a total loss of 4,000 metric tons. In the 1996/97 crop year, Regions 2, 3 and Region 6 were affected by flood causing a loss on the spring crop season that amounted to 20,000 metric tons (approximately 4% of the total production for the 1996/97 crop year). The autumn crop in Region 3 was affected by floods in 1997/98. The amount of losses on paddy production due to this event amounted to 4,700 metric tons. Both spring and autumn paddy were affected by floods during the 1998/99 crop year with total losses amounting to 24,300 metric tons. While Region 2 was affected during the spring paddy crop season causing a loss of 3,000 metric tons for that season, Regions 3, 4, and – most severely – Region 5 were also affected by floods during the autumn crop season. During the paddy spring crop season corresponding to the 1999/00 crop year, 28,700 metric tons of paddy crops (approximately 6% of the national production) were lost, mainly in Region 5. In January 2005, a flood, which is believed to be the worst in the history of Guyana, caused a loss of 53,300 metric tons of paddy. This represented 13% of the annual crop production and 26% of the spring crop production of 2004/05. Region 5 was the most affected with production losses accounting for approximately 47% of the regional expected production for the spring crop season. In

43 Paddy Rainfall Index: The Paddy Rainfall Index is an index that aims to have a representation of the rainfall in the paddy production areas of the country. The methodology followed to develop this index consisted in adding the accumulated rainfall for each of the paddy crop seasons (i.e. spring and autumn crop seasons) weighted by a factor equal to their sown area share over the national sown area for each season.

44 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.

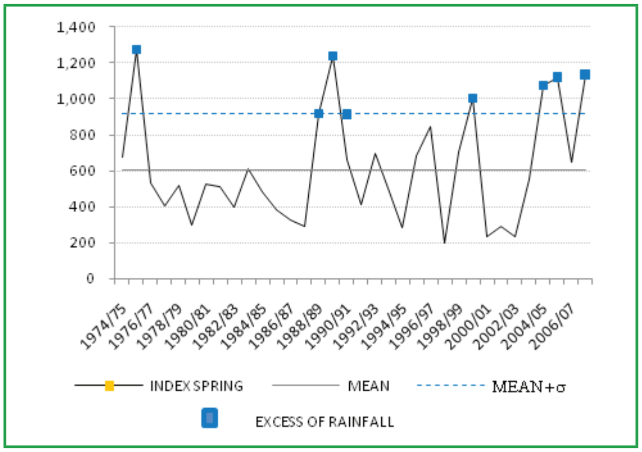
45 Dartmouth Flood Observatory. Dartmouth College, Hannover, NH, 03755, US (2005).

46 EM-DAT. OFDA/CRED International Disaster Database. www.em-dat.net. Universite Catolique de Lovrain, Brussels, Belgium.

47 Flood event is considered, for the purposes of this pre-feasibility study, as the occurrence of flooding in any particular region.

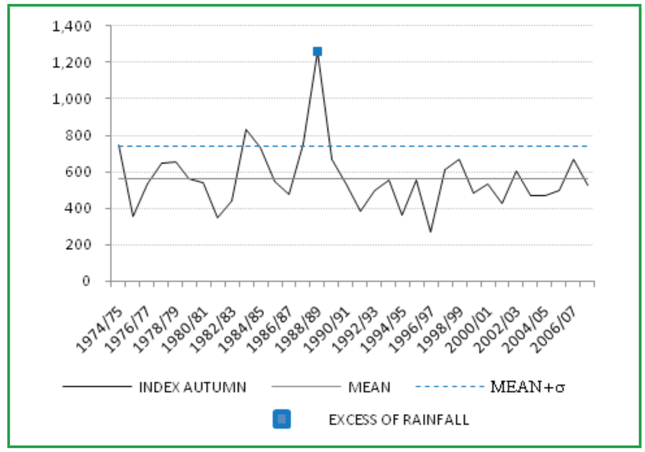
48 The methodology used under this study to calculate the production losses assumes that these losses are compounded by the loss of production due to sown area losses and loss of production due to yield shortfalls. The methodology used for the calculation of production losses due to sown area losses consisted in computing the loss in area (acres) for each of the crop years under analysis times the corresponding expected yield at harvest for the year under analysis. The expected yield at harvest was determined by the corresponding historic yield trend value for the year under analysis. The methodology used for the calculation of yield shortfalls had two steps. The first step consisted, whenever was applicable, in determining the yield shortfall based on the difference between the expected yield at harvest for one particular year less the actual average yield for the same year. Once the amount of the yield shortfall was determined, the second stage consisted in multiplying the amount of the yield shortfall times the harvested area.

Figure 3.5. Guyana. Historic Evolution of the Paddy Rainfall Index for the Period December – March (Spring Crop Season) 1974/75 – 2007/08 (mm/period)



Source: HYDROMET.

Figure 3.6. Guyana. Historic Evolution of the Paddy Rainfall Index for the Period July – October (Autumn Crop Season) 1974/75 – 2007/08 (mm/period)



Source: HYDROMET.

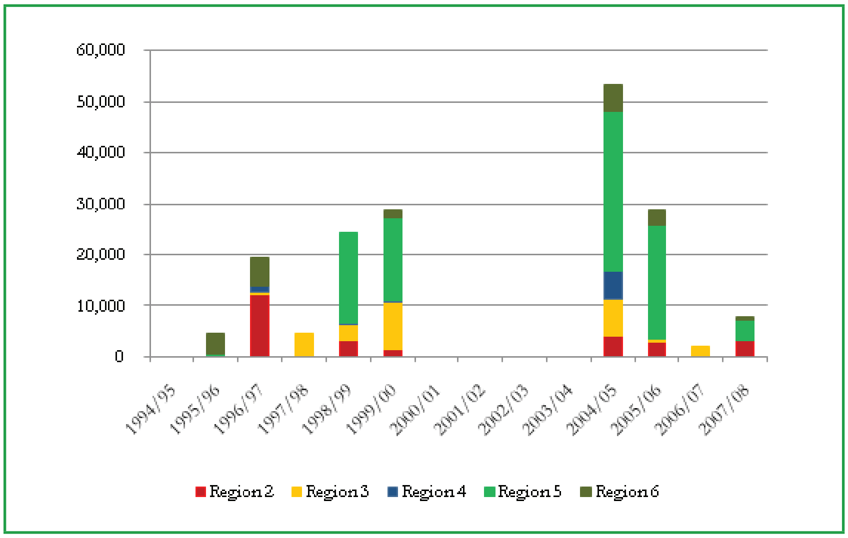
January 2006, another severe flood affected again the spring paddy production. This time the production losses amounted to approximately 28,700 metric tons, equivalent to 6% of the national production of the 2005/06 crop year and 13% of the paddy production of the spring crop season, respectively. Region 5, again, was the most severely affected, with paddy production losses accounting for 52% of the regional expected production for the spring crop season. In December 2008, a flood affected the country causing a loss of 8,000 tons on the spring paddy production. The flood damage figures on paddy production in the period between 1994/95 and 2007/08 suggest a possible increasing trend in the severity of flood losses on paddy production in Guyana. Figure 3.7 shows the national paddy production losses due to flood from the 1994/95 to the 2007/08 crop years.

18. **Several factors converge to increase the frequency and severity of flood losses on paddy production in Guyana.** The most important are: (i) the increased frequency and severity of rainfall events; (ii) the outdated conservancy and drainage systems; and (iii) flood management issues. Rather than acting in isolation, each of these factors is closely interrelated with the others in determining the severity of flood events in the country.

19. **The increase of both the frequency and severity of extreme rainfall events is intensifying the vulnerability of the rice farmers to floods.** The rainfall events of January 2005 and January 2006 were totally abnormal for Guyana. In January 2005, the amount of rainfall received by the coastal plains between January 14th and January 22nd was 1108.2 mm, almost 6 times the average rainfall for the same period for the past 30 years (UNDP/ECLAC, 2005) and the highest recorded since 1888. The same year-end rainy season, which began in December 2005, and continued into February 2006, resulted in another major flood. According to the ECLAC/UNDP Report (2006), rainfall in Region 2 was twice the normal amount in December of 2005 and 5.5 times the average amount in January of 2006 (ECLAC/UNDP, 2006). Figure 3.8 shows the rainfall measurements at the Georgetown Botanical Gardens for periods between December 20th, 2004 and February 14th, 2005, which totaled 1308.2 mm and caused the devastating flood of 2005 (Map 3.2).

20. **The outdated conservancy and drainage systems in Guyana contribute to increasing the vulnerability of rice farmers to floods.** Drainage structures were designed approximately 150 years ago 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 in the Drainage and Irrigation (D&I) areas; however, the design of the existing drainage structure has been unable to cope as annual rainfall intensifies and the sea level keeps increasing in Guyana, resulting

Figure 3.7. Paddy. National and Regional Production Losses in Metric Tons due to Floods (1994/95 – 2007/08)

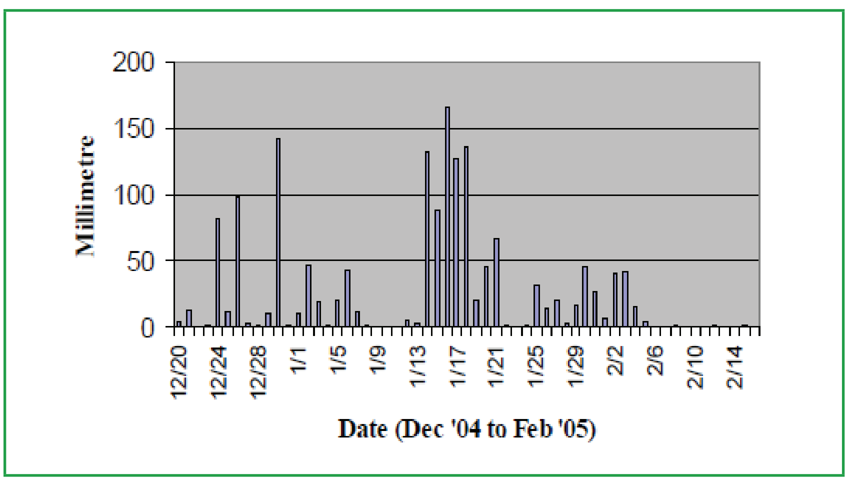


Source: Authors, from GRDB Annual Reports, EM-DAT, Stabroek News, and Dartmouth Observatory.

in more frequent and severe flooding. The design factor has a direct impact on the run-off capacity of the system. The rise in the sea level is shortening the time window for drainage availability and thus, the drainage capacity of the system. Drainage is currently done, mainly, through gravity flow during low tides; this flow is facilitated by the difference in elevation of the water levels in the upstream canals compared with the sea and river levels. The rise in the sea level is reducing the existing difference in elevation of the water levels in the upstream canals to the sea and river levels; thus the time window available for gravity flow during low tides has been reduced. So far, the challenge of running off the excess water during rainfall events has been overcome by managing the drainage through the use of gravity-based systems augmented with pumps. However, this system is under increased stress and suffering from the impacts of the sea level rise because an adequate discharge window is no longer guaranteed.

21. **The current status of the conservancy and drainage systems infrastructure in Guyana also contributes to increase the vulnerability of rice farmers to floods.** The conservancy and drainages systems in place in Guyana present severe infrastructural limitations to their ability to prevent flooding and manage flood waters. The current structural conditions of the dams of many conservancy areas are unsafe and exhibit failures in many of their sections. Relief canals are currently operating with limitations as changes in land use and the rise in sea level have greatly limited their effectiveness. Many of the drainage canals suffer of 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, the GoG has carried out extensive repair 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.

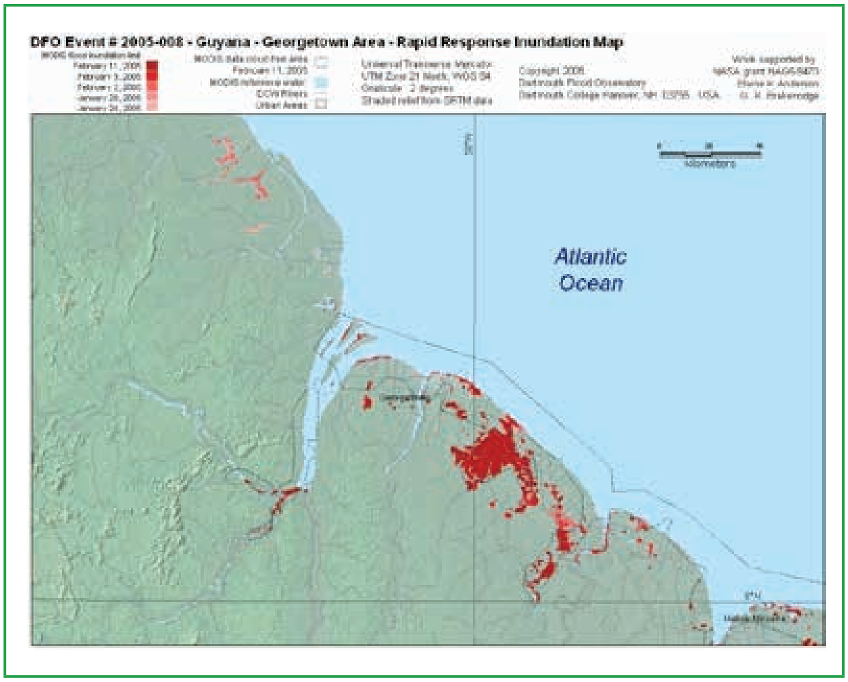
Figure 3.8. Daily Rainfall for Georgetown Botanical Gardens Weather Station (12/20/2005 to 02/14/2006)



Source: ECLAC (2005), from HYDROMET.

22. **Flood management issues also affect the vulnerability of rice farmers in Guyana.** There are severe limitations on the ability to prevent flooding and manage flood waters. 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-

Map 3.2. Affected Areas by the Flood of January 2005



Source: Dartmouth Observatory.

hoc system of flood control is no longer effective and increased limitations exist on the ability to manage water levels in the coastal plain and prevent flooding.

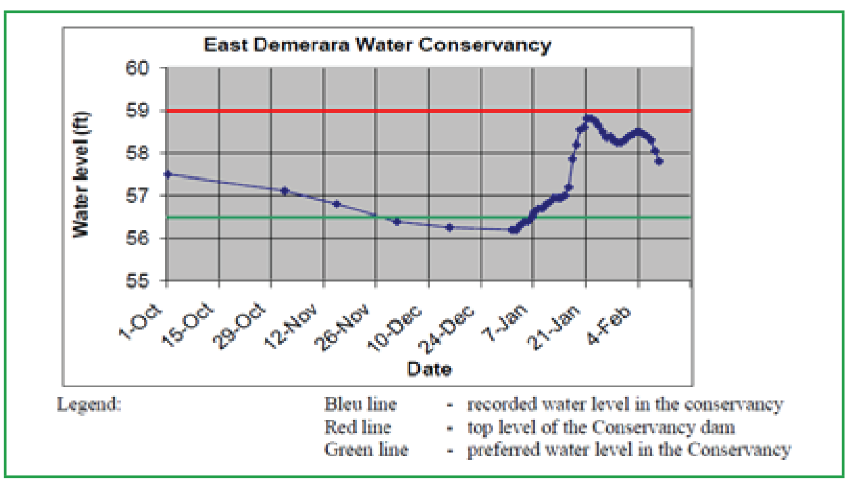
23. **Natural, infrastructural and management drainage issues are closely interrelated.** A good example to explain this statement is the situation at the East Demerara Water Conservancy (EDWC) during the January 2005 floods. During this event, because of the intensive rain and the increase in the sea level, the system was unable to run off the water to the sea. As a result, the EDWC reached a critical stage and there was a serious danger of water levels rising above the top and collapsing the structures. If this situation had happened, the Mahaica-Abary coastal areas would have been flooded by 3 feet of water on average. In the days after January 21st. To manage the situation, the decision was taken to release water from the EDWC to the Mahaica area, which was already facing flood problems, causing serious distress to its farmers and inhabitants. However, a situation in which the conservancy would surely have breached into the coastal zone was prevented. Figure 3.9 shows the water levels at the EDWC during the period between October 2004 and February 2005.

Drought/Shortage of Water for Irrigation

24. **Most of the paddy production in Guyana relies on irrigation; however, the system of lakes and reservoirs used to ensure the water irrigation supply may suffer occasional water shortages.** While, in most years, water supply is ensured throughout the year, if severe droughts occur during one or both of the paddy crop seasons in the year, these conservancies may experience water shortages and be incapable of supplying the water demanded for crop use. Water shortages may also occur in the Tapakuma conservancy, which is partly supplied by pumping water from the Pomeroon River.

25. **Drought and irrigation water shortages are reported to be an important cause of paddy crop losses in Guyana.** According to the information obtained from the farmers' focus groups performed for this study, drought is an important cause of paddy production losses in almost all the regions, being

Figure 3.9. Water Level at the EDWC (10/01/2004 to 02/14/2005)



Source: UNEP/OCHA (2005).

particularly important in Region 3 and Region 2. This finding is confirmed by several studies. Chandarpal (2005) found that in Region 5, 59% of the farmers had experienced losses in the past because of droughts. GuySuCo (2006) found that in Region 3, 50% have experienced losses in the past due to drought. Doodanauth (2004) found that the lack of water for irrigation during prolonged dry spells was also another critical issue in Leguan Island, where 70% of farmers indicated that they had suffered crop losses due to drought-like conditions.

26. **The paddy production areas in Guyana have been affected by several lack of rainfall events during recent history.** The frequency of occurrence of lack of rain events[49] is similar in the spring and autumn crop seasons, amounting to seven events on each of these seasons during the period between 1974/75 and 2007/08. Figures 3.10 and 3.11 show the historic evolution of the Paddy Rainfall Index and highlights the main lack of rainfall events along the period comprised from the 1974/75 crop year up to and including the 2007/08 crop year for the spring and autumn crop seasons, respectively.

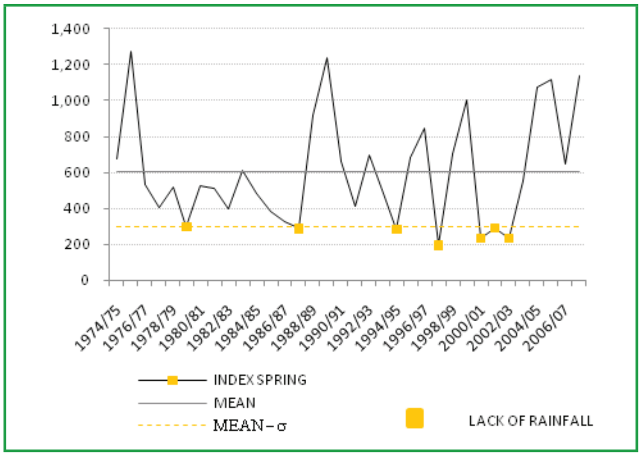
27. **There is evidence that paddy production in Guyana has faced acute water shortages and droughts.** According to the records obtained from EM-DAT[50] and HYDROMET, in the period between 1974/75 and 2007/08, paddy production has been affected by severe water shortages and droughts in 1979/80, 1987/88, 1994/95, 1997/98, 2000/01, 2001/02, 2002/03 and 2009/10, averaging – approximately – one drought event every five years. Estimations based on the aggregate annual paddy production indicate that, for the 1988 crop year, the total losses on paddy crops due to water shortages and/or drought accounted for 10% of the expected paddy production. A detailed analysis based on the actual losses[51] at the zonal level indicates that, during the 1994/95 crop year, 4,900 metric tons (1% of the total expected paddy production for the 1994/95 crop year) were lost due to drought/water shortage conditions. Out of the 4,900 metric tons that were lost during the 1994/95 crop year, 80% (4,100 metric tons) was lost due to the effect of dry conditions in Regions 3, 5 and 6 during the autumn crop season. The same analysis also shows that during the 1996/97 crop year, the second paddy crop season (in Regions 3, 5 and 6) was also affected by dry conditions. The total paddy production losses for the second paddy crop season in 1996/97 amounted to 7,300 metric tons, which was equivalent to 1.33% of the total expected paddy production for the 1996/97 crop year. Crop production losses due to the *El Niño* event of 1997/98 amounted to 33,000 metric tons of paddy (approximately 6.3% of the total expected paddy production for the 1997/98 crop year). The details of the effects of the 1996/97 *El Niño* event on paddy production are provided in Box 3.2. During the 2000/01, 2001/02 and 2002/03 crop years, the spring paddy production has been affected by several dry spells at the phenological stage of flowering. In the 2000/01 spring season, 3,300 metric tons of paddy were lost due to dry/water shortage conditions in Regions 3, 4, 5 and 6. In 2001/02, the same dry conditions were repeated over the same regions during the spring season; this time the paddy losses amounted to 7,000 metric tons. During the 2002/03 spring crop season, another dry event affected – mainly – Regions 3, 4 and 5 causing a loss on paddy production of 4,500 metric tons. At the time of writing this report, the spring paddy crop season for 2009/10 is suffering a severe drought. Although there are no harvest estimates available, unless the country receives significant amounts of

49 For the purposes of this analysis, a lack of rain event is defined as a rainfall event that is below the threshold established as the historic average rainfall for each of the periods under analysis minus one standard deviation of the historic rainfall of the period under analysis.

50 EM-DAT. OFDA/CRED International Disaster Database. www.em-dat.net. Universite Catolique de Lovrain, Brussels, Belgium.

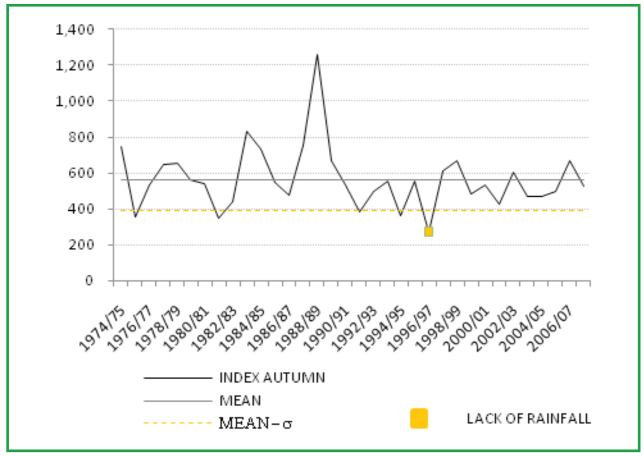
51 The methodology used under this study to calculate the production losses assumes that these losses area compounded by the loss of production due to sown area losses and loss of production due to yield shortfalls. The methodology used for the calculation of production losses due to sown area losses consisted in computing the loss in area (acres) for each of the crop years under analysis times the corresponding expected yield at harvest for the year under analysis. The expected yield at harvest was determined by corresponding historic yield trend value for the year under analysis. The methodology used for the calculation of yield shortfalls had two steps. The first step consisted, whenever was applicable, in determining the yield shortfall based on the difference between the expected yield at harvest for one particular year less the actual average yield for the same year. Once the amount of the yield shortfall was determined, the second stage consisted in multiply the amount of the yield shortfall times the harvested area.

Figure 3.10. Guyana. Historic Evolution of the Paddy Rainfall Index for the Period December – March (Spring Crop Season) 1974/75 – 2007/08 (mm/period)



Source: HYDROMET.

Figure 3.11. Guyana. Historic Evolution of the Paddy Rainfall Index for the Period July – October (Autumn Crop Season) 1974/75 – 2007/08 (mm/period)

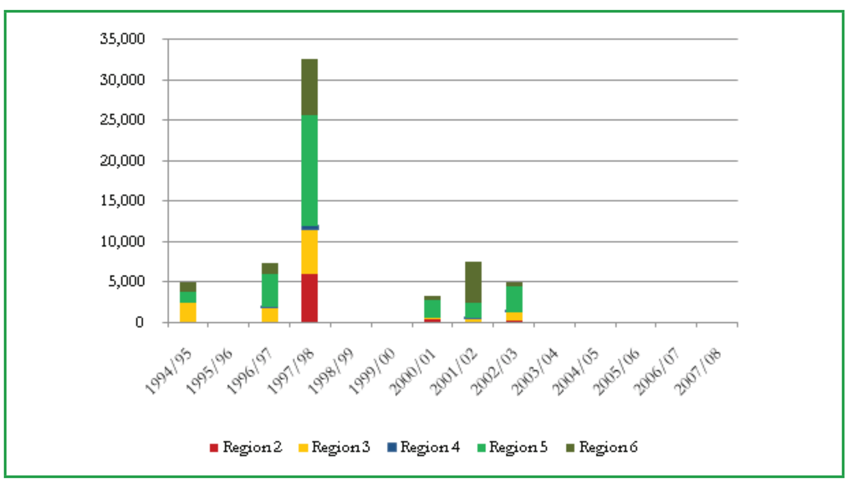


Source: HYDROMET.

rain during March, severe paddy production losses are expected for the 2009/10 spring crop season. According to the farmers' opinion, the current drought, which has extended from the beginning of the spring crop season, could have a worse impact on paddy crop yield than the 1997/98 drought, which started at the middle of the crop season. The GoG is currently making a major effort to mitigate the water shortage for irrigation by pumping waters from rivers to the irrigation system. However, despite the GoG's efforts, it is estimated that 10,000 acres of paddy have already been lost in Region 2 and Region 3. In Regions 5 and 6, although they are also suffering the problems associated with the current dry condition, the performance of spring paddy seems to be better than in the western regions of the country. Figure 3.12 shows the national paddy production losses due to drought and/or irrigation water shortage between 1994/95 and 2007/08.

28. **Irrigation infrastructure and irrigation management issues affect water use efficiency for paddy production in Guyana.** While there are no recent studies measuring this variable, water use efficiency levels in Guyana are unlikely to exceed 25%. Two factors are influencing this low performance. The first one is the outdated irrigation infrastructure. The state of disrepair of irrigation systems contributes significantly to lowering Guyana's water use efficiency. Most of the irrigation infrastructure in Guyana was built 150 years ago and, currently, needs extensive rehabilitation. The second factor is inadequate irrigation management. All irrigation schemes in Guyana have the same delivery arrangements, there are no metered structures and the entire system is operated through the concept of nearly constant water levels. Due to the above, and the

Figure 3.12. Paddy. National and Regional Production Losses in Tons due to Water Shortages (1994/95 – 2007/08)



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

Box 3.2. Summary of the Situation due to the Effects of the 1997/98 Drought

The *El Niño-La Niña* Southern Oscillation (ENSO) phenomenon had pervasive effects on the 1997/98 spring crop season. Between September 1997 and February 1998, the total amount of rainfall in the paddy productions areas in Guyana amounted – in average for the whole production areas- to 194 mm, which was only about 30% of normal precipitation over the coastal areas. As a result of the lack of rain, almost all of the lakes, reservoirs and other irrigation sources were almost completely dried up. As farmers struggled to avoid a bad crop by pumping residual water from both the drainage and irrigation ditches, they also accelerated salt-water intrusion as seawater moved inward. In many of the main rivers and creeks, salt water reportedly reached as far as thirty miles inland (in normal times salt water usually travels only a small distance from the sea coast).

During the 1996/97 spring crop season, farmers had sowed about 185,000 acres in both rain-fed and irrigated lands. At the beginning of the 1997/98 spring crop season the farmers, responding to ENSO warnings, decided not to sow about 40,000 acres. During the 1997/98 spring crop season, out of the –approximately– 145,000 acres sown, about 25,000 were lost and overall yields were reduced by 5% because of lack of irrigation water. Instead of about 250,000 tons expected for that crop season, total output was 215,171 tons. About 1,300 paddy farmers, most of them small farmers, lost their entire crop.

Source: **World Bank (1998).**

fact that there is no control on the volumes of water released at any point throughout the system, farmers can divert as much water as they want during their irrigation allotted period. Under this scheme, it is almost impossible to implement irrigation management measures needed to avoid water shortages in the system during dry periods. Furthermore, the lack of control on the irrigation systems may lead to unfair situations and conflicts among the farmers during water shortages: those located upstream pump more water to irrigate their crops, diminishing the possibility of downstream farmers to do the same.

Saline Intrusion

29. **Saline intrusion is a risk faced by paddy production in Guyana in areas closest to the seashore.** Two main causes can generate saline intrusion in Guyana. The first one is in connection with irrigation water shortage issues. Sometimes, during extremely dry periods, farmers, having no other source of water for their crops, use water coming straight from the rivers, streams or remaining in the drainage and irrigation canals. However, the problem with this practice is that during the dry periods, especially in areas closest to the mouth of the rivers or to seashore canal outlets, this water becomes saline. Under normal situations, the waters at the river mouths or seashore canal outlets is a mix of fresh inland water and salt water from the ocean. This produces brackish water most of the time. But during dry periods, this water tends to be more saline than brackish, and when used for irrigation purposes has often resulted in damage to farmlands. Saline intrusion during dry periods is a common problem along the paddy production areas closest to the seashore, but in particular, in Leguan and Wakenaam Islands in Region 3. The second cause of saline intrusion in Guyana is the flow of saline water to the paddy fields directly from the sea. In the context of Guyana, this situation happens when high tides overtop the sea wall or due to the existence of breaches on the sea wall. The coastal plain is particularly vulnerable at high tides, since the elevation of the sea surface is usually above the land level, thus the need to maintain the sea defenses and other protection, such as mangroves, for the continued occupation of the coastal areas. In the event of high tides accompanied by high winds, there could be storm surges that can overtop the walls and cause flooding, similar to what happened in 2008 between the Montrose to Better Hope area in Region 4 (Guyana Chronicle, March 23, 2008), and at several other places such as the Island of Leguan in Region 3 and Crane on the West Coast of Demerara in Region 4. Currently the sea level rise in Guyana is 10.2 mm per year. (Guyana's National Vulnerability Assessment to Sea Level Rise, 2002). The country's sea defenses are currently designed to accommodate a sea level rise of 6 mm. It is important to note, that in case a massive scenario of saline intrusion happens, agricultural losses could be as high as 20% of GDP in low lying coastal states (IPCC, 2007).

Excess of Rain at Harvest

30. **The effects of excess of rain at paddy harvest season was identified by paddy farmers as a source of risk for their production.** The effects of excess rain at paddy harvest on paddy production are two folded. The first effect is that, sometimes, the excess rain at harvest results in paddy fields becoming inaccessible, exposing the crop to insect, rodent and bird pests, in addition to increasing the risks of lodging and grain shattering. As a result of that, the crop loses quality or, in the worst case scenario, rots. The second effect is that, during rainy harvest seasons, the paddy ripens with high moisture content and farmers suffer a discount on the paddy price they receive due to the additional cost the millers incur to dry the paddy to required storage levels. This reduction in price is proportional to the moisture content of the paddy; however, the price discounts applied due to excess of moisture are always onerous for the farmers. Paddy crops that are sown late in the season are more likely to be affected by excess rain at harvest.

31. **Unseasonal rainfall events are becoming more normal in Guyana causing losses in the rice sector, as it is critical that certain stages of production be specifically performed during the rainy season or the dry season.** In 1973, the excess of rain at harvest was a severe problem, the fields were not accessible and, as a result, several paddy fields were lost during that crop year. In May 2007, the occurrence of intense and early rainfall prevented the harvesting of about 1,000 acres of rice in various regions in Guyana. For the current, 2009/10 crop season, since many of the paddy was sown late, based on the expectation of rain, a delay in the harvest is expected; thus, it is highly probable that the harvest season will coincide with the beginning of the rainy season and, consequently, the risk of excess of rain at harvest will be high.

Key Risk Exposures and their Impact on Paddy Crop Production at the Zonal Level

32. **This section describes the paddy crop-yield risk assessment at the zonal level in Guyana.** The principle objectives of the zonal crop-yield risk assessment are to assist decision makers in assessing the spatial distribution of crop production values and to quantify the risk of crop production and yield loss for spring and autumn paddy crops in each of the 9 paddy production zones in which the country can be divided according to the GRDB reporting criteria. The section is based on the output generated by the Crop Risk Assessment Model (CRAM), which has been specially designed for the context of paddy production during the spring and autumn crop paddy crop seasons in Guyana.

33. The key underlying crop production yield and valuation data and assumptions on which the CRAM model for Guyana is built, include the following:

- **Selected crops:** the two major paddy crops seasons, spring and autumn, for which zonal-level[52] crop area, production and yield data are available for the past 14 years, 1994/95 to 2007/08.

- **Cultivated area:** In order to remove seasonal variation from the cultivated and harvested area in each district, the model takes the average sown area for each paddy crop season for the past three seasons: 2005/06, 2006/07, and 2007/08. The model then assumes that the cultivated area has remained constant over the past three years. For the purposes of the risk analysis exercise, the minimum cropped area in any given district or region is set at 1,000 acres for both crop seasons.

- **Crop yields:** the crop yields are based on the GRDB's reported zonal average yields (total production, in metric tons, divided by sown area-acres). For the purposes of eliminating the effects of the increase in yield due to technology improvements (seed genetics, crop management practices, use of agrochemicals, etc.), the 14-year historical yields have been de-trended and readjusted to an expected yield based on the most recent three-year average.

- **Crop output prices:** the eight crops are valued at the GRDB's published 2007-08 average farm-gate gross prices for Guyana, which are detailed in Appendix A.

52 Following the same geographical definition as used in the GRDB reports' production data.

34. **Assessing yield losses and value of losses for the CRAM.** The risk assessment model assumes that the losses occur when the actual average yield at the zonal level falls short of the expected yield for the zone, defined as the average yield for the most recent three crop years. In any year where the actual yield is below the zonal average expected yield for each crop season, the amount of yield loss is calculated as a percentage of the expected yield to derive the pure loss cost (loss/gross value of production x 100%). The average pure loss cost for each crop is then calculated as a simple average over the 14 years of yield data. In summary, the CRAM uses a historical database of 14 years of yield data, adjusted by (i) the 100% area losses to represent more accurately the average yields sown area-basis and (ii) technological improvements in crop yields for both paddy crop seasons grown in all 9 paddy production zones of Guyana in order to establish the expected value of losses, and to estimate probable maximum losses for the national portfolio. Full details of the assumptions used in the design of the CRAM are contained in Appendix A.

National Aggregate Crop Values

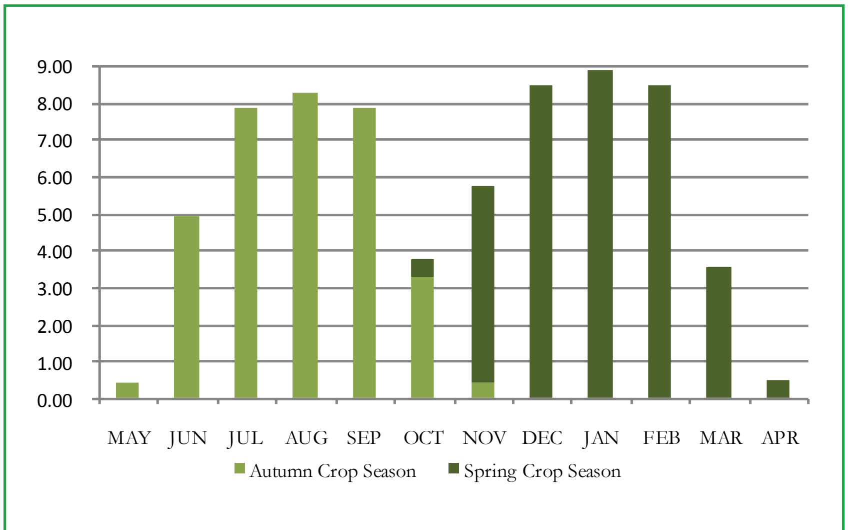
35. **The total value at risk (VAR) for the analyzed portfolio amounts to G$17.1 billon (US$85.5 million).** Both paddy crop seasons have almost similar exposures, the exposure for the spring crop season being slightly higher. While the paddy spring crop season, with a VAR of G$8.9 billion accounts for 51.4% of the portfolio's VAR, the autumn crop season with a VAR of G$8.2 billion accounts for 48.15% of the portfolio's VAR. Several assumptions were made in order to arrive to the VAR figures for paddy crop production in Guyana. These assumptions can be summarized as follows: (i) both paddy crops seasons are included; (ii) the full 3-year average sown area of each paddy crop season in each zone is included, representing a total of 278,338 acres; (iii) a 100% coverage level on the paddy crop expected yield for each paddy crop season and zone where the harvested area exceeds 1,000 acres; and (iv) the crop production is valuated at 2007/08 farm-gate prices for the month of harvest of each crop .

36. **In the planning of any public-private crop insurance program for Guyana, due consideration must be given to the spatial and temporal distribution of crop values and careful accumulation control should be exercised.** The temporal distribution of VAR is determined by the length of the crop cycles, the predominant cropping patterns, and the crop prices that will impact directly on the exposed values.

37. **In Guyana, the temporal distribution of VARs for major crops presents two main peaks.** The major peak, G$8.86 billion, is reached during the spring crop season in the months of January and February. The second peak, G$8.43 billion, is reached during the autumn crop season in the months of August and September. Conversely, the VAR for the crops dips, once during the months of April and May, and the other during the month of October. Figure 3.13 shows the monthly distribution of VARs on paddy production in Guyana.

38. **Paddy crops VARs in Guyana vary greatly so it is not possible to evenly distribute them geographically.** Region 5 and Region 6, on which the paddy production areas are located within a distance of less than 50 km, lie in the middle north-eastern part of the country and concentrate around 59% of the VARs for spring crop production as well as 55% of the VARs for the autumn paddy production. Region 5, which comprises the Mahaica-Abary and the West Berbice zones, shows the higher exposure in terms of VARs, accounting for 38% and 33% of the total VARs for spring and autumn paddy in Guyana, respectively. Region 6, which comprises the Black Bush Polder and the Frontlands zones, accounts for 21% of the spring paddy VARs and 22% of the autumn paddy VARs. In third place, in terms of paddy production exposure, is Region 2, which is located on the middle north-western part of the country, accounting for 23% and 26% of the VARs for spring and autumn paddy, respectively. Between Regions 5 and 6, and Region 2, are Regions 3 and 4. Region 3 – which comprises West Demerara, Wakenaam Island and Leguan Island zones – is in fourth place in terms of VARs accumulation, accounting for 12% of the spring paddy VARs and 15% of the autumn paddy VARs in Guyana. Region 4 is on the last place with VARs accounting for 6% of the spring paddy total VARs and 5% of the autumn spring paddy VARs, respectively. Table 3.2 shows the distribution of paddy crops VARs per zone in Guyana.

Figure 3.13. Guyana. Spring and Autumn Paddy. Monthly Distribution of Values at Risk (VAR) (G$ billions)



Source: **Authors estimation based on information collected in the field.**

Estimation of Paddy Crop Losses

39. **The estimation of the crop losses for the spring, autumn and national portfolio of paddy crops in Guyana is performed based on an "as if" analysis over the simulated output yields generated through the CRAM.** That means that the CRAM, according to the assumptions made for the simulation, estimates the expected losses for the portfolio and their associated pure loss ratios based on what would have occurred for each of the 10,000 yields generated by Monte Carlo Methodology under the CRAM in each crop and each zone (details of the methodology followed for the CRAM are provided on Appendix A). The process for this estimation can be described in 3 steps. The first one consists in calculating – for each crop season and particular zone – the percentage of yield shortfall for each of the 10,000 yield simulations generated by Monte Carlo Methodology under the CRAM. Then, for any crop season and zone, if the yield generated by Monte Carlo Methodology is bellow the expected yield calculated based on the average of the three most recent years annual average yields determined for the crop season and zone, then the percentage of the deviation is recorded as a loss; otherwise it is recorded as cero loss. The second step consists, for each crop season and zone, in applying the percentage of the loss to the respective value at risk (VAR) to obtain the amount of losses per each of the 10,000 yields generated through Monte Carlo Methodology in the CRAM. The third and last step consists in adding up, for each crop season and zone, the calculated loss figures per each of the 10,000 yields generated through Monte Carlo Methodology in the CRAM.

Table 3.2. Guyana. Paddy Crops. Total Values at Risk (G$ billions)

Region	Zone	Spring Crop Season		Autumn Crop Season		Annual Aggregates	
		VAR	%	VAR	%	VAR	%
2	Essequibo	2.01	23%	2.14	26%	4.15	24%
3	Leguan	0.10	1%	0.13	2%	0.23	1%
3	Wakenaam	0.06	1%	0.11	1%	0.17	1%
3	West Demerara	0.87	10%	0.95	12%	1.82	11%
4	Cane Grove	0.54	6%	0.42	5%	0.96	6%
5	Mahaica-Abary	1.40	16%	1.34	16%	2.74	16%
5	West Berbice	1.91	22%	1.36	17%	3.27	19%
6	Black Bush Polder	0.82	9%	0.81	10%	1.63	10%
6	Frontlands	1.16	13%	0.97	12%	2.13	12%
	Grand Totals	**8.87**	**100%**	**8.23**	**100%**	**17.10**	**100%**

Source: **World Bank.**

40. **The main conclusion of this risk assessment is that paddy crop production in Guyana is risky.** This is evidenced on the annual average expected losses for the national paddy portfolio – spring and autumn crop seasons – which, according to the CRAM estimates, amounts to G$1.3 billion per year (approximately US$6.3 million), equivalent to an annual average loss cost ratio of 7.28% of the total value of the expected production for major crops. The spring paddy crop season – 51% of VAR for paddy production – exhibits the highest loss cost of (8.01% of total value). The autumn paddy crop season – 49% of VAR for paddy production – exhibits the lowest loss costs with average annual losses of 6.52%. Table 3.3 shows the average annual expected loss for each paddy crop season and zone in Guyana.

41. **The geographical distribution of the risk among the different paddy production zones in Guyana is uneven.** The result of the analysis of the geographical distribution of expected losses show that the expected values of crop losses vary according to the crop season and the paddy crop production zones. In the case of the geographical distribution of annual average expected losses for the spring paddy crop season, the heterogeneities are bigger than those observed for the autumn paddy crop season.

42. **In the case of the spring paddy crops, the variations in terms of expected losses at zone level seem to be related to the condition of the existing D&I infrastructure on each zone.** Leguan, Wakenaam, and West Demerara zones in Region 3 (with average expected losses above 12% of the spring paddy VARs) have the highest spring paddy crop expected losses in Guyana (Table 3.3). Leguan and Wakenaam Islands have a very weak drainage and irrigation infrastructure, and saline intrusion during the dry periods is a recurrent problem in these zones. During the 1997/98 drought event, Leguan and Wakenaam suffered almost a 100% lost of the paddy production. These zones were also affected by floods. Due to the January 2005 flood event, the paddy spring crop yield in Leguan and Wakenaam suffered losses on the expected yields for spring paddy of 45% and 23%, respectively. West Demerara zone also suffered acute yield shortfalls during the 1997/98 droughts and 2004/05 floods. Spring paddy crop yields in West Demerara zone were affected by 75% due to the 1997/98 drought and by 23% owing to the January 2005 floods event. According to this analysis of expected losses on spring paddy production, Region 4 and Region 5 (with average expected losses above 9% of the VARs of spring paddy production) are the second most risky zones for spring paddy production in Guyana. These regions – due to issues on their drainage infrastructure –face flood risks but, at the same time, cope very efficiently with drought risk. During the 2004/05 flood events, Cane Grove zone in Region 4 lost 43% of its spring paddy crop production; while, as a result of the same flood event, Mahaica-Abary and West Berbice zones in Region 5 lost 40% and 24% of their paddy production, respectively. Mahaica-Abary and West Berbice zones also suffered losses due to flood during the 2005/06 spring crop season. In the 2005/06 flood event the paddy production shortfall was 39% in Mahaica-Abary zone and 22% in West Berbice zone. Region 6 follows Regions 4 and 5 in terms of annual expected losses for spring paddy crop production. Region 6 shows relatively low expected losses for spring paddy crop production amounting to 6.3% of VAR in the case of Black Bush Polder zone and 6.7% of VAR in the case of Frontlands zone. Region 6 enjoys an efficient and well managed irrigation infrastructure that allows the region to cope very well with drought situations. According to the analysis of expected losses in spring paddy, Region 2 – with annual average expected losses of 5.2% of the spring crop VAR – is the less risky zone for spring paddy in Guyana. Region 2, besides enjoying a more regular rainfall pattern than the other regions, has an efficient drainage and irrigation system in comparison with other regions in Guyana.

43. **Conversely, the expected losses for the autumn paddy crop season show a regular distribution among the different paddy production zones in Guyana.** Leguan, Wakenaam and West Demerara zones in Region 3, and Cane Grove in Region 4 have the smallest annual average expected losses for autumn paddy crop production in Guyana. The annual average expected loss figures for Leguan and Wakenaam are 2.6% and 2.9% of the VARs of autumn paddy production in these zones. The annual average expected loss figure for West Demerara and Cane Grove zones (5.1% and 4.3%, respectively) are slightly higher than those observed for Leguan and Wakenaam zones. Region 5 and Region 6 on the western part of the country, with annual average expected losses above 7% of the VARs of autumn paddy, have higher annual average expected losses for autumn paddy production. Region 6, with an annual expected loss

Table 3.3. Guyana. Paddy Crops. Annual Average Value of Crop Losses

Region	Zone	Crop Season	3-Year Average Planted Area (acres)	Total Values at Risk (G$ millions)	% of Values	Average Values of Losses (G$ millions)	Losses as % of Total Values
2	Essequibo	Spring	31,650	2,011	23%	116.1	5.8%
3	Leguan	Spring	2,721	103	1%	14.5	14.1%
3	Wakenaam	Spring	1,191	60	1%	7.2	12.0%
3	West Demerara	Spring	13,863	867	10%	110.3	12.7%
4	Cane Grove	Spring	7,153	541	6%	47.2	8.7%
5	Mahaica-Abary	Spring	21,132	1,397	16%	126.6	9.1%
5	West Berbice	Spring	27,899	1,910	22%	158.9	8.3%
6	Black Bush Polder	Spring	14,777	816	9%	51.4	6.3%
6	Frontlands	Spring	21,385	1,160	13%	77.5	6.7%
Subtotal Spring Crop Portfolio			**141,773**	**8,865**	**51%**	**709.9**	**8.0%**
2	Essequibo	Autumn	31,561	2,137	25%	144.2	6.7%
3	Leguan	Autumn	3,426	131	2%	3.3	3.5%
3	Wakenaam	Autumn	1,689	112	1%	5.8	5.1%
3	West Demerara	Autumn	13,863	951	11%	27.9	2.9%
4	Cane Grove	Autumn	7,023	422	5%	18.0	4.3%
5	Mahaica-Abary	Autumn	21,479	1,341	16%	105.9	7.9%
5	West Berbice	Autumn	24,197	1,363	16%	105.1	7.7%
6	Black Bush Polder	Autumn	12,909	809	9%	56.8	7.0%
6	Frontlands	Autumn	20,418	1,276	15%	89.7	7.0%
Subtotal Spring Crop Portfolio			**136,565**	**8,541**	**49%**	**556.8**	**6.5%**
Portfolio Grand Total			**278,338**	**17,406**	**100%**	**1,266.7**	**7.3%**

Source: Authors from the CRAM.

of 6.7%, is on the mezzanine level in terms of annual expected losses for autumn paddy production.

Probable Maximum Loss

44. **The analysis of 14-year (1994/95 -2007/08) paddy zonal yields for spring and autumn paddy in Guyana shows that 2004/05 was the worst loss year in this series when total loss of paddy production amounted to 53,300 metric tons of paddy, which represented 13% of the 2004/05 annual paddy crop production and 26% of the 2004/05 spring crop production in Guyana.** However, although 2004/05 was a severe loss year in Guyana, even worse crop losses could occur in the future. From an insurance view point, underwriters need to know, with a high degree of confidence, the maximum losses that they might incur (termed the Probable Maximum Loss, PML[53]) either 1 in 100 years, or if it is necessary to be even more conservative, 1 in 250 years. This information is an invaluable aid to structuring an insurance and reinsurance program and to determining how much capital must be reserved to cover the PML loss year. Figure 3.14 and Table 3.4 show the results of the World Bank's

53 The Probable Maximum Loss is defined as "An estimate of the maximum loss that is likely to arise on the occurrence of a single event considered to be within the realms of probability, remote coincidences and, possible but unlikely catastrophes being ignored".

PML loss cost analysis for return periods of 1 in 2 years up to a maximum of 1 in 250 years for the spring and autumn paddy crop national portfolio simulated under the CRAM, assuming a 100% insured yield coverage level. The analysis shows that: **(a) the losses in 2004/05 with 13% loss cost at 100% coverage level equate to approximately a 1 in 8-year return period; and (b) the 1 in 100 year estimated PML loss cost is 27.8% at 100% coverage level, equivalent to a financial loss of G$4.8 billon (US$24.2 million).**

45. **The results of the crop risk assessment for 100% coverage level at paddy production zone level provides a notion about the potential exposure to losses of paddy crops cultivated in Guyana that can be used to layer the risk and delineate a reinsurance strategy for the country.** The results of the national portfolio PML analysis confirm that agricultural losses in Guyana could be as severe as 17.0% loss cost (G$2.97 billon) in a 1 in 10 years period, and that 27.8% is expected for 1 in 100 years (G$4.84 billon). This means that catastrophe losses in agriculture like the ones experienced in the 2004/05 floods and the drought of 1997/98 are likely to be repeated in the near future. The evidenced by the pattern of the PML figures for each of the analyzed return periods, suggests that retention of the total liability arising out of retaining 100% of the risk in the country is not possible; thus, risk layering and risk financing issues must be considered seriously in delineating the risk financing strategy.

46. **The PML analysis performed individually for each of the crop seasons, spring and autumn, show that the PMLs for any of them – at same recurrence period – are higher than the PML for the aggregate portfolio.** The estimated PML for paddy spring crop season shows that the 1 in a 100 year estimated PML loss cost is 43.6% at 100% coverage level, equivalent to a financial loss of G$3.86 billon (US$19.3 million). Concomitantly, the estimated PML for paddy autumn crop season shows that the 1 in a 100 year estimated PML loss cost is 40.6% at 100% coverage level, equivalent to a financial loss of G$3.47 billon (US$17.3 million). The reason for the higher PML values on each of the seasonal portfolio PMLs analysis in comparison with the aggregate portfolio PML analysis is because the spring and autumn crop seasons, as it was noted, are not correlated; thus, it is improbable that both spring and autumn paddy crop portfolios suffer losses simultaneously. Figures 3.15 and 3.16 show the results of the World Bank's PML loss cost analysis for return periods of 1 in 2 years up to a maximum of 1 in 250 years for the spring paddy crop portfolio and autumn paddy crop portfolio, assuming a 100% insured yield coverage level.

Figure 3.14. Guyana. National Paddy Crop Portfolio Modeled PML Loss Cost (at 100% coverage level)

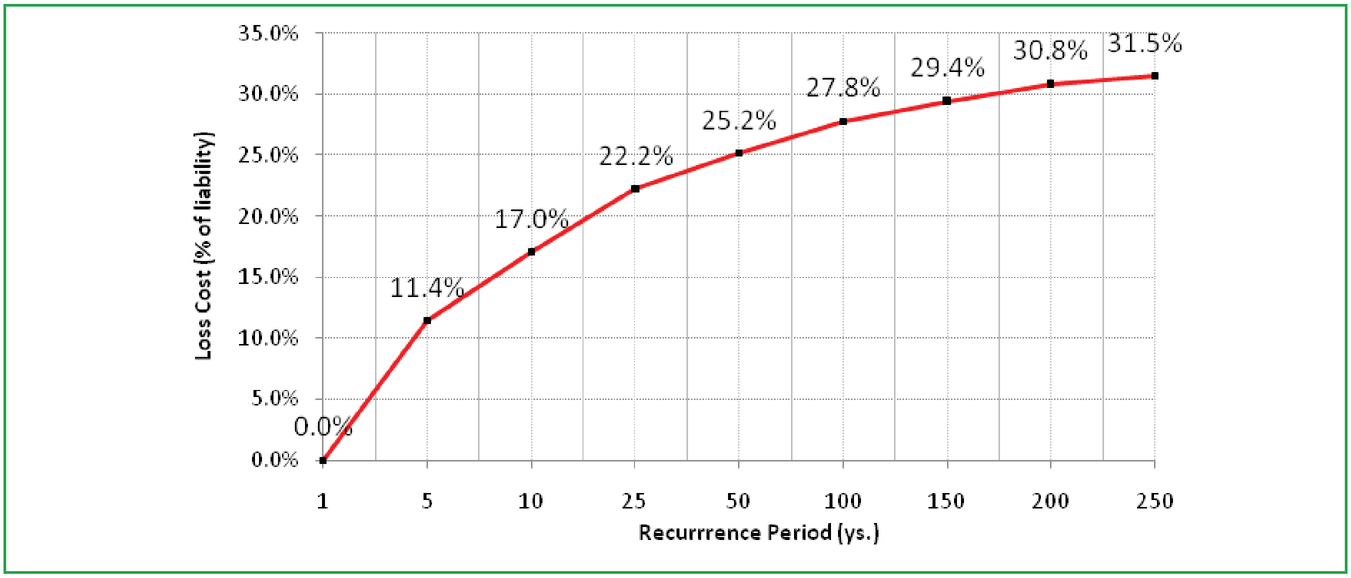


Table 3.4. National Paddy Crop Portfolio Modeled PML Loss Costs for Different Return Periods

Return Period (years)	2 years	10 years	50 years	100 years	150 years	200 years	250 years
Expected Loss (G$ billions)	0.94	2.97	4.38	4.84	5.13	5.37	5.48
Expected Loss (US$ millions)	4.7	14.8	21.9	24.2	25.6	26.8	27.4
Loss Cost	5.4%	17.0%	25.2%	27.8%	29.4%	30.8%	31.5%

Source: Authors from the CRAM.

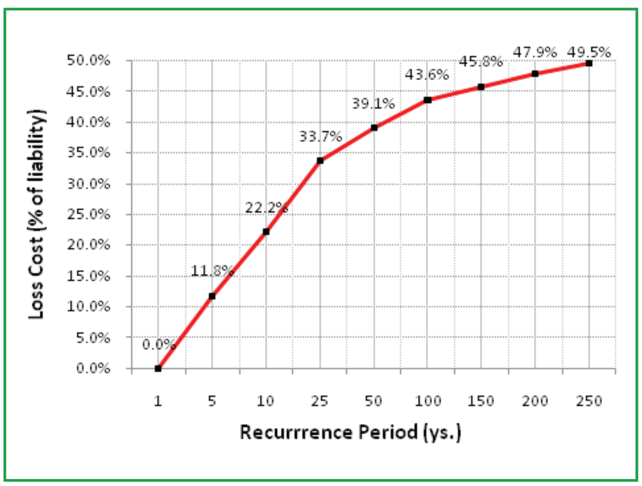
Conclusions

47. **The analysis of zonal level crop production and yields for spring and autumn paddy crops in Guyana shows that paddy production is exposed, in almost all of the country, to a combination of flood, drought/irrigation water shortages, saline intrusion, and excess of rain at harvest.** This is evidenced by the average loss cost estimated through the CRAM for a 14-year period, 1994/95 up to 2007/08, estimated at 7.28% of the total gross value of paddy production and a calculated 1 in 100 year PML of 27.8% of the national paddy crop gross value of production.

48. **In an eventual crop insurance program for paddy production in Guyana, special consideration should be taken to management issues affecting the drainage and irrigation system and the protection against sea intrusion.** As it is seen from this paddy crop risk assessment, many of the factors influencing paddy production risks are related with management issues. Insurance is a financial tool designed to cover unpredictable and unforeseen losses. Management issues are neither unpredictable nor unforeseen; thus, they are not object of insurance. In an eventual crop insurance program for Guyana, the insurers/reinsurers will take all the provisions in order to avoid insuring any man-made aspect influencing paddy production. High levels of insurance deductibles and specific provisions in this regard on the insurance policy wording should be expected.

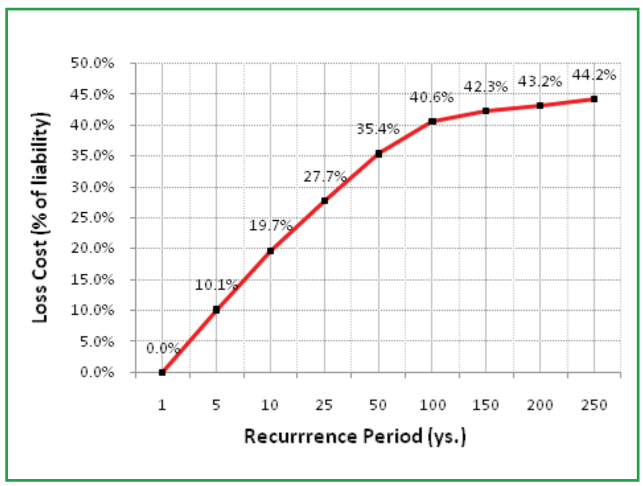
49. **Any eventual crop insurance program for paddy production in Guyana, in order to avoid adverse selection of risks within the insurance portfolio, should consider a distinction, in terms of guaranteed yields and rates, among the different production zones and paddy crop seasons in Guyana.** The analyzed spring and autumn crop seasons as well as the different paddy production zones in

Figure 3.15. Guyana. Spring Paddy Crop Portfolio Modeled PML Loss Cost (at 100% coverage level)



Source: Authors from the CRAM.

Figure 3.16. Guyana. Autumn Paddy Crop Portfolio Modeled PML Loss Cost (at 100% coverage level)



Source: Authors from the CRAM.

Guyana show different exposures to risk. The spring paddy crop season is more risky than the autumn paddy crop season. The spring paddy crop annual average loss cost reaches a national average of 8.0%; as for the autumn paddy crop season, annual average loss cost reaches 6.50%. While within the spring crop season risky zones like West Demerara reach average loss cost of 12.7%, other zones that are less risky, like Region 2, reach average loss cost of 5.7%. Equally, while within the autumn crop season risky zones like Mahaica-Abary reach average loss cost of 7.9%, other zones are less risky than Mahaica-Abary like Leguan Island, which reaches an average loss cost of 2.6 percent.

Appendix A

Crop Portfolio Risk Assessment Model – Design Features

This Appendix presents the basic design features of the Crop Risk Assessment Model (CRAM) for paddy production in Guyana. The CRAM is constructed based on the analysis of variation of spring paddy and autumn paddy annual average yields for a 14-year time-series, beginning with the 1994/95 crop year up to and including the 2007/08 crop year, at the zone level[54].

The CRAM was developed using the sown area, harvested area, production and annual average yield statistics for each of the paddy crop seasons in Guyana at the zone level as are published in the Annual Reports of the Guyana Rice Development Board (GRDB).

Selected Crops

The selected crops for the CRAM were spring paddy and autumn paddy. According to the GRDB, both crops have a similar share of the total planted area with paddy in Guyana, which is 278,000 acres according to the average for the period 2004/05-2007/08.

Cultivated Area

The CRAM assumes that the annual sown area has remained constant for the three year average (2005/06 -2007/08 period) over the 14-year sown area series. The reason for this assumption is to remove seasonal variations from the areas in each region. The three year average total sown area for spring and autumn paddy crops in Guyana amounts to 278,338 acres. The breakdown of this information at the region level is shown in Table A.1.

In order to be eligible for the CRAM, two criteria have been set: minimum planted area per region and a minimum of 14 years continuous annual average yield data. In order to ensure that there are sufficient numbers of farmers growing the crop in a selected region, a

54 The CRAM uses the same definition as per the GRDB production reporting. That is Region 2 (Essequibo); Region 3, Wakenaam zone; Region 3, Leguan Island zone; Region 3, West Demerara zone; Region 4, Cane Grove zone; Region 5, Mahaica-Abary zone; Region 5, West Berbice zone; Region 6, Black Bush Polder zone; and Region 6, Frontlands zone.

Table A.1. Spring and Autumn Paddy. 3-year Average Harvested Area at Zone Level (acres)

Region	Zone	Spring Paddy Sown Area (acres)	Autumn Paddy Sown Area (acres)	Grand Total (acres)
2	Essequibo	31,650	31,561	63,211
3	Leguan	2,721	3,426	6,148
3	Wakenaam	1,191	1,689	2,880
3	West Demerara	13,863	13,863	27,726
4	Cane Grove	7,153	7,023	14,176
5	Mahaica-Abary	21,132	21,479	42,611
5	West Berbice	27,899	24,197	52,096
6	Black Bush Polder	14,777	12,909	27,686
6	Frontlands	21,385	20,418	41,803
Grand Total		**141,773**	**136,565**	**278,338**

Source: GRDB.

minimum area of 1,000 acres has been provisionally settled as a requirement for a crop in a certain region to be eligible for the model. The second criterion, at least 14 continuous years of yield data available for each region to qualify for the CRAM, has been settled to have continuous series in order to establish possible yield correlations among different paddy production zones.

In the case of Guyana, all the paddy production zones defined by the GRDB met the eligibility criteria. As a result, the total acreage considered for the CRAM was 278,338 acres. Out of the total acreage considered for the CRAM, 51% of the total acreage –1 41,773 – belongs to spring paddy and the remaining 49% – 136,565 acres – to the autumn crop.

The main geographic concentration of crops selected for the CRAM is in Mahaica-Abary and West Berbice in Region 5, accounting together for 34.5% and 33.5% of the total sown area with spring and autumn paddy, respectively. The second area, in terms of crop concentration, comprises Black Bush Polder and Frontlands zones in Region 6, accounting for 25.5% and 24.4% of the spring and autumn sown area, respectively. Region 5, Essequibo, is situated in third place in terms of spring and autumn paddy sown area, accounting for 22.3% and 23.11% of the spring and autumn sown area, respectively. Region 3 – comprising West Demerara, Leguan Island and Wakenaam Island – is in fourth place in term of crop concentration, accounting for 12.5% and 13.9% of the spring and autumn sown area, respectively. The last region in terms of paddy crop concentration is Region 4 accounting for only 5% of the total area sown with paddy in the country.

Regional Crop Yield Data

The CRAM uses zonal annual average yields for spring and autumn paddy crops for the period between 1994/95 and 2007/08 crop years as reported by the GRDB on its Annual Reports. The original zonal annual average yields from 1994/95 to 2007/08 are included in Appendix 2.

The GRDB reports average yields on sown area at the zonal level. This is an important advantage for risk modeling purposes, since the yields on sown area basis capture, both the variations due to yield performance, as well as the yield variations due to full crop losses.

In order to report crop production, the GRDB follows an ad-hoc zonal division of Guyana. Under the zonal division the paddy production areas are divided into 5 regions, and 9 paddy production zones, specifying to which region each zone belongs. A zone has, on average, 15,700 acres, which seems to be appropriate[55] to perform a crop risk ratting exercise for area-yield index.

55 In India, the area-yield index insurance operated by AIC under NAIS currently operates with 25,000 acres as the insured unit.

There are no significant differences in terms of yield performance between the spring and autumn paddy crops. While the average of the annual average yields for autumn paddy during the period between 1994/95 and 2007/08 is 26 bags per acre, the average of the annual average yields for spring paddy during the same period is 25.7 bags per acre.

Table A.2. Features of Zone Annual Average Yields Inputted to the CRAM (1994/95 – 2007/08)

Parameter	Spring Paddy	Autumn Paddy
Average Yield (Bags/Acre)	25.7	26.0
Standard Deviation (Kg/Acre)	4.0	2.4
CoV%	16%	9%
Minimum Yield (Bags/Acre)	20.9	22.4
Maximum Yield (Bags/Acre)	28.9	29.5

Source: Authors from GRDB.

Autumn paddy annual average yields are less volatile than spring paddy annual average yields. All the varieties of autumn paddy crops showed an average coefficient of variation (CoV), calculated per region along the 14-year annual average yield series, of between 6.3% and 11.8%. Conversely, the CoV figures for spring paddy were higher than those observed for autumn paddy crops with values of CoV ranging from 8.8% to 28.7 percent.

The spring and autumn annual average yields imputed to the CRAM showed an increasing trend in their productivity for the period between 1994/95 and 2007/08. Table A.2 and Figures A.1 and A.2 summarize the features of the crops included in the CRAM.

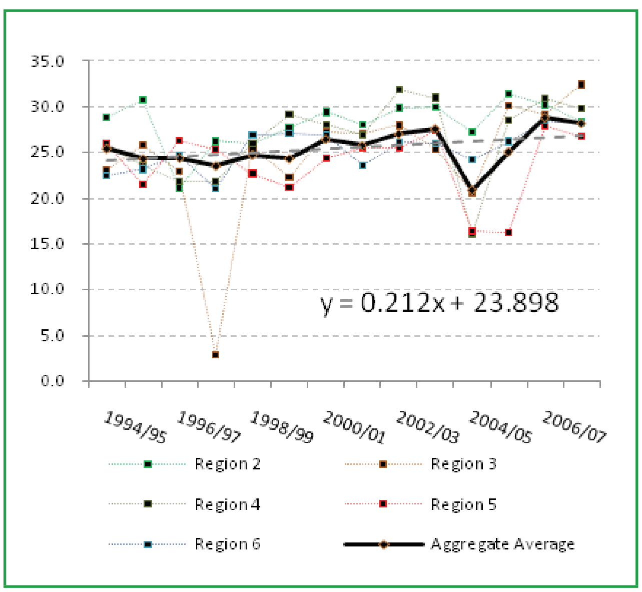
Valuation Prices

For CRAM risk modeling purposes, spring and autumn paddy crops have been valued at the average market price per bag for the month of harvest for the 2008/09 crop year. These crop prices are maintained at a constant 2008/09 value for all the past 14 years. Table A.3 shows the crop prices used for modeling under the CRAM.

Yield Data Cleaning and Trending to Establish the Central Tendency

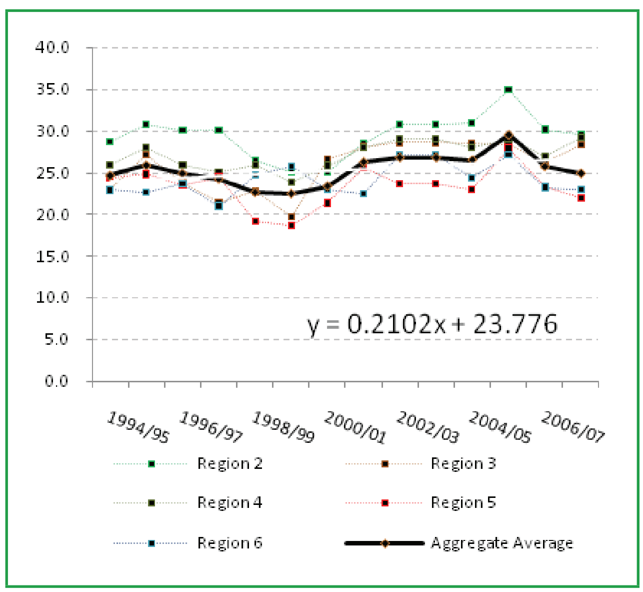
The annual average yield series at the zone level used to feed the CRAM must be adjusted in order to reflect

Figure A.1. Guyana. Paddy: Spring Crop Season. Historic Average Yields at Regional Level (1994/95 - 2007/08) (bags/acre)



Source: Authors/GRDB Annual Reports.

Figure A.2. Guyana. Paddy: Autumn Crop Season. Historic Average Yields at Regional Level (1994/95 - 2007/08) (bags/acre)



Source: Authors/GRDB Annual Reports.

Table A.3. Average 2008/09 Farm-gate Prices at Harvest for Crops Selected under the CRAM

Region	Spring Paddy Price (G$/bag)	Autumn Paddy Price (G$/bag)
2	2,250	2,250
3	2,300	2,800
4	2,300	2,800
5	2,850	2,400
6	2,150	2,500

Source: GRDB.

the current state-of-the-art information in terms of expected yields and yield variability for the selected crops for the risk assessment. This sub-section describes the methodologies followed to clean the yield data, determine the trend in yield data and, finally, to adjust the historical yields to the current expected yield at the region level.

Eliminate Yield Outliers

The first step was to detect and eliminate the statistical outliers from the annual average yield series for each of the selected crop and regions by applying the Chauvenet[56] criteria. Each of the 14-year annual average yields records for each spring and autumn paddy on each of the 9 zones on which paddy production is reported in Guyana were checked for implausible outliers. If, by applying the Chauvenet criteria, a yield outlier was detected, then the annual average crop yield was compared with the annual average crop yield performance for the same crop and year in neighboring regions. If, as result of this comparison, it was detected that the crop yield performance in neighboring regions diverged significantly in respect to the annual average yield for the target crop and year, then yield, production and harvested area figures were revisited to find out the cause of the divergence. If any anomaly with yield, production and harvested area figures was detected, and there was no reason explaining the anomaly, then the procedure was to replace the outlier with the average annual average yield of a contiguous region.

56 In statistical theory, the Chauvenet's criterion is a means of assessing whether one piece of experimental data – an outlier – from a set of observations, is likely to be spurious.

Adjusting Zonal Average Yield Data for Trends

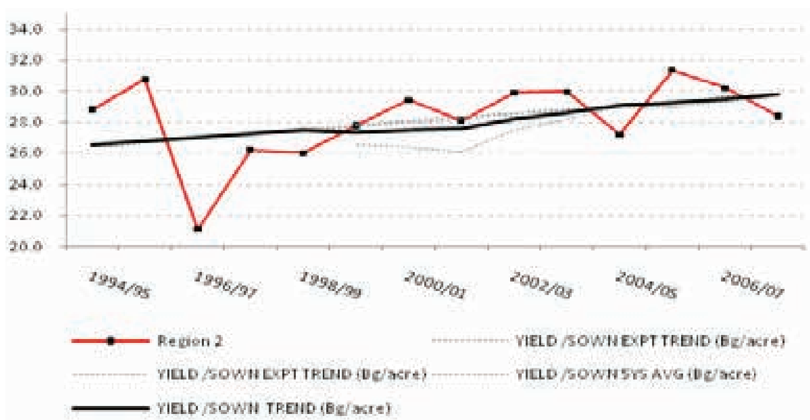
The next step was to adjust the annual average yield series for maximum central tendency over the 14-year period. The crop yield central tendency is associated with crop management and technology practices; crop yield deviations from the central tendency are associated with effects of nature. The main objective of adjusting the historic annual average yield series was to isolate the effect on yields of the improvement on crop management practices and the increase in technology application to the crops along the 14-year period considered for the analysis. A simplified method was adopted for determining the central tendency for each crop and each zone in the CRAM. The method aims to capture the non-linear yield tendency in the 14-year annual average yield series at zonal level by using this yield series fitted to a lineal trend line and to an exponential trend line, and the 5-year moving average of the 14-year annual average yield series. The yield trending method followed to determine the central tendency is summarized for spring paddy in Essequibo, Region 2, in Figure A.3.

Expected Yields and Adjusted Crop Variability

The last step was to estimate the expected yields and adjust the crop variability for each crop and region to be used as inputs for risk modeling.

The design of the CRAM is based on the annual average yields for the period 2005/06-2007/08 at the zone level and their standard deviation for each of the selected crops and zones in Guyana; thus, these inputs must be representative of the current state-of-the-art crop production in each of the analyzed zones. That is, all the long-term and cyclical effects of crop management practice and of technology application on the historic

Figure A.3. Guyana. Paddy: Region 2 (Essequibo) Spring Crop Season. Historic Average Yields at Yield Trends Zonal Level (1994/95-2007/08) (bags/acre)



Source: Authors from GRDB Annual Reports 1995-1998.

annual average yields must be eliminated prior to estimating these parameters for risk modeling purposes.

In order to calculate the expected annual average yield for each of the crops and regions under analysis, the simple average of the most recent three years historic annual average yields was calculated. The fact that the expected annual average yield for risk modeling purposes is estimated based on a simple average of the most recent three year historic annual average for each analyzed crop and zone, can be discussed. The authors are conscious that the ideal method to estimate the annual average expected yields would be to extend the trend yields by one additional year. Yet, this method to estimate annual average expected yields for a certain crop located in a certain zones is common in the agricultural insurance practice in countries where the constraint of scarce annual average crop yield data is a problem.

The second part of this analysis was to estimate the expected annual average yield volatility of the annual average yield. The method used for this purpose was to measure the deviations between the historic annual average yields for each year of the series with respect to the corresponding annual average yield of the trend line. Then, these deviations were applied to the expected yield to obtain an adjusted annual average yield series. The method used to estimate the central tendency for yields and the yield deviation with respect to the central tendency is illustrated in Table A.4 and Figure A.4.

Estimation of Losses for the National Paddy Portfolio

The estimation of losses for the national paddy portfolio crop was performed through a risk modeling exercise using the CRAM. Risk modeling is a fundamental step in agricultural insurance program design and rate-making procedures. The main objective of crop risk modeling is to estimate, based on the available information, a yield probability density function that reflects the stochastic nature of yield outcomes. The model has two components: (a) the normal risk component, and (b) the catastrophic risk component.

The normal risk component of the CRAM is based on probability density functions that reflect the stochastic nature of yield outcomes for each crop season and zone. The main objective of crop risk modeling is to estimate, based on the available information, a yield probability density function that reflects the stochastic nature of yield outcomes. The model is underlaid by two basic fundamentals: (a) a crop yield probability density function inferred from the historic annual average yields for each zone and paddy crop season in the analyzed portfolio, and (b) a correlation matrix of each zone's annual average paddy crop yield which reflects the covariant risk under the portfolio. The probability density functions were inferred from the technology-adjusted annual average yields from the annual average yield series 1944/95-2007/08 that were fitted to a Weibull probability distribution.

The outputs of yield probability density functions obtained for each zone and paddy crop season were correlated in order to reflect the covariance on yields for risk modeling purposes. Paddy crop production in Guyana is exposed to systemic risks. Variations in crop yields are often caused by factors that typically affect a large area. The fact that a portfolio is exposed to systemic risk, since it affects the degree on which the risks can

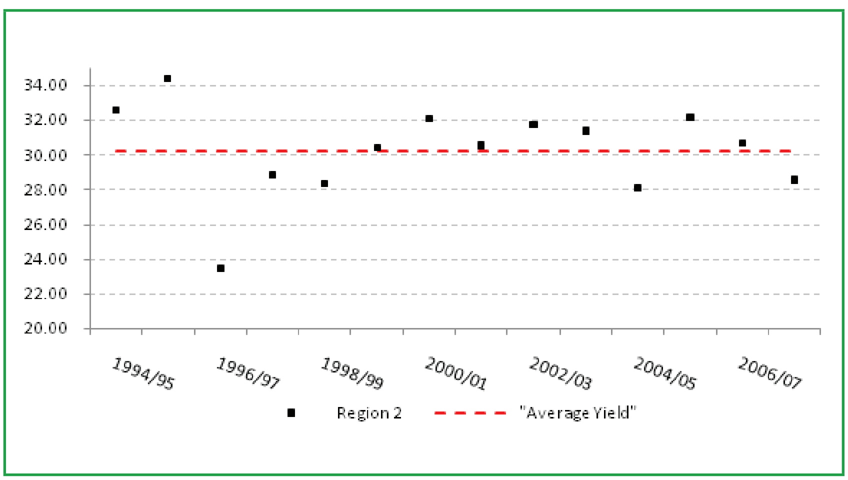
Table A.4. Paddy: Region 2 (Essequibo) Spring Crop Season. Calculation of Adjusted Yields

Crop Year	Historic Annual Average Yields (bags/acre)	Exponential Yield Trendline (bags/acre)	Lineal Yield Trendline (bags/acre)	5-year Moving Average (bags/acre)	Average Annual Yield Trendline (bags/acre)	Historic Annual Average Yields Deviations from Trend	Average Yield 2003-2007 (bags/acre)	Adjusted Yield (bags/acre)
1994/95	28.8	26.4	26.6		26.5	8.6%	30	32.58
1995/96	30.8	26.7	26.9		26.8	14.9%	30	34.46
1996/97	21.1	26.9	27.1		27.0	-21.9%	30	23.43
1997/98	26.2	27.2	27.4		27.3	-3.8%	30	28.85
1998/99	26.0	27.5	27.6		27.5	-5.5%	30	28.34
1999/00	27.8	27.7	27.9	26.6	27.4	1.5%	30	30.44
2000/01	29.4	28.0	28.1	26.4	27.5	7.0%	30	32.10
2001/02	28.1	28.3	28.4	26.1	27.6	1.9%	30	30.57
2002/03	29.9	28.5	28.6	27.5	28.2	6.0%	30	31.78
2003/04	30.0	28.8	28.9	28.2	28.6	4.7%	30	31.41
2004/05	27.2	29.1	29.1	29.0	29.1	-6.3%	30	28.09
2005/06	31.4	29.3	29.4	28.9	29.2	7.4%	30	32.21
2006/07	30.2	29.6	29.6	29.3	29.5	2.4%	30	30.72
2007/08	28.4	29.9	29.9	29.7	29.8	-4.7%	30	28.58
3-year average	30							

Source: GRDB original paddy yield data, adjusted by World Bank.

be diversified, has severe implications for the designing of crop insurance. In light of the systemic risk faced by paddy production in Guyana, the CRAM considered the correlations among each zone and paddy crop season in order to simulate the potential losses for the portfolio. According to the results of the correlation analysis, the average correlation between spring and autumn crop season annual average yields at zone level is very low. The coefficient of correlation found for these two crop seasons was equal to 0.1, which is an indication that these crop seasons are weakly correlated; thus, it may be concluded that spring and autumn annual average yields have relatively independent performances. The average coefficient of correlation among different zones within the spring paddy crop season was 0.5. This coefficient of correlation indicates that, although not strong, zonal annual average yields within the spring crop season tend to have similar performances. Likewise, the average correlation among different zones within the

Figure A.4. Paddy: Region 2 (Essequibo) Spring Crop Season. Adjusted Variability of Average Yields



Source: World Bank based on NBS data.

autumn crop season was also 0.5; therefore, it may also be concluded that zonal annual average yields within the autumn season tend to have similar performances. In a nutshell, autumn and spring paddy annual average yields tend to have similar performances within the same crop season, but they tend to show independent yield performance between the autumn and spring crop seasons. Table A.5 shows the correlation matrixes for spring and autumn paddy crops in Guyana.

The catastrophic risk component of the CRAM was based on the probability of frequency and severity of unforeseen losses for paddy production in Guyana. The main objective of the catastrophic component of the risk model for paddy production in Guyana is to estimate the possible frequency and severity of those events that were not captured in the 14-year annual paddy average yields for the spring and autumn seasons. In order to reflect the possible catastrophic scenarios for paddy production in Guyana, three possible scenarios were included in the model. The first one was the occurrence of severe droughts affecting paddy production. The second was the possible event in which the conservancies in Region 3 and 4 would be

Table A.5. Guyana. Paddy Crops. Zonal Annual Average Yield Correlation between Autumn and Spring Crops

@RISK Correlations	1st season/R2/Essequibo	1st season/R3/Leguan	1st season/R3/Wakenaam	1st season/R3/West Demerara	1st season/R4/Cane Grove	1st season/R5/Mahaica-Abary	1st season/R5/West Berbice	1st season/R6/Black Bush Polder	1st season/R6/Frontlands	2nd season/R2/Essequibo	2nd season/R3/Leguan	2nd season/R3/Wakenaam	2nd season/R3/West Demerara	2nd season/R4/Cane Grove	2nd season/R5/Mahaica-Abary	2nd season/R5/West Berbice	2nd season/R6/Black Bush Polder	2nd season/R6/Frontlands
1st season/R2/Essequibo	1																	
1st season/R3/Leguan	0.43	1																
1st season/R3/Wakenaam	0.44	0.81	1															
1st season/R3/West Demerara	0.33	0.7	0.81	1														
1st season/R4/Cane Grove	0.53	0.64	0.41	0.52	1													
1st season/R5/Mahaica-Abary	-0.1	0.41	0.21	0.5	0.53	1												
1st season/R5/West Berbice	-0.1	0.08	-0.4	-0.2	0.35	0.56	1											
1st season/R6/Black Bush Polder	0.32	0.5	0.48	0.64	0.62	0.27	-0.1	1										
1st season/R6/Frontlands	0.15	0.62	0.57	0.53	0.52	0.34	-0	0.44	1									
2nd season/R2/Essequibo	0.26	0.32	0.18	0.05	-0.1	-0.4	-0.1	-0.1	-0.2	1								
2nd season/R3/Leguan	0.65	0.45	0.54	0.4	0.34	0.03	-0	-0.1	0.27	0.32	1							
2nd season/R3/Wakenaam	0.37	0.59	0.47	0.19	0.34	-0	0.11	-0.2	0.3	0.44	0.75	1						
2nd season/R3/West Demerara	0.07	0.4	0.4	0.45	-0.2	0.12	0.02	-0	-0	0.56	0.38	0.34	1					
2nd season/R4/Cane Grove	0.48	0.67	0.64	0.47	0.23	0.03	-0	0.04	0.21	0.68	0.76	0.79	0.74	1				
2nd season/R5/Mahaica-Abary	0.05	0.13	-0	-0	-0.1	-0.1	0.22	-0.3	-0.5	0.79	0.27	0.38	0.63	0.52	1			
2nd season/R5/West Berbice	0.38	0.13	0.08	0	-0.1	-0.4	0.01	-0.2	-0.4	0.8	0.38	0.36	0.42	0.49	0.83	1		
2nd season/R6/Black Bush Polder	0.11	-0.1	-0.2	-0.2	0.25	-0.3	-0.1	0.2	-0.1	0.33	-0	-0	-0.2	0.01	0.17	0.12	1	
2nd season/R6/Frontlands	0.35	0.5	0.66	0.56	0.44	0.07	-0.4	0.35	0.56	0.24	0.49	0.38	0.22	0.51	-0	-0.1	0.45	1

Source: **Authors based on the GRDB paddy production data.**

overtopped, causing a generalized flood in the area. The last scenario considered for the risk model was the possible overtopping of the sea wall due to abnormal high tides, causing a major problem of saline intrusion in coastal areas.

The first catastrophic scenario included in the CRAM was the occurrence of severe droughts, like the 1997/98 *El Niño*. The main objective of the catastrophic scenario for drought was to consider the possible effects of a severe drought event which were not included in the annual average yield crop series from 1994/95-2007/08. According to the records obtained from EM-DAT[57] and HYDROMET, during the period between 1974/75 and 2007/08, paddy production has been affected by severe water shortages and droughts in 1979/80, 1987/88, 1994/95, 1997/98, 2000/01, 2001/02, 2002/03 and 2009/10. The CRAM assumes that the frequency of occurrence of a drought like the one in 1997/98 is about once in a ten year period. Once this drought occurs, the severity of the losses is estimated at the same level than those occurred in 1997/98 with a margin of plus/minus 20%. Two scenarios were considered for drought. One for high prone areas like Leguan, Wakenaam, and West Demerara; and another for low prone areas like Cane Grove, Mahaica, West Berbice, Black Bush Polder and Frontlands. The loss severity in drought high prone areas was represented in the model through a Beta distribution with a minimum value of affectation at 0%, a most likely value at 30%, mean at 40%, and maximum at 100% loss. The loss severity for drought low prone areas was represented in the model through a beta distribution with a minimum value of affectation at 0%, a most likely value at 20%, mean at 30%, and maximum at 100% loss.

The second catastrophic scenario included in the CRAM was the possible water overtopping of conservancies. Both the EDWC and the Boeraserie Conservancy are outdated. According to EMLAC (2005), the EDWC is on serious risk of collapse and needs major rehabilitation work. The Boeraserie Conservancy also needs rehabilitation work. In any risk analysis, these issues with the conservancies must be taken into consideration. The possible scenario of water overtopping in the EDWC and the Boeraserie Conservancy were included in the CRAM. The model assumes that the frequency of occurrence of a possible collapse of each of the conservancies, given their current status of maintenance, is once in a thirty year period. Once this scenario occurs, the model estimates the severity of losses through a Beta density distribution with the following parameters: a minimum value of affectation at 0%, a most likely value at 30%, mean at 40%, and maximum at 100% loss. This scenario was only applied to West Demerara, Cane Grove, Mahaica-Abary, and West Berbice zones. Essequibo, Leguan. Wakenaam, Black Bush Polder and Frontlands were not considered for the scenario of possible water overtopping on the conservancies because these zones are outside the influence of the EDWC and the Boeraserie Conservancy.

The third catastrophic scenario considered in the CRAM is saline intrusion due to the overtopping of the sea wall. While the sea defenses in Guyana are designed to accommodate a sea level rise of 6 mm per year, the current rate of sea level rise is 10.2 mm per year (Guyana's National Vulnerability Assessment to Sea Level Rise, 2002). Therefore, in the event of high tides accompanied by high winds, there could be storm surges that can overtop the walls and cause saline intrusion in areas close to the seashore. This scenario was included in the CRAM. The model assumes that the frequency of occurrence of water overtopping the sea defenses is once in a fifty year period. Once this scenario occurs, the model estimates the severity of losses through a Beta density distribution that has the following parameters: a minimum value of affectation at 0%, a most likely value at 20%, mean at 30%, and maximum at 100% loss.

The CRAM design integrates the normal yield component and the catastrophic components in order to produce the final output. The damage calculated for the catastrophic components in the CRAM is deducted from the yield output of the normal component of the model in order to produce a final annual average yield output that takes into account the normal variations in annual average yields for spring and autumn paddy in each of the zones considered in the portfolio, as well as the impact of the catastrophic events due to droughts, conservancy water overtopping and sea wall overtopping.

57 EM-DAT. OFDA/CRED International Disaster Database. www.em-dat.net. Universite Catolique de Lovrain, Brussels, Belgium.

The CRAM simulates 10,000 iterations of the model in order to arrive to the final paddy yield output. The final yield output for each zone and paddy crop season is given by the multiplication of the crop yield generated by Monte Carlo Methodology simulation with a Weibull distribution, times the simulated percentage of yield loss deduction due to the drought catastrophic scenario (if it applies), times the simulated percentage of yield loss deduction due to the conservancy overtopping catastrophic scenario (if it applies), and times the simulated percentage of yield loss deduction due to the sea wall overtopping catastrophic scenario (if it applies). This formula is simulated, through the Monte Carlo Methodology, by using @Risk software with 10,000 interactions. A diagram summarizing the CRAM is presented on Figure A.5.

Figure A.5. CRAM. Risk Modeling Process Description

Source: Authors.

Appendix B

Paddy: Annual Sown Area, Production and Average Yields at the Regional Level

Figure B.1. Region 2. Spring Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

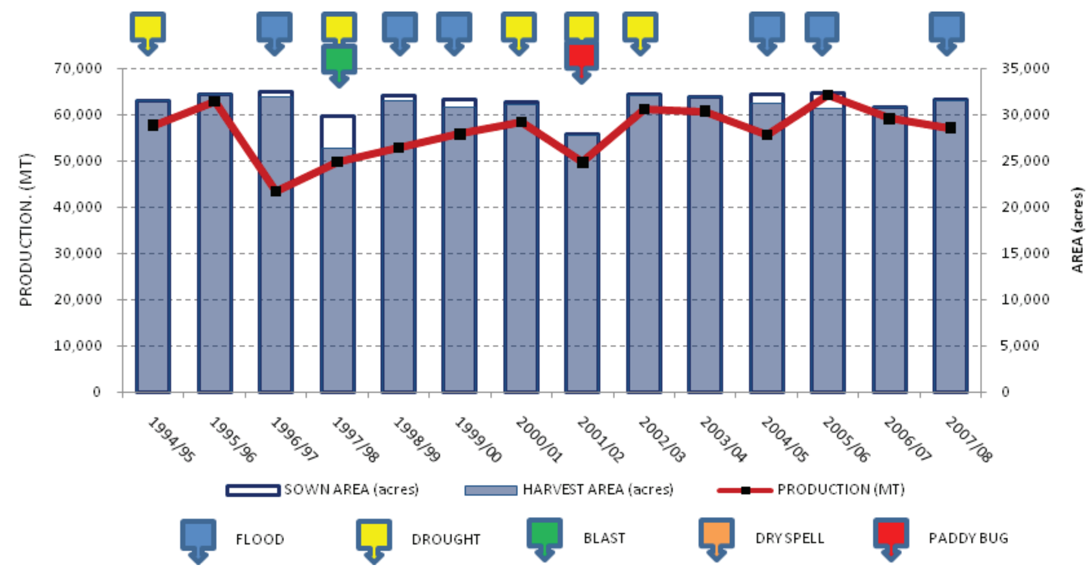


Figure B.2. Region 2. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

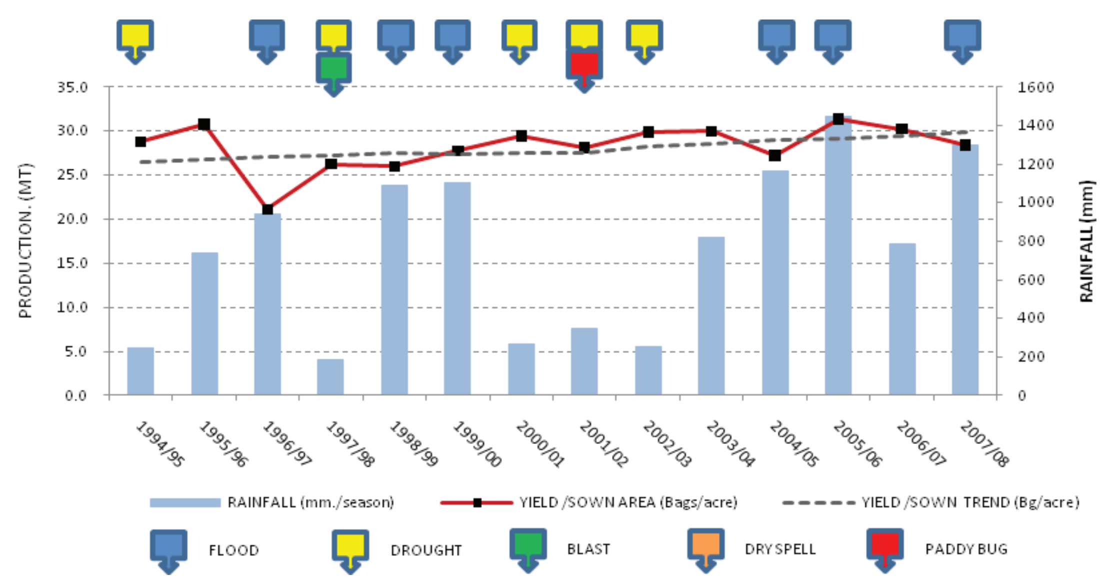


Figure B.3. Region 2. Autumn Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

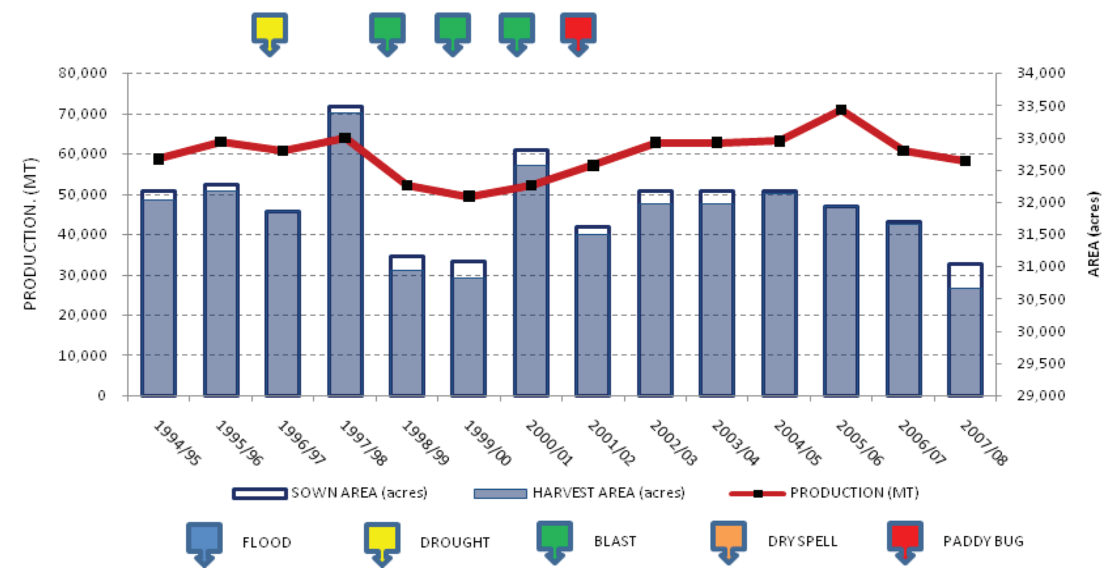


Figure B.4. Region 2. Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

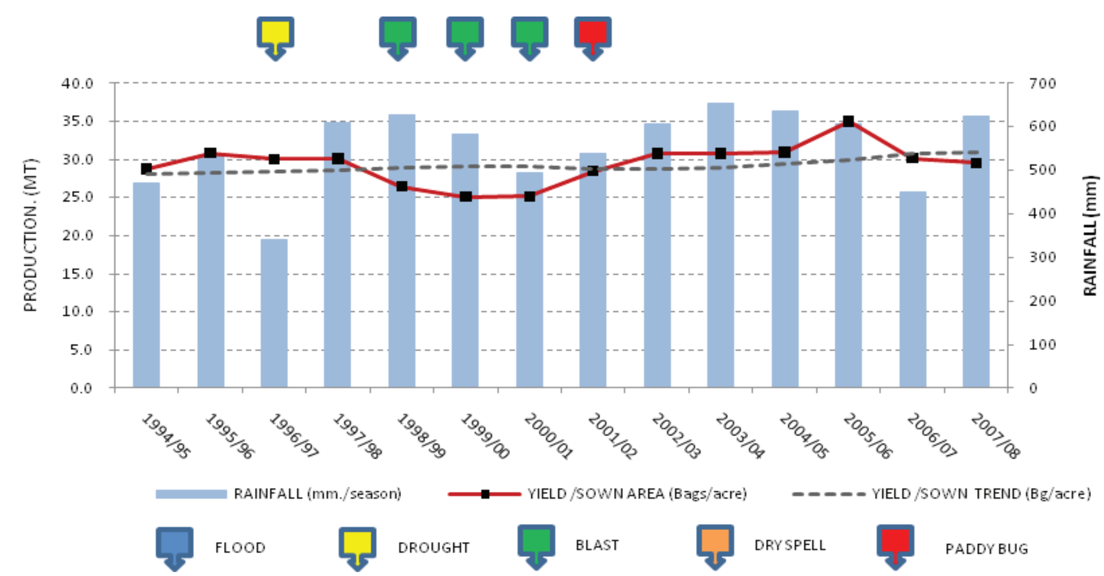


Figure B.5. Region 3. Spring Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

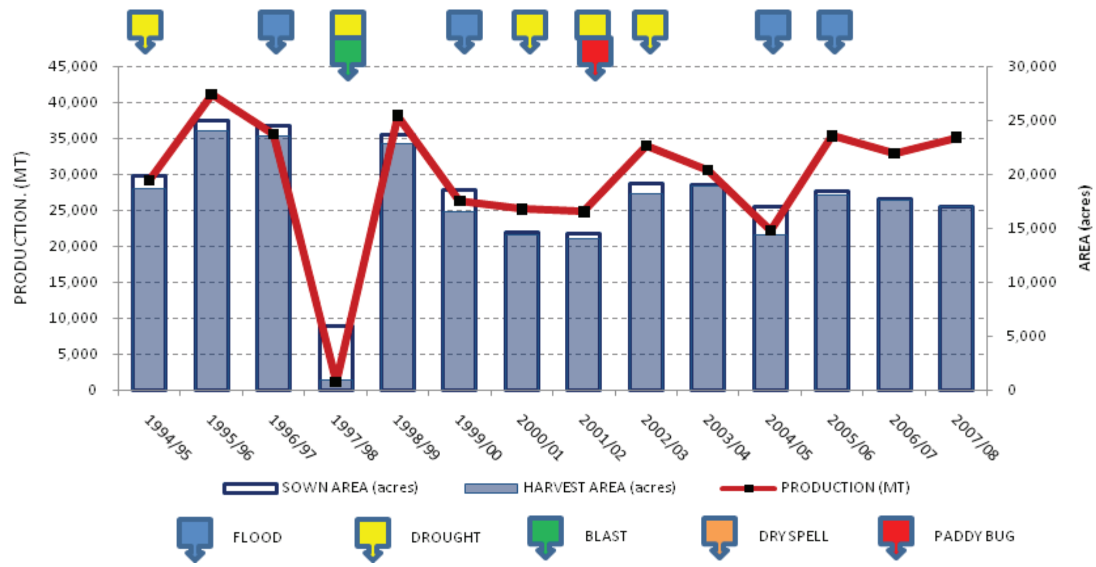


Figure B.6. Region 3. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

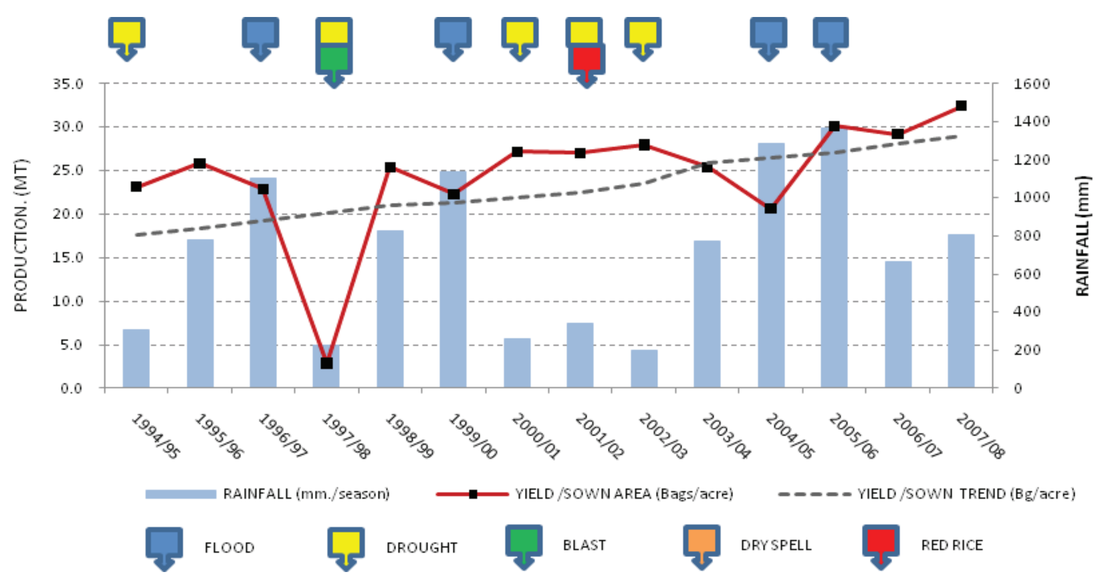


Figure B.7. Region 3. Autumn Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

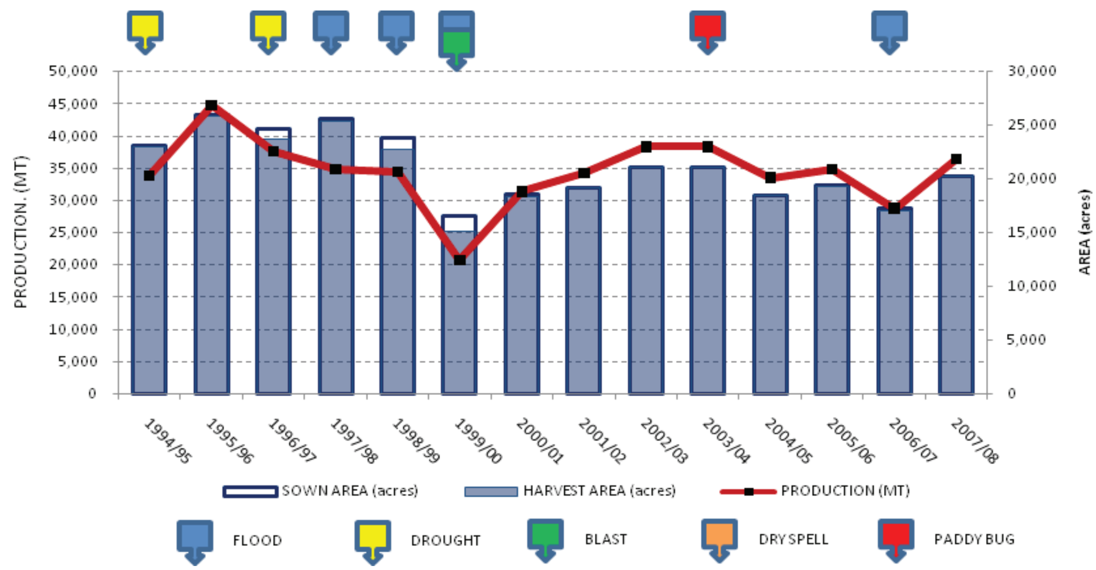


Figure B.8. Region 3. Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

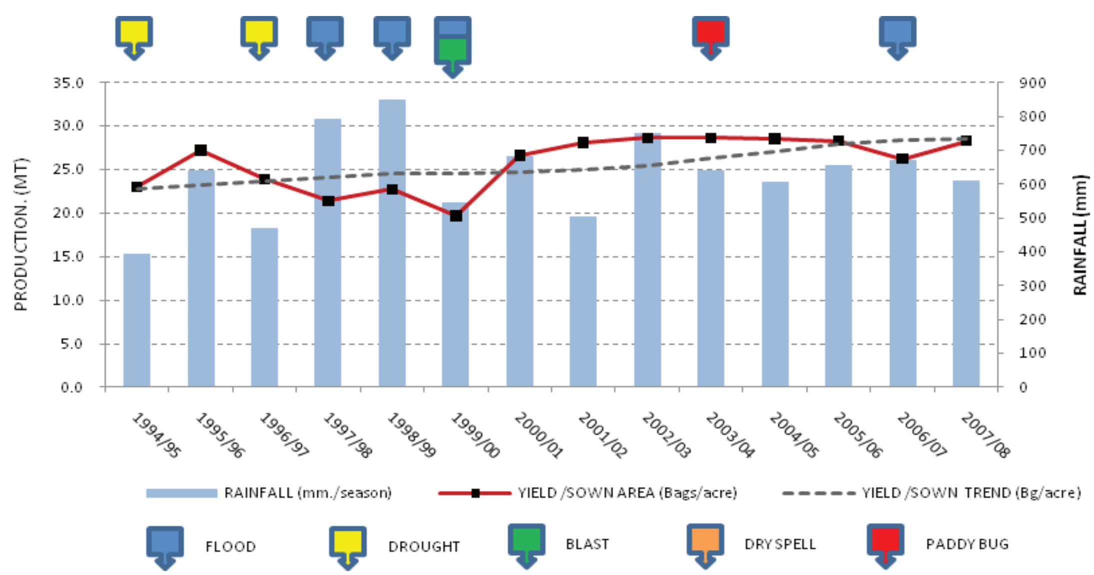


Figure B.9. Region 4. Spring Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

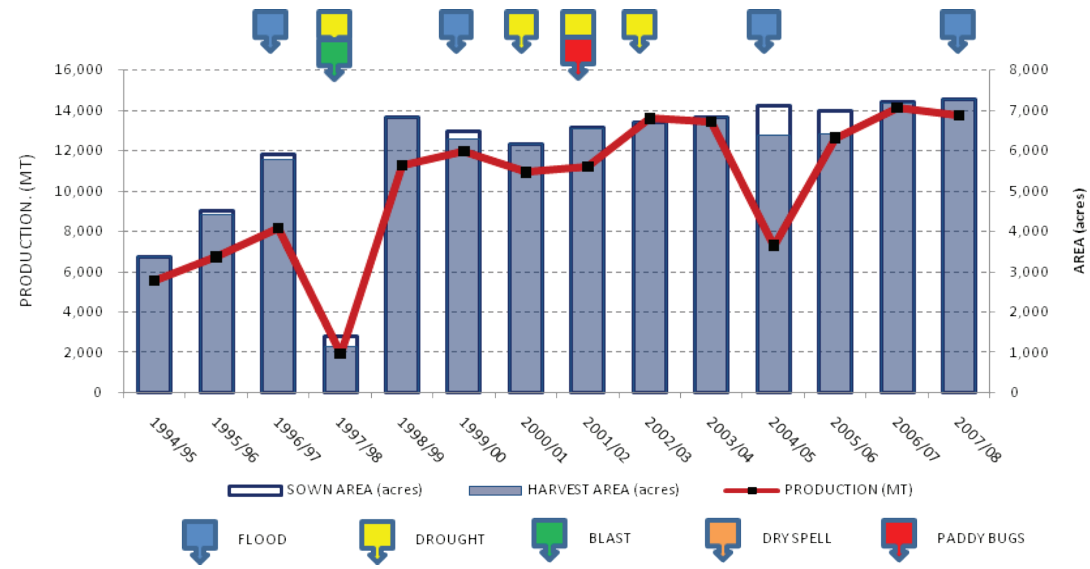


Figure B.10. Region 4. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

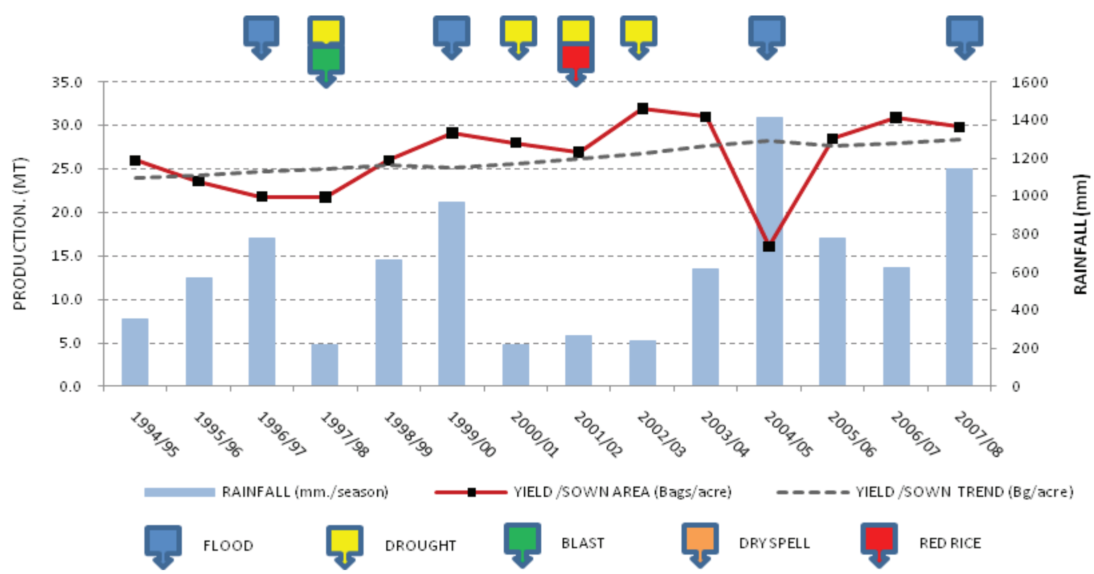


Figure B.11. Region 4. Autumn Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

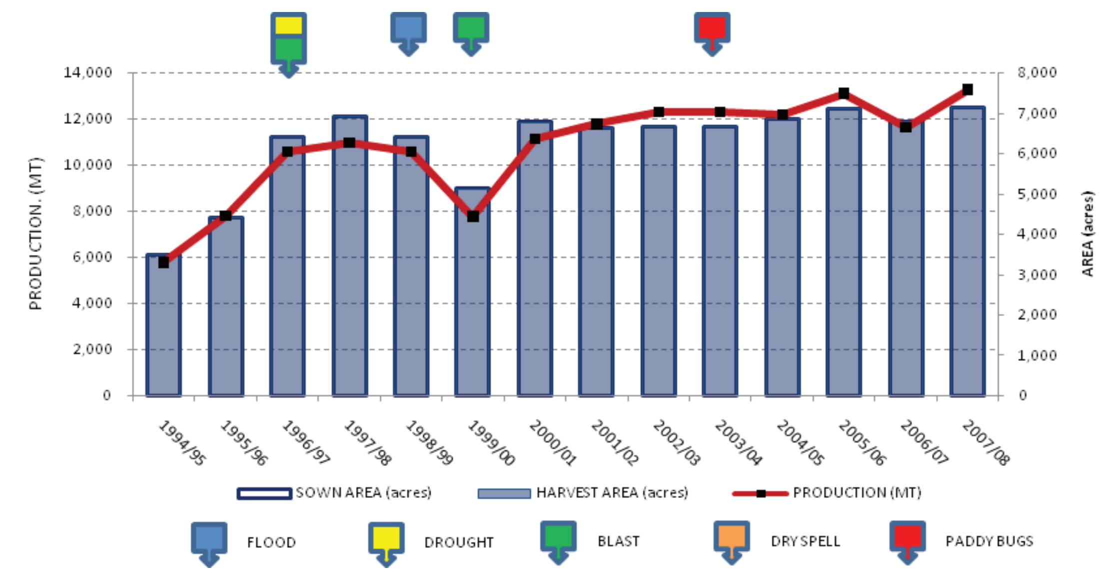


Figure B.12. Region 4. Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

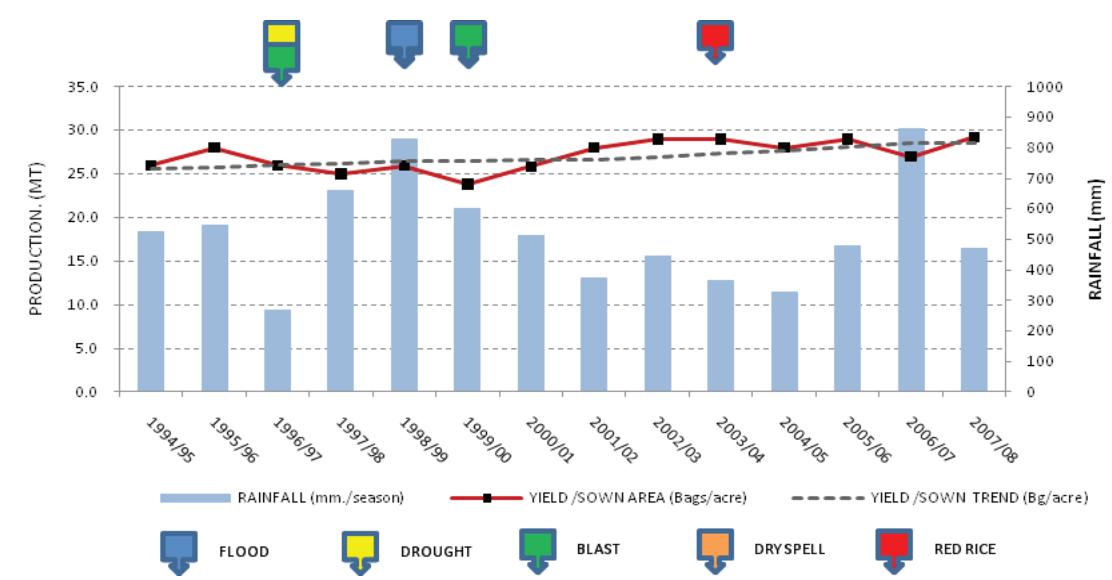


Figure B.13. Region 5. Spring Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

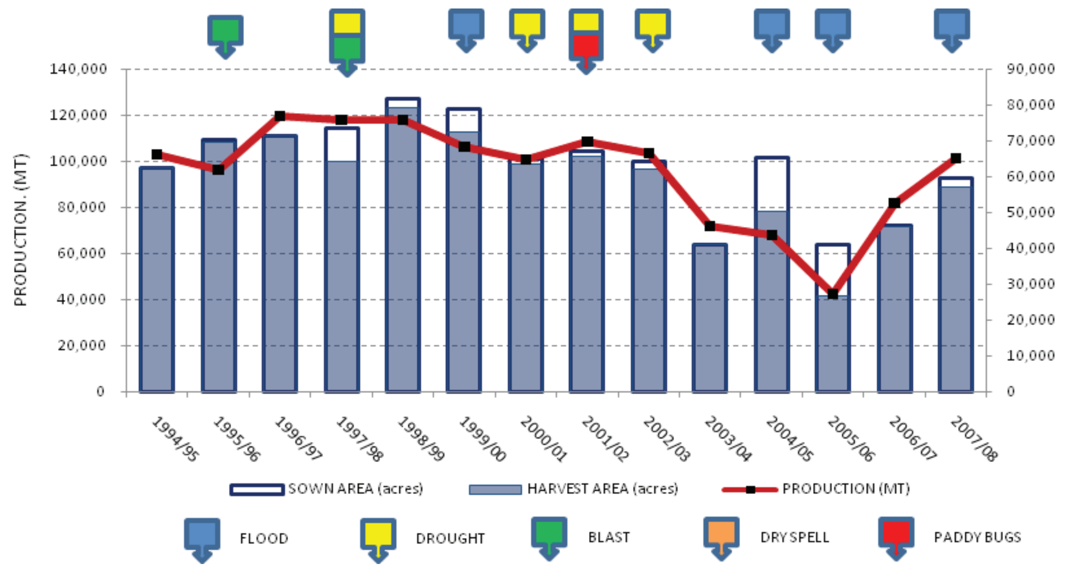


Figure B.14. Region 5. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

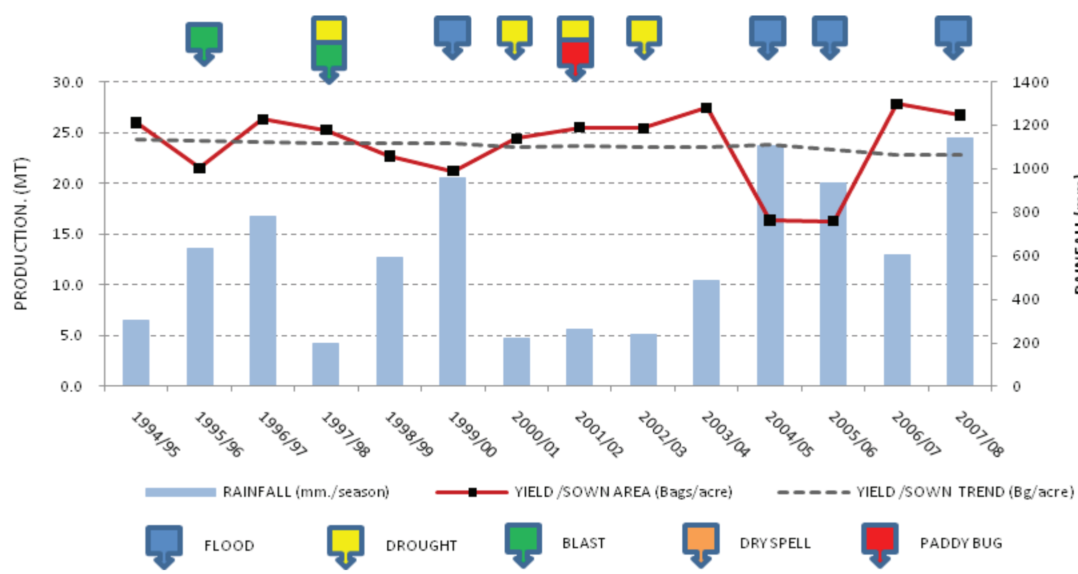


Figure B.15. Region 5. Autumn Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

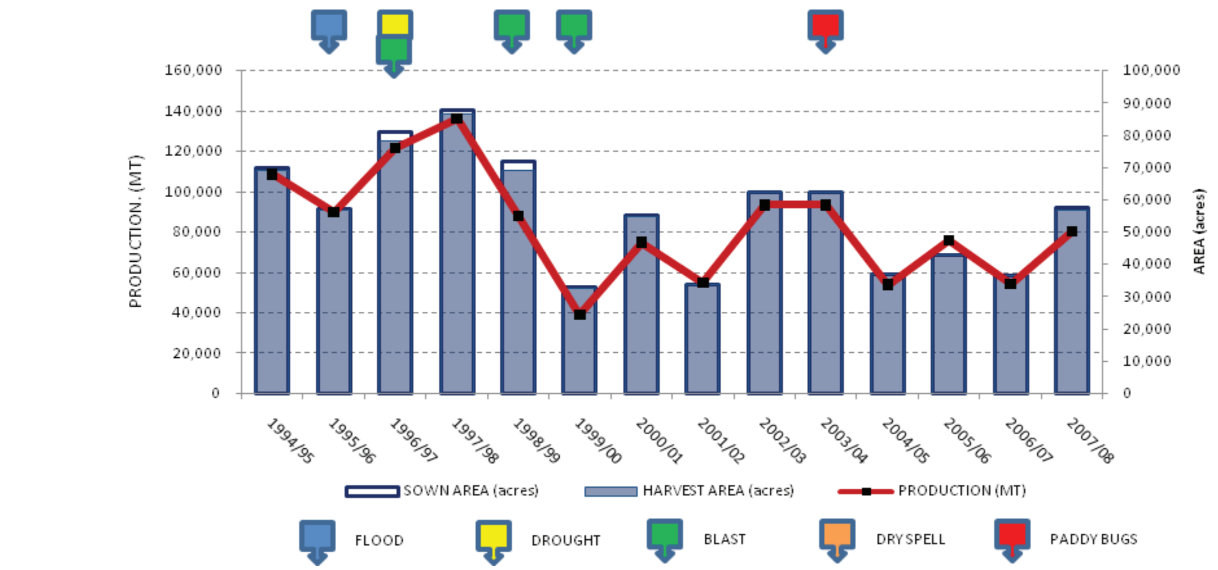


Figure B.16. Region 5. Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

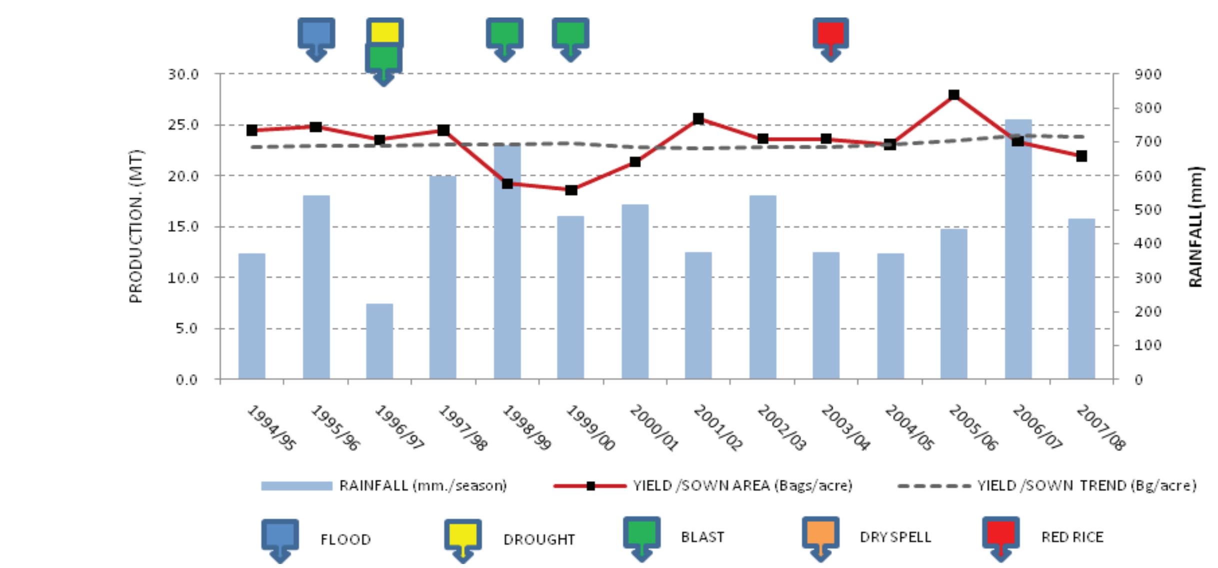


Figure B.17. Region 6. Spring Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

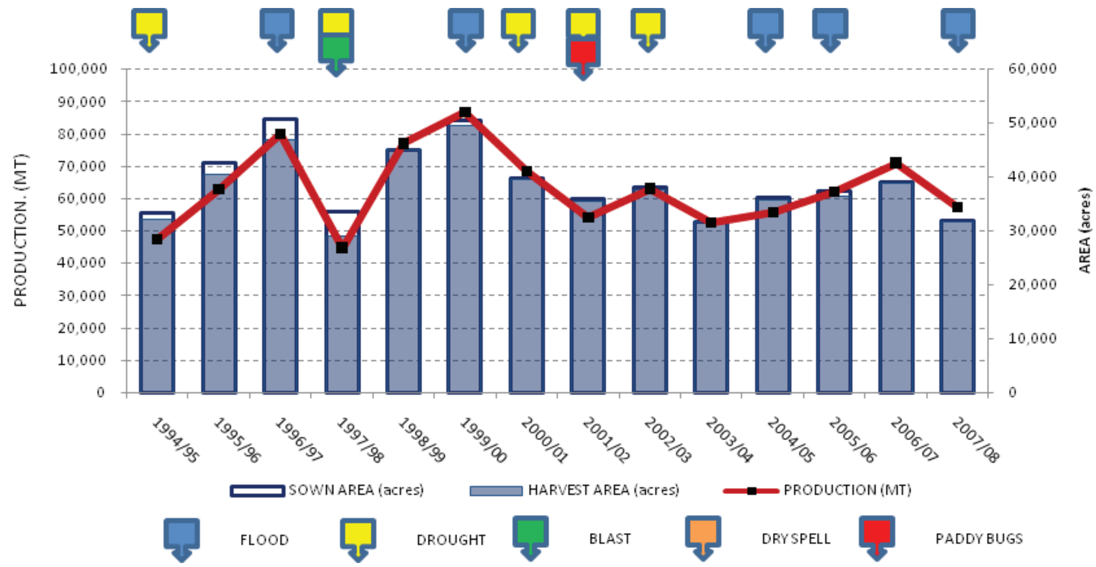


Figure B.18. Region 6. Spring Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall

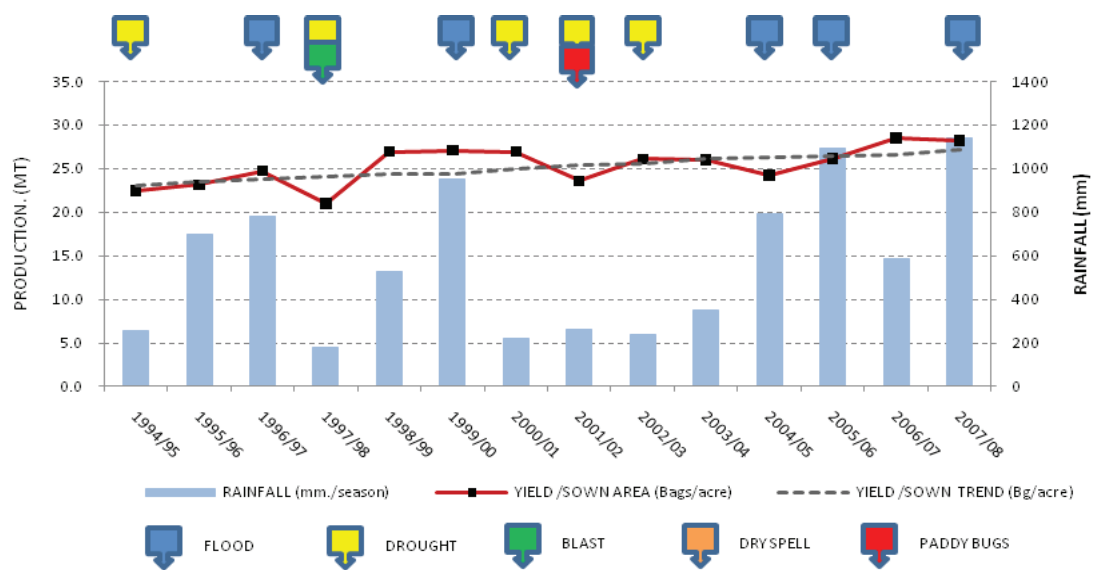


Figure B.19. Region 6. Autumn Crop Season. Historic Sown and Harvested Area and Production (and Main Events Affecting Crops)

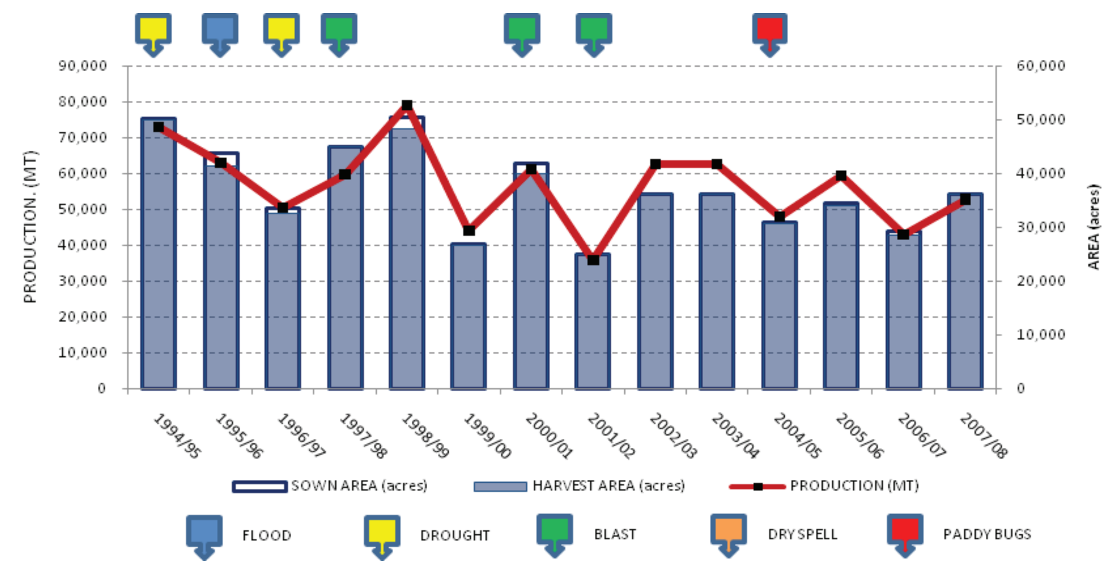
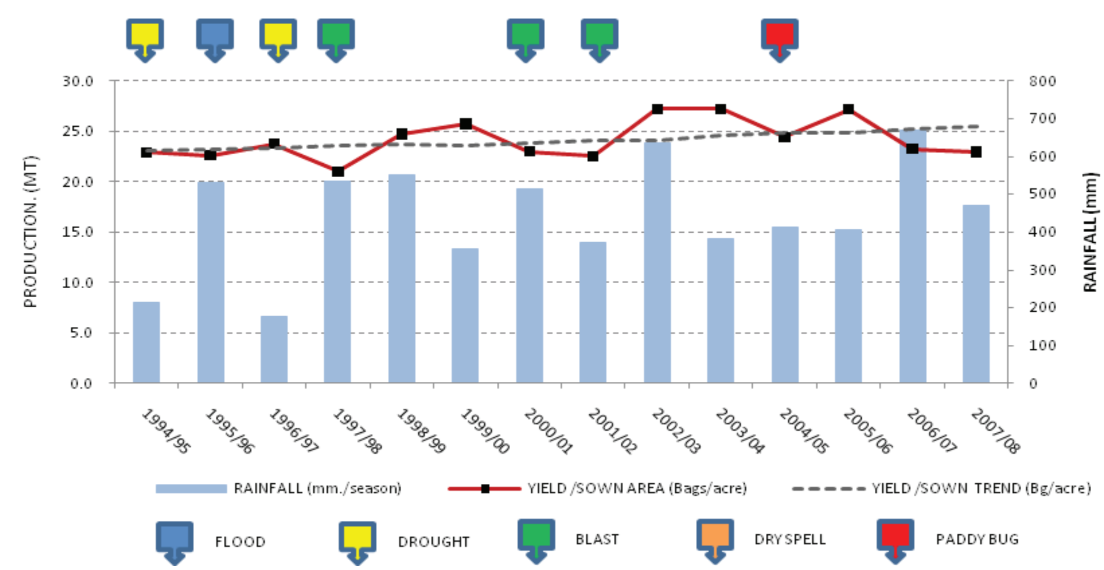


Figure B.20. Region 6. Autumn Crop Season. Historic Annual Average Paddy Yields and Seasonal Rainfall



Annex 4. Crop Weather Risk Assessment

1. **This Annex provides an initial assessment to identify options regarding weather index insurance introduction as a risk management mechanism to support farmers in better handling weather risks.** The Annex describes the pre-requisites for weather index insurance implementation; the findings obtained from the evaluation of weather data captured by the current weather station network that is managed by the Ministry of Agriculture; and the risk assessment[58] conducted for rice and non-traditional crops in the coastal plain. The analysis undertaken was based on information collected from HYDROMET databases, existing studies, as well as farmer focus groups. Finally, the Annex concludes with comments about the suitability of weather index insurance for individual farmers in Guyana.

Data Availability for Crop Weather Index Insurance

2. **Updated historical weather information is a precondition to assess the possibility of designing and implementing crop index insurance contracts.** The Hydrometeorological Service (HYDROMET), attached to the Ministry of Agriculture, monitors and provides official information on weather, water, climate and related products for Guyana. Data collected by weather stations observers in about 72 locations out of 147 is transmitted daily to the HYDROMET head office between 8 and 9 a.m.[59]. Daily data is digitized on excel worksheets and then entered to the CLICOM rainfall storage system; however, digitizing and storage activities are usually interrupted due to staff shortages or to technical problems with the system. Due to a malfunction in the system last December of 2009, subsequent difficulty has been experienced in updating weather information in the electronic databases for the majority of active weather stations that comprise the national station network, affecting the estimates related to existing missing values.

3. **The existence of a catalogue of weather stations is another key prerequisite for the development of weather index contracts.** Knowing the proximity of active instruments to crop field areas is crucial in order to assess whether or not index-based agricultural insurance products are a suitable option to transfer agricultural risks in Guyana. Index-based insurance contracts could be adopted if there are similar climatic conditions between the point at which the parameter is measured and the crop fields for which policy contracts would be issued; and if there is a correlation between the weather parameter and crop production and yields. The spatial and temporal variability of a weather parameter will define the area of influence of a weather station and the crop area that could be submitted under specific policy contract conditions. The initial data assessment suggests the need to have an updated clean catalogue for both active and inactive weather stations on which information related to data availability (e.g. percentage of data on digitized and hard copy formats), types of weather stations, names and codes, location, mean of data transmission, and **missing values, could be checked by insurers, reinsurers and others.**

4. **Agreements between the Hydro-meteorological Service and other government institutions (e.g. GuySuCo, NARI, the Guyana Forestry Commission) are used to relay some operational and maintenance activities of weather stations.** The weather data that is collected by other institutions seems to be transmitted fluently and efficiently; however, during a field inspection of 6 manual rain-gauges and weather stations (1 out of the 6 weather stations visited is operated by GuySuCo), the team observed that there is a large degree of heterogeneity in terms of types of instruments, level of maintenance and security conditions between them (see Figure 4.1). Instrument calibration should be a priority to reduce possible data systematic errors that could negatively affect risk analysis and quantification. The comparison and correlation between data collected from weather stations with different instruments was not analyzed; however, conducting such a study and the investment on strengthening HYDROMET's capacity

58 The authors suggest the reader to revise the content of other annexes which explain in more detail the interrelation between the influence of climate and the drainage and irrigation infrastructure on rice cropping patterns.

59 Rainfall is the most transmitted and collected parameter on a daily basis by the Hydrometeorological Service.

Figure 4.1. Field Inspection of Six Manual Rain-gauges: a) No. 63 Village, b) Anna Regina, c) Uitvlugt Back and d) MARDS.

should be considered in order to provide confidence on data quality to the stakeholders that are interested in promoting weather index insurance contracts in the country. Quality of weather data is the most critical piece of information dictating technical feasibility for index-based insurance. It is essential for constructing the index, ensuring accurate rating and risk transfer, and for minimizing basis risk[60].

5. **The availability of historical weather data is needed to analyze and quantify the risk, and to determine if there is a relationship between the variable that is measured by a weather station and the crop production obtained on a covered area.** Based on the digitized historical information obtained from 32 out of 147 stations, 6 stations have been collecting information since the 1940's, 6 since the 1960's, 18 since the 1970's; and 2 since the 1990's; but there is a major issue of missing daily rainfall data values and, therefore, just a very limited number of weather stations (4 out of 32) comply with index insurance data requirements in terms of missing values (see Table 4.1). Currently, the very low number of usable weather stations is a major constraint to the development of weather index insurance in Guyana and a great deal of work will need to be done to reconstruct, clean and make use of the available data sets.

6. **The development of weather index insurance requires a weather station network with good spatial coverage. Areas without access to weather data or areas with poor spatial coverage may limit the chances to design weather risk management products.** However, a further analysis based on data reconstruction with nearby stations or synthetic data should be considered in the near future in order to conduct analyses regarding risks identification and quantification, to establish whether it is possible to make the available data sets usable, and to augment the number of usable weather stations, thereby increasing the areas that could potentially be covered by insurance policies.

7. **The development of weather index insurance products requires meeting some preconditions in terms of weather data quality.** Typically, weather insurance market agents request the following list of items to offer weather index insurance: (i) historic weather data covering between 20 and 25 years which includes extreme risks; (ii) uninterrupted daily data (no more than 5 – 5.5% of missing values) for index design and rating purposes – in some cases discontinuities can introduce artificial trends to the data, or impact the variance or the average value of readings; (iii) data integrity; (iv) availability of a nearby station for a "buddy check" or for a backup during the contracts' operation; (v) reliable settlement mechanism; (vi) integrity of the recording procedure; and (vii) little potential for measurement tampering.

60 Basis risk refers to the variance around the loss as reflected in the index versus the individual loss. Indexes will rarely perfectly match individual losses. Basis risk increases as the geographical area covered by the index widens.

Table 4.1. Estimated Daily Rainfall Missing Values of 32 Weather Stations in Regions 2, 3, 4, 5 and 6

ID	WS ID	Station Name	Adm. Region	Long	Lat	Missing Values (%)_Rainfall
1	02ANNREG	ANNA REGINA	II	58.47	7.25	19.00%
2	02CAPOEY	CAPOEY COMPOUND	II	58.48	7.20	28.40%
3	02CHARTY	CHARITY POMEROON	II	58.58	7.38	15.71%
4	02MCNABB	*MC NABB BACK*	II	58.55	7.33	5.15%
5	02ODENMG	*ONDERNEEMING ESSEQUIBO*	II	58.47	7.10	5.17%
6	02PICKGL	PICKERSGILL POMEROON	II	58.72	7.25	38.41%
7	03BAGLEG	La BAGATELLE LEGUAN	III	58.40	6.90	7.43%
8	03BELVBK	BELLE VUE BACK W B D	III	58.22	6.72	30.01%
9	03BELVFR	BELLE VUE FRONT W B D	III	58.20	6.72	53.12%
10	03BOERAS	BOERASIRIE W.C.D	III	58.35	6.82	11.60%
11	03DEKENB	DE.KINDEREN BACK W.C.D	III	58.32	6.83	11.32%
12	03DEKENF	DE KINDEREN FRONT W.C.D	III	58.33	6.87	13.79%
13	03LNORAB	LEONORA BACK.W.C.D	III	58.28	6.78	11.04%
14	03LNORAF	*LEONORA FRONT.W.C.D*	III	58.28	6.87	3.83%
15	03REYSNB	REYNESTEIN BACK W.B.D	III	58.22	6.63	38.68%
16	03TUSENF	TUSCHEN FRONT W.C.D	III	58.35	5.87	27.79%
17	03UIVLBK	UITVLUGT BACK.W.C.D	III	58.32	6.80	8.49%
18	03UIVLFR	UITVLUGT FRONT W C D	III	58.30	6.87	67.51%
19	03WAKNAM	SANS SOUCI WAKENAAM ESEQ	III	58.47	6.95	21.79%
20	03WALESF	WALES FRONT W.B.D	III	58.20	6.70	17.48%
21	04CGROVB	CANE GROVE BACK E C D	IV	57.88	6.62	15.93%
22	04CGROVF	CANE GROVE FRONT E.C.D	IV	57.92	6.62	6.07%
23	05MABRDS	M/CONY. ABARY RICE DEV.S	V	57.75	6.45	30.72%
24	05MCHYRW	MAHAICONY	V	57.78	6.57	18.71%
25	06ALBIFR	ALBION FRONT	VI	57.37	6.25	11.73%
26	06CRBCRK	CRABWOOD CREEK	VI	57.15	5.83	17.42%
27	06MRALDS	MARA LAND DEV. SCHEME	VI	57.60	6.02	28.78%
28	06NATIII	NEW AMSTERDAM TECN INS	VI	57.52	6.23	11.57%
29	06NO54VL	NO 54 VILLAGE BERBICE	VI	57.17	6.02	10.22%
30	06NO73VL	*NO 73 VILLAGE*	VI	57.13	5.92	3.96%
31	06ROSALF	ROSE HALL FRONT	VI	57.48	6.23	24.17%
32	06SKELDF	SKELDON FRONT	VI	57.13	5.87	11.19%

Crop Weather Risk Assessment (Rice, Fruit and Vegetables)

8. **Main rice-growing areas (Region 2, 3, 4, 5 and 6) produce two crops of rice annually.** The first crop season is planted around November and December; meanwhile the second crop season takes place around June and July. Around 8 newly released blast-resistant and high-yielding rice varieties contribute to over 74% of commercial cultivation (Table 4.2); meanwhile, 25% of the rice commercial crop area is covered by 2 rice varieties which were released between 1976 and 1982. The rice-growing cycle of all planted varieties in Guyana takes approximately 120-130 days from seed germination to harvest.

9. **Rice water requirements vary depending on the total growth stages and on the local climatic conditions.** Evapotranspiration starts to increase at the vegetative stage and it reaches the highest level just before the reproductive growth stage. Depending on the variety and crop growing system, growth crop to flood of 5-7.5 cm is generally maintained until around 85 to 90 days after seeding. Water level at rice fields is completely drained for the application of fertilizers, post-emergence herbicides and for harvesting activity. As it was noted on the rice risk assessment section, to reach rice water requirements and to achieve success on water drainage at crop vulnerable stages during agronomic practices, or when there is excess of water during any of the crop seasons, rice production relies

Table 4.2. Main Rice Seed Varieties Planted in Guyana

Id	Rice Varieties	Grain Yield (Bags/acre)	Released (Years)	Percentage of Commercial Cultivation
1	Rustic	29	1976	23%
2	Diwani	33	1982	2%
3	F7-10	30	1997	74%
4	BR 240	28	1997	
5	BR 444	32	1997	
6	G98-22-4	38	2001	
7	G98-24-1	35	2001	
8	G98-30-3	35	2001	
9	G98-196	35	2001	
10	G98-135	35	2005	

Source: GRDB.

on a complex and outdated drainage and irrigation system which requires constant rehabilitation work.

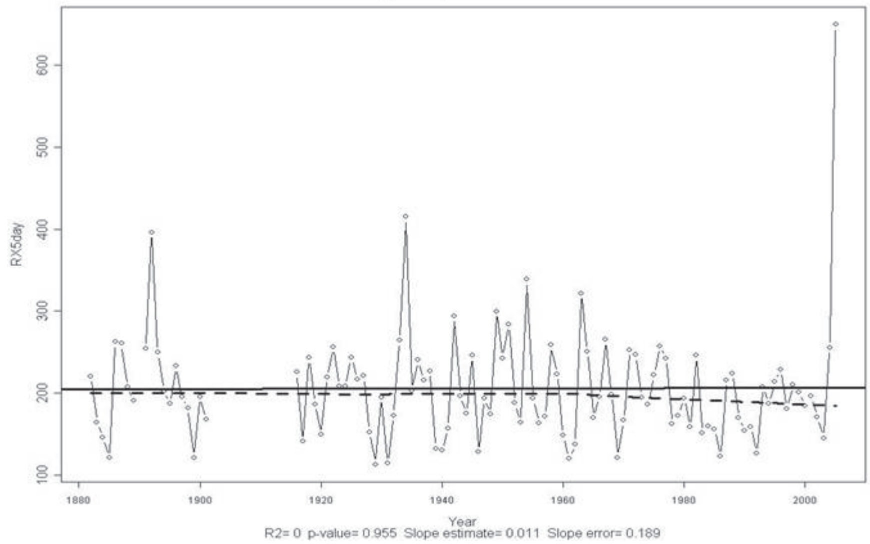
10. **The relationship between weather and crop production obtained from irrigated fields is complex.** There is a complex system of lakes and reservoirs linked by canals and ditches which irrigate about 80% of the paddy fields. The water supply is derived from water conservancies in Regions 2, 3, 4 and 5, and from the rivers, through pumping, in Region 6. Very few control structures exist along the main canals and distributor canals. Flows in the secondary canals are controlled by head gates and farmers access water from secondary canals normally by gravity. The system uses a series of sluice gates along the sea walls to allow the outflow of fresh water during low tide and to block the inflow of salt water during the high tide. The total length of the irrigation canals in Guyana is 485 km of main canals and 1,100 km of secondary canals (see *Agricultural Production Systems in Guyana*).

11. **Findings indicate that there is a weak correlation between cumulative annual rainfall and seasonal rainfall with rice yield production.** When there are extreme rainfall events, "rigid artificial periods" in which weather parameters are measured at the specific weather station during the effective date of the weather contract[61] should be considered, as it could misread the magnitude or intensity of a specific event over a pool of weather stations. For example, an index contract, which is purchased by a rice farmer that wants to be covered against excess of rainfall, is divided in four phases, each corresponding to one month; then, during the growing cycle an hypothetical 5-day "extreme rainfall event" occurs, but 2 days of that event are captured on phase 2 and the other 3 on phase 3. Although the example of 5-day intense rainfall could exceed occurrence probability of an "X" amount with respect to the same average cumulative values (5-day rainfall), by splitting the extreme event into two, the cumulative rainfall obtained on any of the phases could not surpass normal deviation conditions by much. On the other hand, it can also be seen that, as rainfall is characterized by high spatial and temporal variability, cumulative rainfall during long periods of time (i.e. three months) does not differentiate between rainfall that is well distributed over the growing season versus rainfall in a growing season that has long dry periods of days followed by one or five days of torrential rainfall. Consequently, the index insurance contract designed to cover high deviations in rainfall over seasonal periods may not capture the agricultural risk faithfully. *Although it could be technically feasible to design an excess rainfall index for shorter cumulative days (pentads or 10-day periods), contract implementation would require a higher density of active weather stations in order to be capable of capturing the event on rice fields.*

12. **Extreme rainfall events have been associated to crop losses and failures in the past.** The major excess rainfall event ever recorded in history occurred in 2005. In the period between January 14th and January 22nd, unusual wet conditions (1,108.2 mm) across the country greatly exceeded the average rainfall data recorded since 1888 and also exceeded around 6 times the average rainfall for the same period in the last 30 years (UNDP/ECLAC, 2005). As a result of this event, and its combination with malfunctioning drainage structures and high tides, prolonged flooding occurred in Regions 3, 4 and 5. Months later (between December 2005 and February 2006), another major flood affected Region 2 and Region 5 and, with less magnitude, Regions

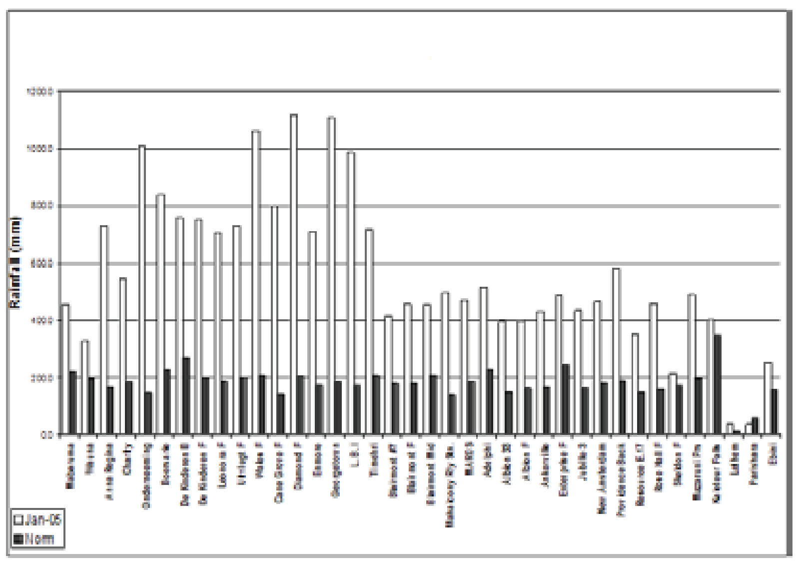
61 The effective date is defined as the period over which the weather risks are monitored and the underlying index is calculated.

Figure 4.2. Cumulative 5-day Rainfall in Georgetown (1882-2005)



Source: HYDROMET.

Figure 4.3. Cumulative Rainfall for Selected Weather Stations and their Normal Rainfall Values



Source: HYDROMET.

1, 3 and 4. Recorded losses in the rice industry were around G$1.9 billion for a total of 27,583 acres planted by approximately 1,118 farmers[62]. Interestingly, farmers in Region 2 reported that the 2006 flooding was mostly due to poor drainage maintenance. Figures 4.2 and 4.3 show the cumulative 5-day rainfall measurements at the Georgetown Botanical Gardens and the comparison between the rainfalls registered on January 2005 and their normal values for selected stations. Regarding non-traditional crops, losses during the same flooding event, amounted to about G$1.7 billion in around 5,107 acres[63]. Concerning the livestock sector, major losses

62 UNDP/ECLAC, 2005.

63 According to the ECLAC report, the non-traditional crops that were most affected were bananas, plantains, root crops, legumes, vegetables and fruits.

were recorded in Region 5 where a total of 103,519 animals were lost, including 8,491 head of cattle, 4,678 sheep, 3,770 goats, 601 pigs, 87,131 birds (poultry) and 148 horses. Other crops, especially for domestic use, also suffered badly, with some parts of the Pomeroon and Mahaica-Mahaicony-Abary areas suffering total losses and real production expected to decline by 4% as a result. The livestock sector was expected to decline by 1.3% in real GDP. The sugar sub-sector escaped most of the damage. Due to the flood, the contribution to the GDP in 2005 dipped from 36% to 30% of agricultural GDP, underscoring the major impact on agriculture. A survey performed by Doodnauth, P. (2004) and Bynoe & Bynoe (2000) among vegetable farmers in Leguan revealed that they suffer significant losses during the annual episodes of flooding on the island, with 48% of farmers indicating that they have suffered from total losses at one point or another.

13. **Non-traditional crops production is highly diversified in terms of cropping calendars and planting areas.** The non-traditional[64] agricultural sub-sector includes about 39 crops which are grown intensively throughout the year, usually in a mixed cropping system, and for commercial and consumption purposes. Although almost all the crops are grown along the coastal belts and in the riverain areas, production is geographically distributed across the 10 regions. Except for coconut palm farmers, this sector comprises a large number of small farmers who use a low level of technology and tend to stick to traditional agricultural practices.

14. **Differences on crops vegetative structures, phenology length, weather requirements for their proper cultivation, harvest periods, and others, complicate the understanding of risk impacts on non-traditional crops production.** Annual crops, which are characterized by having short crop cycles, could be harvested between six weeks to two months after planting. Cultivating these types of crops is very risky since the harvesting period is very short and they are mostly unable to tolerate flooding or drought conditions. Additionally, vegetable crops often have to be supported by sticks as the plants are unable to bear the weight of the vegetables. Therefore, intense rainfall, even without causing floods, still damages the crops to various degrees. Since this activity is not undertaken on a large scale, it is often difficult to adequately implement improvements (e.g. raising the level of the planting beds to reduce the impacts of events such as flooding). Farmers often try to time planting and harvesting of their vegetables to avoid the peak of the rainy season to minimize losses. However, because vegetable prices during the rainy season are significantly higher than at other times, farmers are lured into planting during this period anyway. As such, they are often willing to take the risk of dealing with incidences of crop damage due to flooding, excess humidity or pests and diseases outbreaks, in order to receive more money for their produce.

15. **Crops diversification helps farmers to face the risk from bad weather.** Some crops (i.e. cassava) are more drought resistant than others (i.e. vegetables), as there are crops that are more tolerant to excess of water (i.e. rice) than others (i.e. vegetables), so farmers usually grow a broad portfolio of products in order to reduce the likelihood of suffering complete crop losses and yield reductions when dealing with unfavorable weather conditions. A similar position is taken by farmers to manage price risks, given the expectation that not all products will suffer low prices at the same time. However, small commercial farmers (i.e. tomato growers) are often tempted to plant more area or to do so out of the proper planting windows, for those products that command high prices, causing overproduction and, consequently, a collapse on the future market price.

16. **Extension services and research for non-traditional sub-sectors are sporadic or do not exist at all.** The current limited funding related to technical assistance and extension services for non-traditional farmers is very restricted and it is dispersed over a wide range of crops in diverse geographical zones. On the other hand, and given that these sub-sectors are not structured along the lines of rice and sugar, the incentive packages and specific programs for some components of the industry are trivial.

64 The non-traditional crops include: (i) Cereals and Legumes: corn, blackeye, minica; (ii) Oilseeds: peanut and coconut; (iii) Ground Provisions: cassava, sweet potatoes, eddoes, yam, tania/dasheen, plantains; (iv) Vegetables and greens: tomatoes, cabbage, pumpkin, bora, ochro, boulanger, cucumber; (v) Herbs, spices and seasonings: eschallot, hot pepper, ginger, turmeric; (vi) Fruits: banana, pineapple, pear, carambola and watermelon; (vii) Other fruits: mangoes, genip, cherry, awara; (viii) Citrus: lime, grapefruit, orange; and (ix) Other crops: coffee, cocoa, and cotton; pasture/forage, ornamentals and floriculture.

17. Non-traditional crop yields fluctuate drastically. Given that the production of non-traditional crops is not guided by market intelligence services, non-traditional crops production ranges from gluts to scarcity. Due to the poor organization among farmers at the local and national levels, and that the support given by the Government is still on its infancy, there is not enough information related to existing acreages, costs of production, seasonality, and crop losses, which is needed for planning, lending and risks assessment.

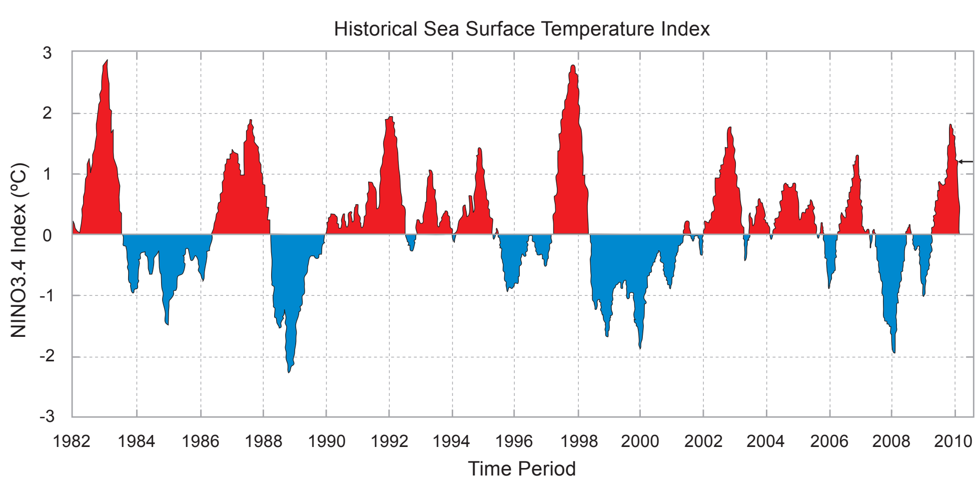
18. The current drainage and irrigation infrastructure is not adequate for non-traditional crops production. The historical design of the drainage and irrigation system was conceived based on rice and sugar requirements, but not for non-traditional crop production, and not even for livestock production; therefore, necessary modifications to the land infrastructure need to be made in order to improve crops yields and efficiency when there are extreme weather conditions.

19. The ENSO phenomenon hits non-traditional crop activities in Guyana. According with the Climate Prediction Center, from 1972 to 2010 drought conditions due to the *El Niño* phenomenon were registered in 1972, 1982, 1986/1987, 1991-1994, 1997/1998, 2002/2003, and, most recently, in 2009/2010, affecting the agricultural sector. Extreme dry periods experienced by small farmers in 1998 forced them to limit their crop planting area and to use potable water to irrigate their crops in order to reduce crops losses. Besides shortages of drinking water, the lack of rain experienced during 1998 also reduced food supplies, as crops and livestock suffered due to a high increase of salinity levels in agricultural areas. In order to cope with the crisis, the GoG requested regional and international assistance and, through the Civil Defense Commission and the Guyana Defense Forces, distributed some food supplies, agricultural inputs (seeds and tools) and portable water pumps to the affected population in all regions of the country. Then again, from October 2009 through the first quarter of 2010, the GoG has imposed water restrictions due to limited rainfall. Initial estimates of agricultural losses could be around US$14.7 million; by February 15th, the MoA informed that 10,000 acres of rice land, livestock and other crops had been already affected. In order to minimize losses, the government is trying to provide water where it is needed. Around US$1.2 million has been allocated in infrastructure work to develop a system to respond and provide the type of assistance that is needed by farmers. The Guyana Sugar Corporation (GuySuCo) has mentioned that the 2009/2010 *El Niño* is very similar to the 1997/1998 *El Niño* (Figure 4.4), where water from the East and West Demerara conservancies could only be obtained by the use of pumps, and saline water moved very far upstream.

Conclusions

20. The historical weather information obtained from the Hydrometeorological Service suggests the need to work on data reconstruction

Figure 4.4. The 1997-98 *El Niño* Event was the strongest *El Niño* ever (1982 to 2010)



and institutional strengthening due to the high presence of missing values on historical data sets that limit the number of weather stations needed to conduct a weather risks assessment, and issues related to data collection, storage and transmission to end users.

21. **HYDROMET staffing and infrastructure should be improved to meet the information requirements for developing a weather index insurance product.** With adequate computer systems and staff, HYDROMET should be able, not only to reduce the time it currently takes to share weather data and related services with external users, but also to generate new products according to stakeholders demand.

22. **Irrigated crop areas are not suited for crop weather index insurance.** Historical rainfall data and crop production is used to evaluate the impact and frequency of drought or excessive rainfall. However, when there is an irrigation system that supplies crop water requirements, the risk of losing crop production is considerably reduced, and so is the correlation between the index and crop losses.

23. **Crop weather index insurance works when the policyholder is not interested in changing his behavior to increase the likelihood of receiving a payment.** Given that there are many factors that seem to influence rice crop production such as: (i) the existing drainage and irrigation system and the heterogeneity of its physical condition within the regions; (ii) the increased frequency and severity of rainfall events that surpass current drainage capacity to accommodate excess water run-off; and (iii) flood management issues, a preliminary conclusion from this initial analysis is that it is not possible to design a crop weather index insurance for individual contracts given the high levels of basis risk.

24. **Flooding is a very challenging risk to be addressed for crop weather index insurance.** The damage caused by flooding to individual farmers is extremely difficult to model, even though rainfall measurement in weather stations and/or stream flow gauges could be used as a proxy for major flood events and provide protection at the macro-level layer. Although such estimations could be used for the design of an index that triggers payments due to excess rainfall (that causes flooding), this should be, however, part of a broader risk management plant. Apart from purchasing a risk management contract against flooding, the GoG could also invest in improving the current drainage and irrigation system.

25. **Nowadays, there is not enough information regarding non-traditional crops lending, planting calendars, cultivated areas, risk exposure and crops vulnerability to develop crop weather index insurance in the near future.** In addition, mixed cropping systems complicate the possibility to properly assess risks for crops that have different phenological stages, differ in terms of nutrient or water requirements, or behave differently regarding weather conditions.

Annex 5. Fruit and Vegetables Crop Risk Assessment

1. **The Guyana Marketing Corporation (GMC), which falls under the Ministry of Agriculture (MoA), is responsible for promoting the increased production and export of fruit and vegetables by farmers in Regions 2 to 6.** In 2008, Guyana exported 7,116 tons of agricultural produce to CARICOM[65]. Key exports include boulanger (eggplant), cabbage, tomatoes, bora (bodi bean), ochro, saeme, squash, coilla and cucumber. Other ADP targeted export crops include peppers, plantains, pumpkins and pineapples.

2. **As part of the effort to boost local production and exports of non-traditional fruit and vegetables, on March 29, 2009, the government launched a "Grow More Food" campaign.** This project is being implemented by the GMC and involves a large program to distribute, at no cost, seeds, fertilizer, chemicals, farming tools and agricultural inputs to commercial and household farmers. The GMC reports that over 100,000 packets of seeds for 16 varieties of crops have been distributed to small-scale farmers and kitchen gardeners under this program[66].

3. **In 2010, the GMC is in the process of forming a marketing database with the goal of registering fruit and vegetable producers, as well as their production and sales of fresh fruit and vegetables.** According to the GMC, the database is currently being built and therefore, at present, figures on the number of farmers producing key export fruit and vegetables, and their regional distribution and crop acreage is not available. The GMC estimates that in 2010 there are 7,515 farmers in Regions 2 to 6, with the highest proportion (34%) located in Region 5 (Table 5.1).

4. **The GMC has established an internet and mobile phone-based market price intelligence service for fruit and vegetable farmers.** Farmers can download daily wholesale market price information for agricultural produce in the main markets. The GMC has also invested in new packing facilities at Parika (East Bank, Essequibo) which is designed to service the large volumes of production from Regions 1, 2 and 3, rather than having to transport these to its other main packing facility at Sophia in Georgetown. Improved food certification and quality control and packaging are preconditions for Guyana if it is to increase its production and exports to CARICOM countries.

Table 5.1. Number of Fruit and Vegetables Farmers by Region

Region	Number of Farms	% of Farmers by Region	Average Farm Size per Region (acres)
2	960	13%	8
3	1,200	16%	15
4	1,300	17%	7
5	2,535	34%	5
6	1,520	20%	5
Total	**7,515**	**100%**	

Source: Guyana Marketing Corporation (2010).

5. **The GMC does not maintain a database of historical damage in fruit and vegetables and, therefore, it has not been possible to conduct a formal risk assessment for this sector.** Some limited information is reported in Table 5.2 and Figure 5.1 for the major flood damage incurred in non-traditional other crops (including fruit and vegetables) in 2005.

6. **Appendices 5A to 5C report 2008 data from the National Bureau of Statistics on the cultivated area (hectares), total production (metric tons) and average yields (MT/ha) for the main fruit and vegetable crops grown in Guyana by Region (2 to 6).** This data suggests that Region 2 is the most important for fruit and vegetable production in Guyana and should be treated with caution.

65 GMC, 2008. Agro Marketer: Confronting Challenges of Global Food Crisis, Vol. 1, Issue 4, February 28, 2009.

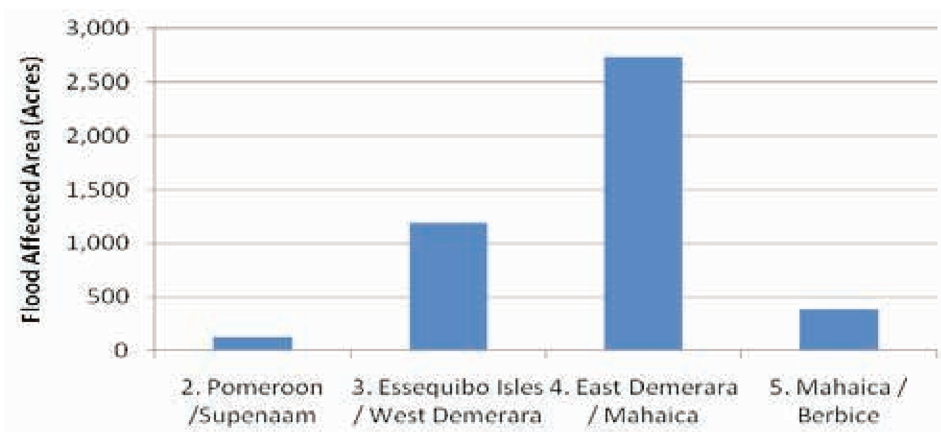
66 GMC ibid.

Table 5.2. January 2005 Flood Damage in Other Crops (Fruit and Vegetables)

Region	Acreage Affected	% of Damaged Area	Direct Losses (G$)	Indirect Losses (G$)	Total Losses (G$)	Loss/affected Area (G$/acre)	% Total Losses
2	124	3%	159,811,000	11,447,785	171,258,785	1,376,568	3%
3	1,189	27%	1,598,412,000	118,644,615	1,717,056,615	1,444,300	29%
4	2,740	62%	3,337,318,000	144,245,371	3,481,563,371	1,270,852	58%
5	388	9%	584,694,000	23,539,365	608,233,365	1,566,602	10%
Total	**4,441**	**100%**	**5,680,235,000**	**297,877,136**	**5,978,112,136**	**1,346,100**	**100%**

Source: UN/ECLAC (2005).

Figure 5.1. January 2005 Flood Affected Area of Other Crops (Fruit and Vegetables) by Region



Source: UN/ECLAC (2005).

Appendix A

2008 Cultivated Area of Non-traditional Crops "Other Crops" (hectares)

CROPS	UNITS	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	TOTAL
Cereals and legumes							
Corn	HECTARES	14	12	5	4	1	**36**
Black eye	HECTARES	3			3	3	**8**
Minica	HECTARES	252		2	4	3	**260**
Other Legumes	HECTARES	1				1	**2**
Oil Seeds							
Peanuts	HECTARES						**0**
Coconuts	HECTARES	7,330	71	80	2,170	791	**10,442**
Ground Provision							
Cassava (bitter)	HECTARES	185		20	8	5	**218**
Cassava (sweet)	HECTARES	169	73	56	12	7	**317**
Sweet Potato	HECTARES	4	47	21	9	3	**84**
Eddo	HECTARES	36	64	35	10	7	**152**
Yam	HECTARES	0	6				**6**
Tannia/Dasheen	HECTARES	0					**0**
Plantain	HECTARES	72	79	16	30	40	**237**
Vegetables							
Tomato	HECTARES	1	40	9	45	44	**138**
Cabbage	HECTARES	2	46	11	18	10	**86**
Pumpkin	HECTARES	20	60	12	15	8	**115**
Bora	HECTARES	5	38	82	42	46	**214**
Ochro	HECTARES	7	46	28	37	35	**152**
Boulanger	HECTARES	12	40	21	30	36	**138**
Squash	HECTARES	1	37	15	25	19	**97**
Cucumber	HECTARES	5	0	13	21	16	**55**
All Other Vegetables	HECTARES	7	142	72	57	27	304
Spices & Seasoning							
Eschallot	HECTARES	2	30	12	35	15	**94**
Hot Pepper	HECTARES	7	37	24	38	43	**148**
Ginger	HECTARES						**0**
Tumeric	HECTARES						
Other Spices	HECTARES	2	60	21	75	62	**219**
Citrus							
Lime	HECTARES	25	30	14	16	28	**113**
Grapefruit	HECTARES		10	8		4	**22**
Orange	HECTARES	255	53	29		9	**346**
Other Citrus	HECTARES	18	14	8		2	**42**
Fruits							
Banana	HECTARES	368	74	31	32	43	**548**
Pineapple	HECTARES	46	42	10			**99**
Avacado (Pear)	HECTARES	39	6	4	3	5	**57**
Sapodilla	HECTARES	1	1		13	12	**27**
Carambola	HECTARES	27	16	6	11	8	**69**
Watermelon	HECTARES	10	26	6	41	3	**87**
Cashew	HECTARES		2		3	4	**8**
Mango	HECTARES	41	26	14	26	25	**132**
All Other fruits	HECTARES	35	136	93	74	75	414
Coffee	HECTARES	134					**134**
Cocoa	HECTARES						**0**
Total by Region	HECTARES	**9,136**	**1,364**	**778**	**2,906**	**1,438**	**15,622**
Total excluding Coconuts	HECTARES	**1,806**	**1,293**	**698**	**736**	**647**	**5,180**

Source: National Bureau of Statistics (2009).

Appendix B

2008 Production of Non-traditional Crops "Other Crops" (metric tons)

CROPS	UNITS	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	TOTAL
Cereals and legumes							
Corn	**MT**	291	104	46	36	12	**489**
Black eye	**MT**	20	0	0	6	5	**32**
Minica	**MT**	285	0	3	7	6	**301**
Other Legumes	**MT**	8	0	0	0	2	**10**
Oil Seeds							
Peanuts	**MT**	0	0	0	0	0	**0**
Coconuts	**000 NUTS**	49,975	355	399	10,850	3,955	**65,534**
Ground Provision							
Cassava (bitter)	**MT**	3,076	0	342	136	85	**3,638**
Cassava (sweet)	**MT**	2,822	1,234	955	204	119	**5,334**
Sweet Potato	**MT**	37	480	217	92	31	**858**
Eddo	**MT**	490	870	481	139	94	**2,075**
Yam	**MT**	28	82	0	0	0	**109**
Tannia/Dasheen	**MT**	55	0	0	0	0	**55**
Plantain	**MT**	1,156	1,078	212	408	544	**3,399**
Vegetables							
Tomato	**MT**	15	500	109	563	546	**1,733**
Cabbage	**MT**	35	780	184	298	174	**1,471**
Pumpkin	**MT**	275	816	162	204	103	**1,560**
Bora	**MT**	95	691	1,476	756	833	**3,850**
Ochro	**MT**	111	785	468	629	587	**2,579**
Boulanger	**MT**	111	356	188	270	322	**1,246**
Squash	**MT**	19	754	312	513	390	**1,987**
Cucumber	**MT**	84	580	241	378	293	**1,575**
All Other Vegetables	**MT**	62	945	422	504	215	**2,148**
Spices & Seasoning							
Eschallot	**MT**	33	173	66	158	69	**497**
Hot Pepper	**MT**	78	416	277	433	485	**1,688**
Ginger	**MT**	0	0	0	0	0	**0**
Tumeric	**MT**	0	0	0	0	0	
Other Spices	**MT**	7	396	125	496	438	**1,462**
Citrus							
Lime	**MT**	285	343	161	182	319	**1,290**
Grapefruit	**MT**	0	119	91	0	23	**233**
Orange	**MT**	2,963	606	329	0	103	**4,002**
Other Citrus	**MT**	205	162	90	0	11	**468**
Fruits							
Banana	**MT**	4,955	1,012	415	435	585	**7,402**
Pineapple	**MT**	789	714	172	0	0	**1,675**
Avacado (Pear)	**MT**	735	35	22	17	29	**837**
Sapodilla	**MT**	22	5	0	74	68	**169**
Carambola	**MT**	134	93	36	63	64	**391**
Watermelon	**MT**	638	358	82	558	462	**2,097**
Cashew	**MT**	0	9	0	17	20	**46**
Mango	**MT**	816	738	409	533	513	**3,009**
All Other fruits	**MT**	433	1,386	820	467	485	3,591
Coffee	**MT**	590	0	0	0	0	**590**
Cocoa	**MT**	0	0	0	0	0	**0**
Total by Region	**MT**	**71,732**	**16,977**	**9,311**	**19,425**	**11,987**	**129,433**
Total excluding Coconuts	**MT**	**21,757**	**16,622**	**8,912**	**8,575**	**8,032**	**63,899**

Source: National Bureau of Statistics (2009).

Appendix C

2008 Average Yields of Non-traditional Crops "Other Crops" (MT/HA)

CROPS	UNITS	REGION 2	REGION 3	REGION 4	REGION 5	REGION 6	TOTAL
Cereals and legumes							
Corn	MT/HA	20.6	9.0	9.0	9.0	9.0	13.5
Black eye	MT/HA	7.2			2.0	2.0	3.7
Minica	MT/HA	1.1		2.0	2.0	2.0	1.2
Other Legumes	MT/HA	10.1				2.0	5.6
Oil Seeds							
Peanuts	MT/HA						
Coconuts	000 NUTS/HA	6.8	5.0	5.0	5.0	5.0	6.3
Ground Provision							
Cassava (bitter)	MT/HA	16.6		17.0	17.0	17.0	16.7
Cassava (sweet)	MT/HA	16.7	17.0	17.0	17.0	17.0	16.8
Sweet Potato	MT/HA	10.2	10.2	10.2	10.2	10.3	10.2
Eddo	MT/HA	13.6	13.6	13.6	13.6	13.8	13.6
Yam	MT/HA	137.6	13.6				17.6
Tannia/Dasheen	MT/HA	137.6					137.6
Plantain	MT/HA	16.1	13.6	13.6	13.6	13.6	14.3
Vegetables							
Tomato	MT/HA	12.7	12.5	12.5	12.5	12.6	12.5
Cabbage	MT/HA	19.0	17.0	17.0	17.0	17.0	17.0
Pumpkin	MT/HA	13.6	13.6	13.6	13.6	13.6	13.6
Bora	MT/HA	18.0	18.0	18.0	18.0	18.0	18.0
Ochro	MT/HA	17.0	17.0	17.0	17.0	17.0	17.0
Boulanger	MT/HA	9.0	9.0	9.0	9.0	9.0	9.0
Squash	MT/HA	23.2	20.5	20.5	20.5	20.5	20.5
Cucumber	MT/HA	18.0		18.0	18.0	18.0	28.5
All Other Vegetables	MT/HA	9.4	6.7	5.8	8.8	8.1	7.1
Spices & Seasoning							
Eschallot	MT/HA	18.0	5.7	5.7	4.5	4.5	5.3
Hot Pepper	MT/HA	11.4	11.4	11.4	11.4	11.4	11.4
Ginger	MT/HA						
Tumeric	MT/HA						
Other Spices	MT/HA	3.5	6.6	5.9	6.6	7.1	6.7
Citrus							
Lime	MT/HA	11.4	11.4	11.4	11.4	11.4	11.4
Grapefruit	MT/HA		11.4	11.4		5.7	10.4
Orange	MT/HA	11.6	11.4	11.4		11.4	11.6
Other Citrus	MT/HA	11.4	11.4	11.4		5.7	11.1
Fruits							
Banana	MT/HA	13.5	13.6	13.6	13.6	13.6	13.5
Pineapple	MT/HA	17.0	17.0	17.0			17.0
Avacado (Pear)	MT/HA	18.9	5.7	5.7	5.7	5.7	14.7
Sapodilla	MT/HA	18.1	5.7		5.7	5.7	6.3
Carambola	MT/HA	5.0	5.7	5.7	5.7	8.0	5.7
Watermelon	MT/HA	60.9	13.6	13.6	13.6	136.0	24.1
Cashew	MT/HA		5.7		5.7	5.7	5.7
Mango	MT/HA	19.9	28.4	28.4	20.5	20.5	22.7
All Other fruits	MT/HA	12.3	10.2	8.8	6.3	6.5	8.7
Coffee	MT/HA	4.4					4.4
Cocoa	MT/HA						

Source: National Bureau of Statistics (2009).

Annex 6. Livestock (Cattle) Risk Assessment

1. **It has not been possible to conduct a formal risk assessment for the livestock industry in Guyana because (a) no livestock ownership data are available through the DoL, and (b) no livestock mortality data are available for the different classes of livestock and poultry.**

2. Some limited information on Guyana's livestock epidemic disease status for the period between 2005 and the 1st quarter of 2010 is reported in Table 6.1, based on information available from the World Animal Health Organization (OIE) website.

3. Guyana is a member of the OIE and, in accordance with international protocols, is responsible for notifying the OIE of any suspected and confirmed outbreaks of contagious diseases in its national livestock herd and poultry flocks.

4. Guyana enjoys a major comparative advantage over several of its neighbors in that it is officially free of major diseases such as Foot and Mouth Disease (FMD), meaning that there are no restrictions for the country to export livestock.

Table 6.1. Guyana Outbreaks of Contagious Diseases of Livestock and Poultry reported to the OIE, 2005 to 2010

CLASS A Highly Contagious Diseases:	2005 1st	2005 2nd	2006 1st	2006 2nd	2007 1st	2007 2nd	2008 1st	2008 2nd	2009 1st	2009 2nd	2010 1st
FMD	0	0	0	0	0	0	0	0	...	...	...
African Horse sickness	0	0	0	0	0	0	0	0	...	...	...
Bluetongue	0	0	0	0	0	0	0	0	...	...	...
Contagious Bovine Pleuropneumonia	0	0	0	0	0	0	0	0	...	...	...
Classical Swine Fever	0	0	0	0	0	0	0	0	...	...	...
Highly Pathogenic Avian Influenza	0	0	0	0	0	0	0	0	...	...	...
Lumpy Skin Disease	0	0	0	0	0	0	0	0	...	...	...
Newcastle Disease	0	0	0	0	0	0	0	0	...	...	...
Peste des Petis Ruminants	0	0	0	0	0	0	0	0	...	...	...
Rift Valley Fever	0	0	0	0	0	0	0	0	...	...	...
Rinderpest	...	...	0	0	0	0	0	0	...	...	...
Swine Vesicular Disease	0	0	0	0	0	0	0	0	...	...	...
Sheep Pox and Goat Pox	0	0	0	0	0	0	0	0	...	...	...
Vesicular Stomatitis	0	0	0	0	0	0	0	0	...	...	...
OTHER Contagious Diseases:											
Anthrax	0	0	0	0	0	0	0	0	...	...	...
Aujeszky's	0	0	0	0	0	0	0	0	...	...	...
Bovine Brucellosis	0	0	...	...	...	...	...	...	...	...	...
Bovine Tuberculosis	(+..)		(+..)	(+..)	(+..)	(+..)	(+..)	(+?)	...	...	...
Haemorrhagic Septicaemia	0	0	0	0	0	0	0	0	...	...	...
Nipah virus encephalitis	...	...	0	0	0	0	0	0	...	...	...

Source: World Organization for Animal Health (http://www.oie.int/eng/en_index.htm)

INDEX:

0	**Disease absent**
(+..)	**Disease present but without quantitative data**
+	**Disease present with quantitative data but with an unknown number of outbreaks**
...	**No information available for this disease**
?	**Disease suspected but not confirmed**
(+?)	**Confirmed infection/infestation without clinical signs**
0	**Continuing previous outbreak (s)**

Annex 7. Aquaculture Risk Assessment

It has not been possible to conduct a formal risk assessment for the aquaculture industry in Guyana because there are no records of past production and losses in the industry.

Table 7.1. Guyana. List of Aquaculture Farms, 2010

Company Name	Name of Farmers	Estimated Acreage	Type of Farm
Kaymar Sankar	Beni Sankar	30	Fish
Maharaja Oil Mill	Chico Persaud	15	Hatchery
Pooran Farms	Pooran Mohess	5	Fish
Newline Aquaculture	Saleem Azeez	120	Fish
MBS Fisheries	Shirley Haniff	30	Fish
Trafalgar Union Community Development Council	Lloyd Angus	1	Fish
Mainstream Enterprise	Godfrey Washington	5	Fish
Jaskasa Agri and Aqua Farm	C. Mohammed	0.1	Fish
	Chris Jugdeo	5	Fish
	Shrikhan Dewan	0.1	Fish
	Angud Persaud	0.1	Fish
	Bagwandin	0.1	Fish
Sub-Total Fish Farms		**211.4**	
Onverwagt Aquaculture Enterprise	Arjune	80	Fish and Shrimp
	Joseph Baichu	60	Fish and Shrimp
	T. Tulshi	100	Shrimp
	Erwin Abdualla	350	Shrimp
	Chandradat Carpen	200	Shrimp
	Hopper, others	105	Shrimp
	Bux, others	100	Shrimp
	Tanlion, others	50	Shrimp
	Name to include	200	Shrimp
	Jaipaul, others	160	Shrimp
	Name to include	600	Shrimp
	Name to include	60	Shrimp
	Kassim	80	Shrimp
Sub-Total Shrimp Farms		**2,145**	

Source: Ministry of Agriculture, Department of Fisheries.

Annex 8. Individual Farmer Crop MPCI and Suitability for Guyana

1. **This Annex presents the basic design features for the implementation of Multiple-peril Crop Insurance (MPCI) policies for paddy crops in Guyana.** The objective of the Annex is to provide a comprehensive overview of the design and possible applications of MPCI policies in Guyana. The Annex starts with a description of the main features of MPCI. Then, it describes the advantages and disadvantages of MPCI policies and the preconditions required for its implementation. Finally, the Annex analyzes the suitability of implementing MPCI to cover risks on paddy production in Guyana.

Features of Multiple-peril Crop Insurance Policies

2. **Multiple-peril crops insurance (MPCI) provides insurance against all perils that affect production, unless specific perils have been explicitly excluded in the insurance contract.** Ultimately, a MPCI policy functions as a yield shortfall guarantee, meaning that all the unavoidable natural, climatic and biological perils affecting the insured crop yields are covered.

3. **MPCI insurance policies are offered on individual farmer basis.** MPCI policies are usually offered to individual farmers. MPCI policies provide insurance protection for all the fields planted with a certain insured crop within a same farm.

4. **The level of coverage under a MPCI insurance policy is determined by a guaranteed yield.** The guaranteed yield under a MPCI insurance policy is settled as a percentage (usually between 50% and 75%) of the historical average yield of the individual farmer. The fact that coverage levels under MPCI insurance policies are defined by a guaranteed yield means that the insurance contract will make payouts only if the actual yield obtained by the insured on its insured unit is below the guaranteed yield.

5. **The settlement of the sum insured in a MPCI insurance policy can be done in two forms: (a) based on the valuation of the guaranteed yield at the future market price for the insured crop at the time of harvest; or (b) based on an agreed value.** Valuing insurance guaranteed yields at the future market price for the insured crop at the time of harvest is the most commonly used method for settling the sum insured for MPCI insurance contracts. The method of basing the settlement of the sum insured based on agreed value basis is commonly used when the insurable interest is in connection with repayments of agricultural loans. However, it is important to note that a sum insured settled on agreed value basis is only allowed by the insurance/reinsurance industry if the agreed values established as sum insured for MPCI contracts is smaller than the valuation of the guaranteed yield at the future market price at the time of harvest.

6. **Under a MPCI policy, the area used for the determination of the actual yield obtained by the insured farmer, and ultimately to determine whether or not an indemnification applies, is named Insured Unit (IU).** In spite of some variants that might exist in the market, the most common practice in the market is to define the IU as the area comprised by all the fields planted with the insured crop within the insured farm.

7. **The loss assessment in MPCI coverage is performed immediately prior to harvest by the insurance company technicians on a field-by-field yield basis.** Whenever the insured reports losses, the insurance company designated loss adjusters to make a yield assessment for the determination of losses just before the harvest. Loss assessment on MPCI policies is a very specialized task.

8. **The payout condition of a MPCI policy is triggered when the actual yield obtained by the insured on its insured unit is below the guaranteed yield.** In such cases, the insurance company will indemnify the insured, according to the modality used to settle the sum insured, based on two methods. First, if the sum insured on the original policy was settled based on the future market value at the month of harvest for the guaranteed yield, then, the insurance company will indemnify the insured with an amount equal to the amount that the actual yield obtained by the insured farmer on

its insured unit falls short of the guaranteed yield, times future market price at the month of the harvest, times the insured area. If the sum insured on the original policy was settled based on an agreed value, then the insurance company will indemnify the insured with an amount equal to the percentage of the yield shortfall, times the sum insured settled on the original policy.

9. Figure 8.1 shows an example of the application of a hypothetical MPCI policy for paddy spring crop season production. The example assumes a MPCI with a coverage level of 70% over an expected yield of 25 bags per acre (i.e. guaranteed yield equals to 17.5 bags per acre). The example also assumes that the insured area is 100 acres and 100% of the area cropped with paddy is insured; hence, 100 acres will be considered as IU for actual yield assessment purposes namely A, B, and C. The scenario A considers that the actual yield obtained by the farmer on its insured unit at the end of the policy period reaches 20 bags per acre; therefore, since the actual yield – 20 bags per acre – obtained by the farmer on its insured unit is greater than the guaranteed yield – 17.5 bags per acre – the farmer does not receive any indemnity from the insurance on this case. The scenario B assumes that the actual yield obtained by the farmer on its insured unit is 8.75 bags per acre; therefore, due to the fact that the actual yield obtained by the farmer on its insured unit – 8.75 bags per acre – is bellow the guaranteed yield – 17.5 bags per acre – the farmer receives an indemnity of G$ 1.75 million. The scenario C assumes that the farmer has suffered a total loss on its insured paddy crop; hence, on this case, the farmer receives a full indemnity equal to the sum insured under the policy – G$3.5 million –.

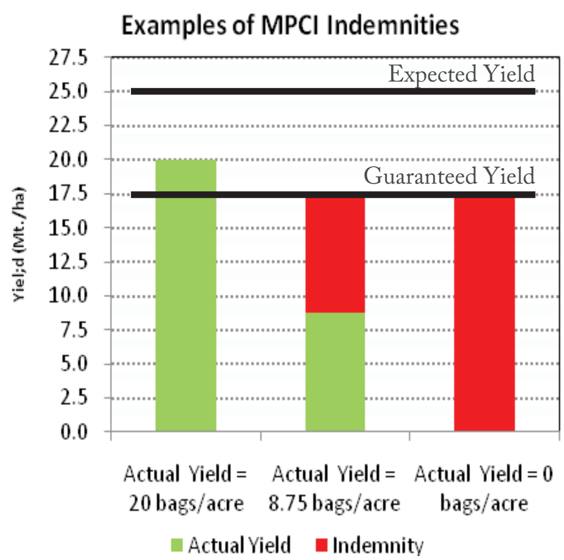
Figure 8.1. Example of Indemnity of a Multi-peril Crop Insurance Product

Insurance Contract Conditions:
Insured Peril: MPCI
Crop: Paddy Spring Crop Season
Expected Yield (EY): 25 bags/acre
Guaranteed Yield 70 % APH (GY): 17.5 bags/acre
Future market price (FMP): G$2,000/bag.
Insured Unit Area (IUA): 100 acres
Total Sum Insured (TSI): G$3.5 million

Loss Adjustment:
Scenario A: Actual yield (AY) = 20 bags/acre
Scenario B: Actual yield (AY) = 8.75 bags/acre
Scenario C: Actual yield (AY) = 0.0 bags/acre

Indemnity Calculation:
If AY < GY, then:
Indemnity = (GY – AY) * FMP* IUA

Indemnity Case Analysis:
A: G$0
B: (17.5. – 8.75 - bags/acre)* G$2,000/bag *100 acres = G$1.75 million
C: (17.5. – 0.00 - bags/acre)* G$2,000/bag *100 acres = G$3.50 million



Source: Authors.

in case of eventual claims at the end of the policy period. An additional assumption for this example is that the paddy future price at the month of harvest is G$2,000 per bag. As a result of these assumptions, the total sum insured under the policy will be equal to G$3.5 million (i.e. 100 acres of sown area, times a guaranteed yield of 17.5 bags per acre, times G$2,000 forward price per bag at the month of harvest). Three crop yield scenarios are considered for this example,

Preconditions of MPCI and Issues for its Implementation in Guyana

10. MPCI is a very complex crop insurance product and – sometimes – unfeasible. The complexities of MPCI insurance arise from the characteristics of the risks covered, and the asymmetries of information that lead to adverse selection and moral hazard problems. Adverse selection occurs when potential insurance purchasers know more about their risks than the insurer does, leading to participation of high-risk individuals and non participation of low-risk individuals on insurance portfolios. Moral hazard refers to the problems generated when the insured's behavior can influence the extent of the damage that qualifies for insurance payouts. Adverse selection and moral hazard problems are the main source of MPCI program failures around the globe.

11. **In order to avoid the adverse selection problems, any further development of MPCI insurance products for paddy production in Guyana would require information about actual yield history and farming practices at the insured unit level.** However, there is no information about individual farmer actual yield history or information about the current farming system at the individual farm level. The current state-of-the-art paddy production information in Guyana indicates that it is not recommendable to initiate a MPCI program to cover paddy production in the country.

12. **Aiming to avoid moral hazard issues, any further development of MPCI insurance products for paddy production in Guyana would require pre-inspections and close monitoring during the paddy crop season.** In the current context of paddy crop production in Guyana, it is improbable to develop the required technical structure and the expertise to perform individual paddy field pre-inspection, crop monitoring, and – eventually – the loss adjustment for MPCI insurance purposes. This is because of two reasons. The first one is that, currently, of the 8,000 farmers cultivating paddy in Guyana, 85% – 6,644 – are planting – in average – 10 acres each. Therefore, performing pre-inspections and monitoring of paddy crops would require a huge staff of technicians to perform these activities. The second reason is that, currently, there is no field level pre-inspection expertise in the country; thus, the pre-inspection expertise must be brought from overseas assuming the additional cost of doing so.

13. **The existence of trained loss adjusters is another precondition for the development of MPCI; however, Guyana lacks of experienced loss adjusters for MPCI insurance.** Currently, there are no trained loss adjusters in Guyana to, eventually, perform the MPCI required in-field loss adjustment at time of harvest. Likewise, the field level pre-inspection and loss adjustment expertise must also be brought from overseas.

14. **MPCI offers comprehensive insurance cover to paddy farmers, but comes at significantly higher cost compared with other crop insurance products.** A preliminary rating exercise for MPCI insurance for Guyana indicates that MPCI indicative rates for insurance contracts at 50% coverage level offered to individual paddy farmers would have to pay approximately between 9% and 20% of the sum insured, depending on the crop season and paddy production zone in Guyana. The premium reflects not only the pure risks costs – which according to the preliminary calculation performed for a coverage level of 50% of the expected yield, farmers would have to pay approximately between 4% and 10% of the sum insured – but also the costs of minimizing the chances of adverse selection and moral hazard through risk inspections, enforcing sales deadlines and overall monitoring of the insured which are estimated to represent 60% of the original gross premium. This cost generally makes this form of cover unattractive to marginal or small producers.

Conclusions

15. **Currently, the basic preconditions for the development of MPCI insurance coverage cannot be met in Guyana; therefore, there are no possibilities to develop MPCI in the short term.** Guyana lacks of sources to obtain the necessary data on actual yield history and farming practices at the insured unit level for the development of MPCI. Moreover, the country also lacks of the required trained staff to perform the required pre-inspections, monitoring and – eventually – loss adjustment activities required by any MPCI program. Preliminary calculations also indicate that, under the current conditions in terms of development of MPCI – even if an insurer/reinsurer would be willing to take MPCI risk on paddy production in Guyana – the final purchase price for the farmers, for a coverage level of 50%, will range from 9% to 20% of the sum insured, being totally unaffordable for them.

Annex 9. Area-yield Index Insurance Policy Design and Rating for Rice in Guyana

1. **This Annex provides an analysis of the key design and rating issues and methodology for an area-yield index program for paddy production in Guyana and draws, where relevant, on international experience.** Outline proposals are presented for a prototype area-yield index program for spring and autumn paddy in Guyana, but it is stressed that further design work will be required if the GoG decides to go forward with this initial idea. The findings presented in this Annex are intended to assist the GoG and the private insurance companies in the design and implementation of an Area-Yield Crop Insurance Program.

2. **The Annex embraces all the steps involved in the design of an area-yield index insurance product and concludes with the notional cost for potential area-yield index insurance for spring and autumn paddy for each of the paddy production zones in Guyana.** It starts with the description of the features of this insurance product and the review of the international experience in area-yield index insurance. Next, the Annex deals with aspects related with the potential basis risk of area-yield index agricultural insurance products. Once the issues related with basis risk are addressed, the Annex explains the aspects related with the coverage design. Next to this, through an applied example for the selected crops and region, the Annex describes the rating methodology for an area-yield index insurance product. Following the explanations regarding the ratting process, the Annex describes the pricing issues and, finally, the outputs of these processes, which are the market reference rates. A simulation of a possible loss scenario is also presented.

Features of Area-yield Index Insurance

3. **Area-yield index insurance represents an alternative approach to MPCI insurance which aims to overcome many of the drawbacks of traditional MPCI crop insurance.** The key feature of this product is that it does not indemnify crop yield losses at the individual field or grower level. Rather, an area-yield index product makes indemnity payments to growers according to yield loss or shortfall against an average area yield (the index) in a defined geographical area (e.g. region or paddy production zone). An area-yield index policy establishes an insured yield which is expressed as a percentage (termed the "Coverage Level") of the historical average yield for each crop in the defined geographical region which forms the Insured Unit (IU). Farmers whose fields are located within the IU may purchase optional coverage levels which typically vary between a minimum of 50% and a maximum of 80% of the historical average yield. The actual average yield for the insured crop is established by sample field measurements (usually involving crop cutting) in the IU and an indemnity is paid by the amount that the actual average yield falls short of the insured yield coverage level purchased by each grower.

4. **The key advantages of the area-yield approach are that moral hazard and anti-selection are minimized, and the costs of administering such a policy are much reduced, offering the potential to market this product at lower premium costs to growers.** The main disadvantage of an area-yield index Insurance policy is that an individual grower may incur severe losses due to localized perils (e.g. hail or flooding by a nearby river), but because these localized losses do not impact on the national or departmental average yield, the grower does not receive an indemnity (see Box 9.1 for further details).

International Experience with Area-yield Index Insurance

5. **Area-yield index crop insurance has been implemented in many countries.** In the late 1970's, India introduced area-yield index crop insurance and the US and Canada introduced this product in the early 1990's. Recently, other countries like Morocco, Mexico, Sudan and Brazil have developed area-yield crop insurance products.

6. **In India, area-yield crop insurance has operated for over 20 years and is currently the world's largest crop insurance program insuring about 20 million farmers.** The Agricultural Insurance Company of India (AICI) is responsible for implementing area-yield crop insurance under the National Agricultural Insurance Scheme (NAIS). The

Box 9.1. Area-yield Index Insurance: Advantages and Disadvantages

ADVANTAGES	DISADVANTAGES
Adverse selection and moral hazard are minimized The indemnity is based on average area yields and not on individual farmer's yields. Individual farmers cannot therefore influence the yield outcome.	**Basis risk issues** The occurrence of basis risk depends on the extent to which individual farmer's yield outcomes are positively correlated with the area-yield index.
Yield data availability for insurance Time-series regional-level or zonal-level area-yield data is available at the Guyana Rice Development Board.	**Not suitable for localized perils** Area-yield insurance will not work in areas with high losses due to localized perils (e.g. hail or localized frost pockets).
Comprehensive multi-peril insurance suited for the insurance of systemic risk The policy acts as an all-risk yield shortfall guarantee policy and is best suited for situations where severe systemic risk (e.g. drought) impacts equally over the defined area Insured Unit (e.g. paddy production zone).	**Requires homogeneous agro-climatic risk regions and cropping systems** Area-yield insurance works best in a homogeneous climatic zone and where cropping systems for the insured crop are uniform (e.g. same varieties, planting dates, management practices).
Lower underwriting and delivery costs There is no need to conduct pre-inspections on individual farms or to collect individual grower yield data.	**Accuracy of historical area yield data** Methods of yield measurement and reporting may not be accurate racing doubts about the historical area yields.
Lower loss adjusting costs There is no requirement for individual grower in-field area loss assessment which is very time consuming and costly.	**Problems of accurate measurement of area yields** Sampling error and enumerator bias can be a major problem in determination of average area yields.
Affordability of the product The combination of reduced exposure to yield loss and reduced administrative costs offers the potential for cheaper premiums than for individual farmer MPCI.	**Time delays in settling claims** Farmers often have to wait for at least 3 to 6 months post-harvest for the official results of the area yields to be published and for indemnities to be paid, if applicable.

Source: Authors.

program is targeted to small and marginal farmers (with less than 2 ha), and whom are highly dependent on access to seasonal crop credit. Crop insurance is compulsory for borrowing farmers, and voluntary for non-borrowing farmers. The Insured Unit is normally the block or *panchayet,* which comprises a group of nearby villages that may include up to 27,000 acres or more of a single crop, and several thousands of small and marginal farmers. Farmers may select coverage levels of 60%, 80% or a maximum of 90% of the 5-year average area-yield. The program is administered through the rural agricultural banks' branch network in each state, department and block (group of villages). Actual area-yields are established through sample crop-cutting. This is a major and costly exercise and suffers from delays in processing the results. Indemnity payments are therefore often delayed for 6 months or more.

7. **In the US, area-yield index insurance is marketed under the name Group Risk Plan (GRP).** Under the GRP, rather than being based on the individual farmer's yield loss experience, the payouts of the coverage are based on the actual value of an area-yield index in a certain area, namely the Insured Unit, which in the US is defined at the county level (2,500 km^2 average Insured Unit). The indemnities on the GRP proceeds when the actual yield for the insured crop at the county on which the insured is situated, as determined by the National Agricultural Statistics Service (NASS), falls below the guaranteed yield chosen by the farmer. Under the GRP, farmers

can choose among different coverage levels (insured yield options): 90%, 85%, 80%, 75% or 70% of the expected county yield. The sum insured value for each crop is based on a percentage of the expected market price. The grower may elect an insured value of between a minimum of 90% and a maximum of 150% of the expected market price. The justification for permitting growers to insure at up to 150% of the expected market price is that this affords adequate protection for growers whose own yields are higher than the county average. Final payments are not determined until six months after the crop harvest, when the NASS releases the actual yields for each county. Payments are then made within 30 days. GRP insurance policies are easier to administrate and less costly than the traditional individual grower MPCI policy. However, individual crop losses may not be covered if the county yield does not suffer a similar level of loss. This type of insurance is most appropriate for farmers whose crop production and yields (and losses) typically follow the county pattern.

The Issue of Basis Risk

8. **The key feature of the area-yield index insurance is that it does not indemnify crop yield losses at the individual field or grower level; rather, an area-yield index product makes indemnity payments to growers according to yield loss or shortfall against an average area yield (the index) in a defined geographical area (e.g. the region or the paddy production zone).** An area-yield index policy establishes an insured yield which is expressed as a percentage (termed the "Coverage Level") of the historical average yield for each crop in the defined geographical region which forms the Insured Unit (IU). Farmers whose fields are located within the IU may purchase optional coverage levels which typically vary between a minimum of 50% and a maximum of 90% of historical average yield. The actual average yield for the insured crop is established by sample field measurement (usually involving crop cutting) in the IU and an indemnity is paid by the amount that the actual average yield falls short of the insured yield coverage level purchased by each grower.

9. **Basis risk can be defined as the potential mismatch in terms of yield performance between the individual field and the geographical area defined as the IU for the area-yield index insurance.** The fact that indemnity payments of an area-yield index insurance are based on a yield loss or shortfall against an average area yield (the index) in a defined geographical area, makes room to the existence of basis risk on these kind of insurance products. Because of this reason, two undesirable situations may occur: (a) growers who did not suffer any yield shortfall below the coverage level receive indemnities because the IU where they are situated has suffered a yield shortfall in respect to the guaranteed yield, and (b) growers that have yields below the coverage level do not receive any indemnity because the actual yield for the IU on which they are situated is above the coverage level. Both situations are serious drawbacks for the sustainability of an area-yield index insurance product. The issue of the basis risk must be seriously addressed on the design of area-yield index insurance.

10. **Basis risk can be mitigated but it cannot be eliminated from an area-yield index insurance portfolio.** The issue of basis risk is related to how correlated are the yields at growers field level and the yields in the geographical area selected as IU for the coverage. The choice of the guaranteed yields for the coverage and the selection of the IU are key topics that need to be addressed in the design of area-yield insurance products to mitigate the basis risk. The experience with area-yield index insurance products demonstrates that, as higher the coverage level is settled, the bigger the basis risk problem is; likewise, as bigger the geographical area selected as IU is, the bigger the basis risk problem is. Basis risk is a serious issue for area-yield index products that have coverage levels settled close to the expected yields. Small yield shortfalls in respect to the expected yields are more in relation with idiosyncratic risks, like crop management and crop husbandry practices, than with weather events. At high coverage levels, the correlations between the yield performance at the individual grower field level and the yield performance at the geographical area selected as IU are not strong enough. The correct definition of the IU is also a key factor for the mitigation of basis risk issues in an area-yield index insurance coverage. Area zone boundaries for an area-yield index insurance must be selected so as to group together the largest possible number of farms with similar climate and soils (Skees, 1997). In

other words, as bigger the geographical area selected as IU is, the lower the probability to group together the largest possible number of farms with similar climate and soils is.

11. **In the context of paddy crop production in Guyana, the issue of basis risk is very relevant for the design of an area-yield index insurance product.** In Guyana, the greatest level of detail for official paddy production data is the paddy production zone level which is reported by the Guyana Rice Development Board (GRDB). Each paddy production zone, in average, comprises 17,500 acres of paddy. An IU settled at 17,500 acres, at a glance, seems to be an appropriate acreage if it is compared with the IU established for other countries in which area-yield crop insurance was implemented like India, where the IU is defined at 27,000 acres. However, considering the particular features of paddy production in Guyana, special caution must be exercised on settling the IU for a potential area-yield crop insurance program for paddy targeting individual farmers.

12. **Several factors should be considering in settling the IU for paddy area-yield index insurance purposes in Guyana.** The first factor is that due to the different technologies that farmers may apply to their paddy crops, the yield performances obtained by different farmers – even in the case where they are situated in the same paddy production zone – can be substantially different. The second factor to take into account at the moment of defining the IU for area-yield index purposes is that the paddy sowing dates in Guyana – even when the paddy seasons are very well defined – are quite flexible. Paddy farmers have almost two months to seed their paddy within each crop season. Due to this fact, it is possible to find, at the same time, different paddy in different stages of development. Therefore, an event which takes place at a certain time in the same paddy production zone would affect the crops situated in the same zone in different manner, increasing the basis risk for the coverage. Last, but not least, a third factor that should be taken into consideration in the definition of the IU for an area-yield index insurance program in Guyana is the fact that paddy production in the country relies on an irrigation and drainage system; thus, the paddy production is heavily influenced by man-made issues that are not insurable. Moreover, the irrigation and drainage system in Guyana shows numerous heterogeneities regarding its efficiency both for supplying water for irrigation or for draining the excess of water from the fields. These heterogeneities of the drainage and irrigation system are evidenced along the different paddy production zones, as well as on specific areas within the same paddy production zones.

13. **According to the preliminary analysis of individual paddy grower yield performed for this study, there is a huge gap in terms of yield performance among different paddy growers situated within the same paddy production zone.** According to the analysis performed with individual paddy grower yield data provided by the GRDB and Rice Lab/Sea Rice, there are huge differences in terms of annual paddy yields obtained by different farmers situated in the same paddy production zone during the same crop season. In average, the coefficient of variation (CoV) of paddy yields among different farmers situated in the same paddy crop zone is higher during the spring crop season than in the autumn crop season. While spring crop season shows – in average – a CoV of 26% of the actual average yield, the autumn paddy crop season shows a CoV of 23%. Different paddy production zones tend to show very dissimilar CoVs on actual paddy yields. While West Berbice, accounting for 36.5% average CoV, shows the highest value for spring paddy yields, West Demerara Coast paddy production zone, with 16.5%, shows the lowest CoV for spring paddy yields. The CoV of paddy yields among different farmers within a same region tend to increase during catastrophic years. The analysis of spring paddy CoVs from 2003/04 and up to 2007/08 for Mahaica-Abary, West Berbice, and Cane Grove shows that the analyzed CoVs are higher in 2005/06 than in the rest of the crop seasons because, as it was noted in Annex 3, spring paddy during the 2005/06 crop year had been affected by severe floods. Table 9.1 shows the analysis of individual farmer paddy yields for the spring and autumn paddy crop seasons during the period 2003/04-2007/08.

14. **The basis risk faced by an area-yield index insurance coverage for Guyana would be high.** An area-yield index policy is only effective in areas where soils, climate, and drainage and irrigation infrastructure and management are relatively homogeneous, and where farmers cropping practices and technology and

Table 9.1. Spring and Autumn Paddy Individual Actual Yield Analysis, Period 2003/04 – 2007/08

Crop Zone	Crop Season	Parameters	Crop Year				
			2003/04	2004/05	2005/06	2006/07	2007/08
Mahaica-Abary	Spring	Farmers sampled	34	10	32	38	57
		Average Yield (bags/acre)	26.1	21.9	19.4	26.1	26.9
		Standard Deviation (bags/acre)	4.0	5.6	10.8	7.6	5.9
		CoV%	15%	25%	56%	29%	22%
	Autumn	Farmers sampled	22	40	34	49	56
		Average Yield (bags/acre)	23.7	23.0	27.4	25.4	27.4
		Standard Deviation (bags/acre)	5.1	8.2	5.8	5.8	6.7
		CoV%	22%	36%	21%	23%	25%
West Berbice	Spring	Farmers sampled		26	19	21	26
		Average Yield (bags/acre)		18.7	14.7	23.9	23.8
		Standard Deviation (bags/acre)		6.0	12.5	4.4	6.6
		CoV%		32%	85%	18%	28%
	Autumn	Farmers sampled	27	14	22	20	20
		Average Yield (bags/acre)	19.6	17.9	24.6	17.0	17.0
		Standard Deviation (bags/acre)	5.4	7.0	4.9	7.0	5.8
		CoV%	27%	39%	20%	41%	34%
Cane Grove	Spring	Farmers sampled	16	12	14	12	20
		Average Yield (bags/acre)	31.1	17.8	28.9	31.3	33.5
		Standard Deviation (bags/acre)	6.8	7.0	10.2	4.3	4.2
		CoV%	22%	39%	35%	14%	13%
	Autumn	Farmers sampled	19	25	14	14	22
		Average Yield (bags/acre)	30.3	30.7	29.5	28.9	31.2
		Standard Deviation (bags/acre)	5.7	3.8	3.9	4.3	3.3
		CoV%	19%	13%	13%	15%	11%
West Demerara	Spring	Farmers sampled	20	22	23	19	30
		Average Yield (bags/acre)	31.8	21.7	34.9	30.5	31.1
		Standard Deviation (bags/acre)	6.6	3.1	4.6	5.2	5.2
		CoV%	21%	14%	13%	17%	17%
	Autumn	Farmers sampled	14	22	21	20	31
		Average Yield (bags/acre)	26.4	27.7	29.7	25.8	29.8
		Standard Deviation (bags/acre)	8.7	5.7	5.0	5.6	4.9
		CoV%	33%	21%	17%	22%	16%

Source: **Authors from Rice Lab and Sea Rice farmers database.**

husbandry levels are similar, so that the production and yields of the same crop are relatively homogeneous throughout the defined zone. Where these conditions are not relatively homogeneous, the problem of basis risk may negate or undermine the effectiveness of the crop insurance program. Basis risk arises where farmers may experience farm-level yield losses when the shortfall at the area level is insufficient to trigger an area-based indemnity and vice versa. The main way to reduce basis risk is to reduce the zone boundaries to a smaller area unit which shows a more homogeneous pattern in terms of cropping conditions. However, if farmers cropping practices, and drainage and irrigation infrastructure and management are highly heterogeneous, reducing the size of the IU will have little impact on reducing basis risk.

Insured Yield Coverage Levels

15. **Area-yield insurance policies usually offer insured yield coverage levels of between 90% maximum and 50% minimum of annual average yield for the paddy production zone.** The average yields and the corresponding 90% down to 50% insurance coverage levels for spring and autumn paddy crop seasons in all the paddy production zones in Guyana are presented in Table 9.2.

Estimated Average Technical Rates for Area-yield Index Insurance

16. **The estimated technical rates for spring and autumn paddy in all the paddy production zones in Guyana at coverage levels of 90% down to 50% show that the spring paddy crop season estimated average technical rates are higher than those estimated for the autumn crop season.** The main reason of this finding is that the spring paddy crop season is riskier than the autumn paddy crop season. A retrospective analysis of the seasonal paddy average yields over the period 1994/95-2007/08 shows that, while the spring paddy crop season has been affected by floods in 2004/05 and 2005/06, and droughts in 1997/98 and 2009/10, the autumn paddy crop season has not been affected by severe events with the exception of the 1995/96 flooding. The analysis also shows that there is a very wide range in the calculated technical rates for each crop season and production zone and that there is a need to set insured yield coverage levels in relation to the exposure to yield loss for each crop production zone and the price (premiums) that farms can afford for crop insurance.

17. **Spring paddy crop season estimated technical rates average 3.68% for 80% coverage level; however, these technical rates vary considerably among the different paddy production zones in the country.** The different paddy production zones in Guyana show different patterns regarding technical rates. Three groups of paddy production zones can be distinguished in terms of their estimated technical rates for spring paddy production. The first one comprises Essequibo production zone in Region 2 as well as Black Bush Polder and Frontlands paddy production zones in Region 6. The estimated technical rates for the paddy production for coverage levels of 80% of the expected yield are 2.40% in all of these paddy production zones. The main reason why these regions enjoy lower average

Table 9.2. Spring and Autumn Paddy. Expected Yields (5-year Average Yields) and Insured Yield Coverage Levels 90% to 50% of the 5-year Acreage Yields

Region	Paddy Production Zone	Spring Crop Season						Autumn Crop Season					
		5-year Average Yield	Coverage Level (% of the 5-year average yield)					5-year Average Yield	Coverage Level (% of the 5-year average yield)				
			90%	80%	70%	60%	50%		90%	80%	70%	60%	50%
2	Essequibo	28	25	23	20	17	14	30	27	24	21	18	15
3	Leguan	16	15	13	12	10	8	14	12	11	10	8	7
3	Wakenaam	22	20	18	15	13	11	24	21	19	17	14	12
3	West Demerara	27	24	22	19	16	14	25	22	20	17	15	12
4	Cane Grove	27	24	21	19	16	13	25	23	20	18	15	13
5	Mahaica-Abary	23	21	19	16	14	12	26	23	21	18	16	13
5	West Berbice	24	22	19	17	14	12	23	21	19	16	14	12
6	Black Bush Polder	26	23	21	18	15	13	25	23	20	18	15	13
6	Frontlands	25	23	20	18	15	13	25	23	20	18	15	13

Source: Authors from the GRDB.

technical rates is because they have better drainage and irrigation infrastructures, as well as better drainage and irrigation management than the remaining paddy production zones in the country. Having a better drainage and irrigation system allows paddy production in these zones to cope better with drought or flood events; thus, the historic yield volatility for spring paddy yields in these regions is lower than in other paddy production zones. The second group of paddy production zones comprises Cane Grove, Mahaica-Abary and West Berbice. The estimated technical rates for coverage levels of 80% for these paddy production zones are 3.12% for Cane Grove, 4.28% for Mahaica-Abary, and 2.87% for West Berbice paddy production zone. These paddy production zones – owing to issues related to their drainage infrastructure – face flood risks but, at the same time, cope very efficiently with drought risk. During the 2004/05 flood events, Cane Grove zone in Region 4 lost 43% of its spring paddy crop production; while, as a result of the same flood event, the Mahaica-Abary and West Berbice zones in Region 5 lost 40% and 24% of their paddy production, respectively. The third group of paddy production zones is the one that shows the highest estimated technical rates for spring paddy. This group comprises Leguan, Wakenaam, and West Demerara zones in Region 3. Leguan Island, with 17.72%, shows the highest estimated technical rates for coverage level at 80% VAR. Wakenaam Island, with 15.73%, and West Demerara Coast production zone, with 10.56%, also show very high estimated average technical rates for a coverage level of 80%. The main reasons for such high estimated technical rates in these regions is the high spring paddy yield volatility due to the impact of drought and floods. Leguan and Wakenaam Islands have a very outdated drainage and irrigation infrastructure, and saline intrusion during the dry periods is a recurrent problem. During the 1997/98 *El Niño* drought, these zones lost almost 100% of their spring paddy production. The West Demerara Coast production zone also faces high paddy crop losses due to drought and floods. In this paddy production zones, the Boeraserie Conservancy, which is in charge of supplying water for irrigation and buffering the effects of excess of rain, is outdated and, currently, has very low capacity to evacuate the excess of water due to heavy rainfall or to store water during the dry periods.

18. **The analysis of the estimated technical rates for the autumn paddy crop season at 80% VAR coverage show a regular distribution among the different paddy production zones.** Cane Grove in Region 4, Mahaica-Abary in Region 5, Black Bush Polder and Frontlands in Region 6, and East Coast Essequibo in Region 6, show the smallest estimated technical rates for autumn paddy in Guyana. The estimated average technical rate for 80% coverage level in these paddy production zones is 2.16% of the VAR of autumn paddy. West Coast Demerara, Leguan and Wakenaam paddy production zones in Region 3, as well as West Berbice paddy production zone in Region 5, are the most risky zones for autumn paddy product in Guyana. The annual average expected losses for these zones are 5.24% for Wakenaam, 3.62% for West Berbice, 3.16% for West Coast Demerara, and 2.38% for Leguan paddy production. The estimated technical rates for the corresponding 90% down to 50% insurance coverage levels for spring and autumn paddy crop seasons in all the paddy production zones in Guyana are presented in Table 9.3.

Estimation of the Probable Maximum Loss (PML) for the Selected Area and Crops

19. **Equally important to determine the technical rates per paddy production zone and crop season is to estimate the probable maximum loss (PML).** The purpose of the PML calculation is to estimate, with a high degree of confidence, the maximum losses that the portfolio of crops under analysis might incur (namely, the Probable Maximum Loss, PML[67]) either in return periods of 1 in 100 years, or, in order to be more conservative, 1 in 250 years.

20. **The combined PML analysis for the spring and autumn crops in all the paddy production zones in Guyana shows that the 1 in 100 year event, in the case where a coverage level of 80% is offered, might cause a loss of G$2.52 billon, with an overall cost for the assessed crop portfolio of 18.1% of the spring and autumn crop total sum insured.** Under the assumption of a coverage level of 70% of the 5-year average, the PML with a return

67 The Probable Maximum Loss is defined as "An estimate of the maximum loss that is likely to arise on the occurrence of a single event considered to be within the realms of probability, remote coincidences and possible but unlikely catastrophes being ignored".

Table 9.3. Calculated Average Technical Rates for Coverage Levels from 90% to 50%

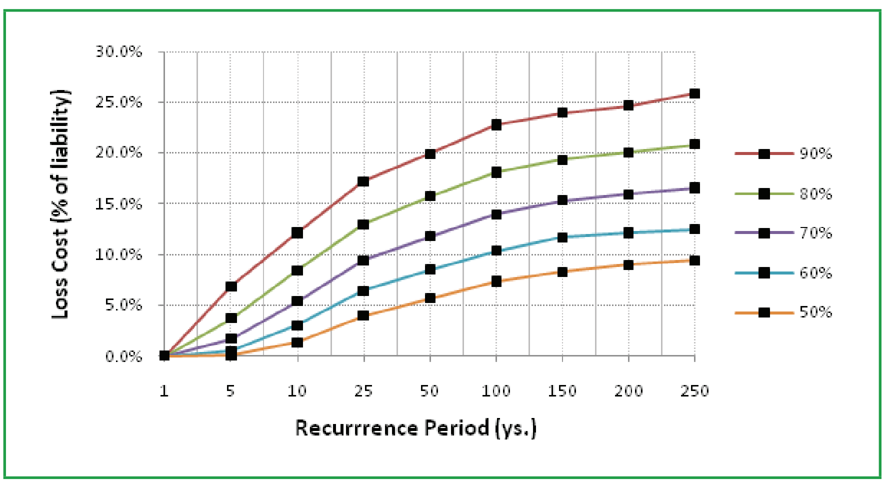
Crop/Season/Zone	Coverage Level								
	90%	85%	80%	75%	70%	65%	60%	55%	50%
Reg2/Spring/Essequibo	3.64	2.65	2.40	2.25	2.10	1.95	1.80	1.65	1.50
Reg3/Spring/Leguan	17.72	15.73	13.86	12.11	10.47	8.92	7.50	6.19	4.97
Reg3/Spring/Wakenaam	12.98	11.19	9.62	8.24	7.02	5.93	4.94	4.02	3.16
Reg3/Spring/West Demerara	12.30	10.56	9.11	7.85	6.75	5.75	4.82	3.93	3.05
Reg4/Spring/Cane Grove	5.97	4.39	3.12	2.25	2.10	1.95	1.80	1.65	1.50
Reg5/Spring/Mahaica-Abary	7.49	5.73	4.28	3.11	2.21	1.95	1.80	1.65	1.50
Reg5/Spring/West Berbice	5.56	4.07	2.87	2.25	2.10	1.95	1.80	1.65	1.50
Reg6/Spring/Black Bush Polder	3.41	2.55	2.40	2.25	2.10	1.95	1.80	1.65	1.50
Reg6/Spring/Frontlands	5.03	3.58	2.45	2.25	2.10	1.95	1.80	1.65	1.50
Average Spring Crop Season	**6.04**	**4.64**	**3.68**	**3.09**	**2.70**	**2.43**	**2.18**	**1.94**	**1.70**
Reg2/Autumn/Essequibo	3.85	2.55	2.16	2.03	1.89	1.76	1.62	1.49	1.35
Reg3/Autumn/Leguan	3.26	2.80	2.38	2.03	1.89	1.76	1.62	1.49	1.35
Reg3/Autumn/Wakenaam	6.39	5.24	4.37	3.70	3.17	2.71	2.28	1.85	1.43
Reg3/Autumn/West Demerara	3.76	3.46	3.16	2.84	2.49	2.11	1.72	1.49	1.35
Reg4/Autumn/Cane Grove	2.43	2.30	2.16	2.03	1.89	1.76	1.62	1.49	1.35
Reg5/Autumn/Mahaica-Abary	4.01	2.75	2.16	2.03	1.89	1.76	1.62	1.49	1.35
Reg5/Autumn/West Berbice	7.21	5.16	3.62	2.48	1.89	1.76	1.62	1.49	1.35
Reg6/Autumn/Black Bush Polder	3.86	2.58	2.16	2.03	1.89	1.76	1.62	1.49	1.35
Reg6/Autumn/Frontlands	4.06	2.75	2.16	2.03	1.89	1.76	1.62	1.49	1.35
Average Autumn Crop Season	**4.39**	**3.16**	**2.54**	**2.21**	**1.97**	**1.81**	**1.64**	**1.49**	**1.35**
Average aggregate crop year	**5.23**	**3.92**	**3.12**	**2.66**	**2.34**	**2.12**	**1.92**	**1.72**	**1.53**

Source: World Bank.

period of 1:100 for the portfolio under analysis will amount to G$1.7 billon and an overall cost of 14% of the **spring and autumn crop total sum insured**. The World Bank's PML analysis for a return period of 1 in 2 years up to 1 in 250 years, and coverage levels from 50% to 90% for spring and autumn paddy crop seasons, is shown in Figure 9.1.

21. **Separate PML analyses for spring and autumn paddy seasons indicate that the exposures to losses on each of these individual crop seasons are higher than the exposure to losses of the aggregate portfolio.** The PML analysis for the spring crop season in all the paddy production zones in Guyana shows that the 1 in 100 year event, where a coverage level of 80% is offered, might cause a loss of G$2.2 billon, with an overall cost for the assessed crop

Figure 9.1. Probable Maximum Loss (PML) for Coverage Levels from 90 to 50% of Spring and Autumn Paddy Aggregate Portfolio



Source: Authors from the CRAM.

portfolio of 30.8% of the spring crop total sum insured. The same PML analysis for the autumn crop season indicates that, when a coverage level of 80% is offered, losses will amount to G$1.9 billon with an overall cost for the assessed crop portfolio of 27.4% of the autumn crop total sum insured. The World Bank's PML analyses for a return period of 1 in 2 years and up to 1 in 250 years and coverage levels from 50% to 90% for the spring and autumn paddy crop season are shown in Figures 9.2 and 9.3, respectively.

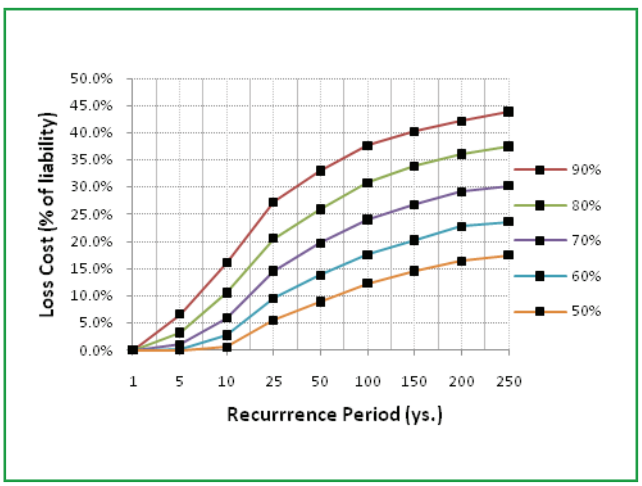
Indicative Commercial Premium Rates for Area-yield Index Insurance

22. **Aiming to develop illustrative portfolio estimates, indicative commercial premium rates were calculated for this study.** It is noted here that, the assumption made to gross up the technical rates to the indicative commercial rates, was that the total administrative, marketing and loss adjustment expenses for the application of an area-yield index insurance for paddy in Guyana would represent 35% of the expected losses. The detailed methodology and assumptions made are presented on Appendix A of this Annex. Caution must be exercised in the use of these indicative commercial premium rates for paddy production in Guyana since they were calculated to perform illustrative portfolio estimates only and have not been agreed either with the insurance industry or the potential reinsurance industry.

23. **The spring paddy crop season indicative average commercial premium rates, for a same level of coverage, are higher than autumn paddy crop season commercial premium rates.** For all the analyzed coverage levels and paddy production zones, the spring crop season average indicative commercial premium rates are higher than the average indicative commercial premium rates for the autumn paddy crop season. For instance, in Cane Grove, the indicative commercial rate at 80% coverage level for the paddy spring season is 4.79% and for the autumn season paddy is 3.32%. In Leguan, also for a 80% coverage level, the paddy spring season indicative commercial premium rate is 21.32%, while the autumn crop season indicative commercial premium rate is 4.31%. The same situation is repeated in Mahaica-Abary paddy production zone where the indicative average commercial premium rates at 80% coverage level are 6.58% and 3.32% for the spring and autumn paddy crop seasons, respectively.

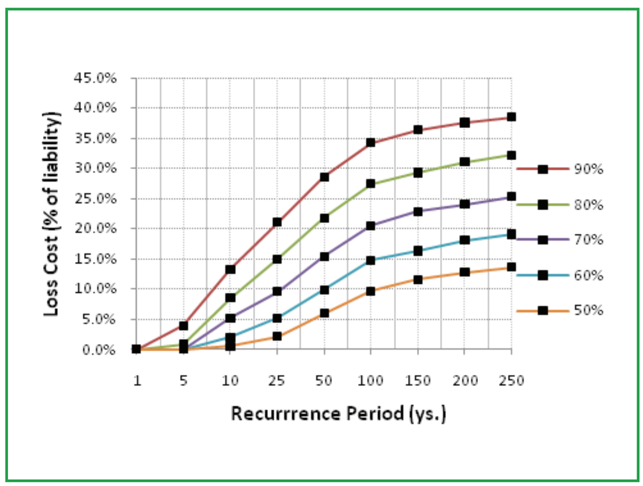
24. **Under an area-yield crop insurance program, the coverage level in each paddy crop production zone should be set in accordance with: (a) the underlying risk exposure and frequency, and (b) a commercial premium rate that is affordable for the farmers.** Special care should be taken into consideration when the coverage levels are settled. The objective of the insurance, rather than covering the frequency, is to cover those low-frequency high-severity events affecting the crops. It is

Figure 9.2. Probable Maximum Loss (PML) for Coverage Levels from 90% to 50% for Spring Paddy Portfolio



Source: Authors from the CRAM.

Figure 9.3. Probable Maximum Loss (PML) for Coverage Levels from 90% to 50% for Autumn Paddy Portfolio



Source: Authors from the CRAM.

recommendable for a sustained agricultural insurance scheme, not to cover any damage/yield shortfalls arising out of events with return periods lower than 1 in 5 or 1 in 7 years. Commercial premium rates for area-yield index insurance that are settled too high discourage the purchase of crop insurance and do not allow the scheme to reach the economies of scale needed to work at reasonable prices. According to the information received from the farmers during the focal groups performed for this study, the commercial rates should not exceed 5% of the VARs for coverage levels of 80 percent.

25. **The indicative commercial premium rates are variable depending on the risk faced by each of the paddy production zones and crop seasons.** For instance, paddy grown in high flood prone zones like Mahaica-Abary, West Berbice or Cane Grove crops show higher commercial rates than others situated in less flood prone areas like Essequibo or those in Region 6. The same situation is repeated for drought prone areas, like Leguan, Wakenaam or West Coast Demerara paddy production zones, where the indicative commercial premium rates reach values above 14% for coverage levels of 80%. The calculated indicative commercial premiums rates for autumn paddy are not as high as those observed for spring paddy crops. For autumn paddy crops, more or less the same geographical pattern as the spring crop season is observed in terms of commercial premium rates. Leguan, Wakenaam and West Coast Demerara in Region 3, as well as West Berbice in Region 5 – with 3.66%, 6.73%, 4.86%, and 3.81%, respectively – are the paddy production zones that show the highest indicative commercial rates. The remaining paddy production zones – Mahaica-Abary, Cane Grove, Black Bush Polder, Frontlands, and Essequibo – with rates of 3.32% of their respective VARs, show relative low indicative commercial premium rates for autumn paddy.

26. **The farmer's willingness to purchase insurance area-yield index insurance is an important issue to take into consideration in any attempt to introduce area-yield index crop insurance in Guyana.** According to the information obtained from the farmers' focal groups, most of the paddy farmers in Guyana would not purchase area-yield index insurance in case it becomes available. The reasons behind their decision to not purchase financial protection for their crop outcomes can be summarized as follows: (i) farmers lack of insurance culture; (ii) low profit margins on the farmers paddy production; and (iii) high potential commercial insurance rates.

27. **Paddy farmers in Guyana lack of insurance culture.** During the farmers' focal groups performed for this study farmers were elicited about whether or not they are purchasing any kind of insurance. Most of the farmers said that they only purchase motor third-party liability because it is mandatory, few of them responded that they purchase life insurance because it is required by some financial institutions to access credit, and none of them responded that they are purchasing insurance because they believe it is a good financial tool. Given this scenario of paddy farmers lack of insurance culture, several efforts must be performed on training and capacity building on agricultural insurance – including but not limited to uses, advantages and disadvantages – among farmers if agricultural insurance is to be introduced in Guyana.

28. **Paddy farmers' decision about purchasing area-yield index insurance is influenced by the fact that they are currently receiving very low profit margins from their paddy crops.** Certainly, the demand for area-yield index insurance, as well as other crop insurance products for paddy production, would be affected by the low profits obtained by farmers on their paddy crops. According to the information obtained from the focal groups, paddy farmers in Guyana – in average – are currently obtaining very low margins from their paddy production. The interviewed farmers have identified low paddy prices and the high cost of inputs as one of the main constraints they are facing on their paddy production. This constraint is verified by the fact that the cost of production of one acre of paddy – according to the information gathered from the farmers' focal groups – ranges from G$50,000 to G$70,000 per acre, depending on the region and whether or not the farmer is renting the land. Assuming, similar paddy prices as those for the 2008/09 crop year (G$2,500 per bag), the break-even yield that rice farmers must obtain to cover their production costs would be between 20 bags to 24 bags per acre. Considering that paddy average yields in Guyana are approximately 25 bags per acre, the gross profit needed by paddy farmers to bear

the indirect costs related to paddy production, and to finance their working capital and subsistence for the next crop season, would be 1 bag per acre and up to 5 bags per acre. Under this scenario, the farmers, rather than being interested in purchasing financial protection to cover their potential financial downside risk due to production shortfalls, will try to assume that risk in order to, if they are lucky enough, capture the potential profit upsides that may allow them to remain in business.

29. **In general, paddy farmers perceive area-yield index insurance as expensive.** Preliminary exercises indicate that the demand for area-yield index insurance will be low. According to an exercise performed with the farmers during the Frontlands' (Region 6) and Mahaica-Abary's (Region 5) focal groups, only a small proportion of the farmers would be willing to purchase area-yield index crop insurance for 80% coverage level assuming that they would have to pay a commercial premium of 5%. During the above mentioned focal group exercises, farmers were elicited (after the area-yield index coverage was explained to them) about whether or not they would be willing to purchase area-yield index coverage of 80% by paying a commercial premium rate of 5% over the guaranteed yield. The feedback received from this exercise indicates that only 20% of the farmers would be willing to purchase area-yield index insurance under those terms and conditions. Additional information obtained from this exercise indicates that the reasons for not purchasing area-yield index coverage are different among the farmers. In this regard, 50% of the farmers indicated that they would not purchase the coverage because they believe that the insurance product does not meet their coverage needs, while the remaining 50% commented that they would not be willing to purchase the product because they consider it to be very expensive. Through the information obtained from the farmers about their willingness to purchase area-yield index insurance and the indicative commercial rates calculated through the CRAM, it is easy to note that demand will be met only for a very few paddy production zones.

30. The detailed area-yield index commercial indicative premium rates for spring and autumn paddy for each of the paddy production zones in Guyana, assuming 35% grossing up, is presented in Table 9.4.

Illustrative Portfolio Estimates

31. **To date, no area-yield crop insurance demand studies have been conducted for paddy crops in Guyana.** Therefore, at this stage, any portfolio modeling is purely hypothetical and will require validation during the implementation/planning phase. However, using the rating model, scenarios assuming 5% and 10% uptake of spring and autumn paddy crops 5-year planted area in all the paddy production zones in Guyana, and with assumed coverage levels of 70% and 80% of 5-year average yield, have been modeled. At the 5% level of demand uptake and 70% coverage level, the insured area of spring and autumn crops in all the paddy production zones in Guyana would be 13,917 acres with a total sum insured (TSI) of G$701.6 million (US$3.5 million), an estimated premium of G$22 million (US$110,000) and expected loss ratio of 65%. At the highest coverage level – 80% – and a 10% insurance uptake assumption, the total TSI would rise to G$696 (US$3.48 million), with a premium of G$33.4 million (US$167,000) and expected loss ratio of 65%. At the 10% level of demand uptake and 70% coverage level, the insured area of spring and autumn crops in all the paddy production zones in Guyana would be 27,834 acres with a TSI of G$1,218 million (US$6 million), an estimated premium of G$43.9 million (US$219,000) and expected loss ratio of 65%. At the highest coverage level – 80% – and a 10% insurance uptake assumption, the TSI would rise to G$1.39 billion (US$6.9 million), with a premium of G$66.9 million (US$334,000) and expected loss ratio of 65%. These results are summarized in Table 9.5.

Conclusions

32. **Area-yield index insurance is technically feasible in Guyana; however, basis risk issues arising from the cropping conditions in the country are a serious drawback for the implementation of such kind of agricultural insurance coverage.** The Guyana Rice Development Board (GRDB) has a statistically designed and comprehensive system of annual area-yield measurement using farmer surveys that are conducted for the paddy crops in each paddy production zone which, with minor improvements, can be used for area-yield index insurance purposes. However, a preliminary analysis of individual farmer's actual paddy yields indicates that the intra-zone

Table 9.4. Average Indicative Commercial Premium Rates for Coverage Levels from 90% to 50%. (Target Loss Ratio = 65%)

Crop/Season/Zone	Coverage Level								
	90%	85%	80%	75%	70%	65%	60%	55%	50%
Reg2/Spring/Essequibo	5.60	4.07	3.69	3.46	3.23	3.00	2.77	2.54	2.31
Reg3/Spring/Leguan	27.26	24.20	21.32	18.63	16.10	13.73	11.54	9.52	7.64
Reg3/Spring/Wakenaam	19.97	17.22	14.80	12.68	10.80	9.12	7.59	6.19	4.87
Reg3/Spring/West Demerara	18.93	16.25	14.01	12.08	10.38	8.84	7.42	6.04	4.69
Reg4/Spring/Cane Grove	9.18	6.76	4.79	3.46	3.23	3.00	2.77	2.54	2.31
Reg5/Spring/Mahaica-Abary	11.52	8.81	6.58	4.78	3.39	3.00	2.77	2.54	2.31
Reg5/Spring/West Berbice	8.56	6.26	4.41	3.46	3.23	3.00	2.77	2.54	2.31
Reg6/Spring/Black Bush Polder	5.25	3.92	3.69	3.46	3.23	3.00	2.77	2.54	2.31
Reg6/Spring/Frontlands	7.74	5.51	3.76	3.46	3.23	3.00	2.77	2.54	2.31
Average Spring Crop Season	**9.29**	**7.14**	**5.67**	**4.75**	**4.16**	**3.74**	**3.36**	**2.99**	**2.62**
Reg2/Autumn/Essequibo	5.92	3.93	3.32	3.12	2.91	2.70	2.49	2.28	2.08
Reg3/Autumn/Leguan	5.02	4.31	3.66	3.12	2.91	2.70	2.49	2.28	2.08
Reg3/Autumn/Wakenaam	9.83	8.06	6.73	5.70	4.88	4.17	3.51	2.85	2.20
Reg3/Autumn/West Demerara	5.79	5.33	4.86	4.36	3.83	3.25	2.64	2.28	2.08
Reg4/Autumn/Cane Grove	3.74	3.53	3.32	3.12	2.91	2.70	2.49	2.28	2.08
Reg5/Autumn/Mahaica-Abary	6.17	4.22	3.32	3.12	2.91	2.70	2.49	2.28	2.08
Reg5/Autumn/West Berbice	11.09	7.94	5.57	3.81	2.91	2.70	2.49	2.28	2.08
Reg6/Autumn/Black Bush Polder	5.94	3.97	3.32	3.12	2.91	2.70	2.49	2.28	2.08
Reg6/Autumn/Frontlands	6.24	4.22	3.32	3.12	2.91	2.70	2.49	2.28	2.08
Average Autumn Crop Season	**6.75**	**4.86**	**3.90**	**3.40**	**3.04**	**2.78**	**2.52**	**2.29**	**2.08**
Average aggregate crop year	**8.04**	**6.02**	**4.80**	**4.09**	**3.61**	**3.27**	**2.95**	**2.65**	**2.35**

Source: **Authors from the CRAM.**

Table 9.5. Area Yield Portfolio Projections for Spring and Autumn Rice in Guyana for Uptakes Rates of 5% and 10% of the Average Sown Area and Coverage Levels of 70% and 80%

Uptake Level 5% and 70% Coverage Level

Paddy Portfolio	Insured Area (acres)	Sum Insured (G$ millions)	Premium (G$ millions)	Average Premium Rate	Loss Ratio
Spring Paddy Crop Portfolio	7,089	310	12.9	4.16%	65%
Autumn Paddy Crop Portfolio	6,828	299	9.1	3.04%	65%
Total	**13,917**	**609**	**22**	**3.61%**	**65%**

Uptake Level 5% and 80% Coverage Level

Paddy Portfolio	Insured Area (acres)	Sum Insured (G$ millions)	Premium (G$ millions)	Average Premium Rate	Loss Ratio
Spring Paddy Crop Portfolio	7,089	354.6	20.1	5.67%	65%
Autumn Paddy Crop Portfolio	6,828	341.6	13.3	3.90%	65%
Total	**13,917**	**696.2**	**33.4**	**4.80%**	**65%**

Table 9.5. (cont…)

Uptake Level 10% and 70% Coverage Level

Paddy Portfolio	Insured Area (acres)	Sum Insured (G$ millions)	Premium (G$ millions)	Average Premium Rate	Loss Ratio
Spring Paddy Crop Portfolio	14,178	620	25.8	4.16%	65%
Autumn Paddy Crop Portfolio	13,656	598	18.1	3.04%	65%
Total	**27,834**	**1,218**	**43.9**	**3.61%**	**65%**

Uptake Level 10% and 80% Coverage Level

Paddy Portfolio	Insured Area (acres)	Sum Insured (G$ millions)	Premium (G$ millions)	Average Premium Rate	Loss Ratio
Spring Paddy Crop Portfolio	14,178	709.2	40.2	5.67%	65%
Autumn Paddy Crop Portfolio	13,656	683.2	26.7	3.90%	65%
Total	**27,834**	**1,392.4**	**66.9**	**4.80%**	**65%**

Source: **Authors from the CRAM.**

production variation in actual yields is too high, such that basis risk would pose a major problem to the successful implementation of an area-yield index program in Guyana.

33. **In case the GoG desires to move forward on exploring the feasibility and piloting of an area-yield index program, the World Bank would recommend – on the basis of preliminary investigation – to perform a detailed analysis of basis risk in those paddy production zones prone to flood.** The GRDB, although not in a systemic manner, is keeping the original historic actual yield records from yield surveys it performed at each of the paddy harvest seasons from 1994/95 up to 2007/08. Independent private firms like Rice Lab are performing their own yield surveys estimates in Guyana. In case the GoG desires to explore in detail the feasibility of area-yield index insurance for paddy production, it is highly recommended that – prior to doing so – the GRDB rebuilds its farmers yield survey database, to perform an exhaustive analysis of the basis risks, and to re-define the boundaries of the paddy production zones in order to reduce, if possible, the intra-zone basis risks. Otherwise, the World Bank would not recommend moving forward with this product.

34. **On the hypothetical case that area-yield index insurance is implemented in Guyana, the demand for such kind of financial tool, unless it gets significant support from the GoG, will be low.** On the supply side, the rating analysis for area-yield index insurance for spring and autumn paddy crops in different paddy production zones in the country shows that the indicative commercial insurance rates that farmers would have to pay for an area-yield index insurance product will be high. For instance, for an insurance coverage providing a guaranteed yield equivalent to 80% of the most recent 3-year actual production history (APH) of the paddy production zone on which the farm is situated, the farmers would have to pay – in average – 5.67% and 4.80% indicative commercial premium rates for the spring and autumn paddy crops, respectively. On the demand side, farmers perceive area-yield index crop insurance as expensive. As it was noted in this section, only 20% of the interviewed farmers in the focal groups would be willing to purchase an area-yield index insurance covering 80% of their paddy production if the price for this cover is less than 5 percent.

35. **Due to the low expected demand for area-yield index insurance in Guyana, the possible volume of premiums for this product will be very limited in its initial stages of development.** The preliminary portfolio estimates performed for 5% and 10% uptake area-yield index insurance for spring and autumn paddy crops in all the paddy production

zones in Guyana for coverage levels at 70% and 80% of 5-year average yield, indicates that the total volume of premiums would be very low. At a 5% level of demand uptake and 70% coverage level, the insured area of spring and autumn crops in all the paddy production zones in Guyana would be 13,917 acres with a TSI of G$701.6 million (US$3.5 million), an estimated premium of G$22 million (US$110,000) and expected loss ratio of 65%. At the highest coverage level – 80% – and a 10% insurance uptake assumption, the TSI would rise to G$696 million (US$3.48 million), with a premium of G$33.4 million (US$167,000) and expected loss ratio of 65 percent.

36. **In case that area-yield index insurance is implemented in Guyana, an active role of the reinsurance industry would be required.** The combined PML analysis for spring and autumn in all the paddy production zones in Guyana shows that the 1 in 100 years event, in case an 80% coverage level is offered, might cause a loss equivalent to an overall cost for the assessed crop portfolio of 18.1% of the spring crop VAR. Under the assumption of a coverage level of 70% of the 5-year average, the PML with a return period of 1:100 for the portfolio under analysis will cause a loss equivalent to an overall cost of 14% of the spring crop VAR.

Appendix A

Area-yield Index Technical Rates Rating Methodology

The technical rates rating methodology is based on standard area yield rating procedures. The loss cost formula is given by:

$$Loss\ Cost = \frac{Losses\ (claims)}{Liability\ (Sum\ Insured)}$$

For the area-yield index program, the loss cost formula is given by:

$$Loss\ Cost_{YUC} = \frac{Maximum(0, 5\ year\ average\ yield_{YUC} * Coverage\ Level_{YUC} - Actual\ Yield_{YUC})}{(5\ year\ average\ yield_{YUC} * Coverage\ Level_{YUC})}$$

Where,

Y= year, 1994/95-2007/08;

U = paddy crop production zone 1 to 9;

C = crops seasons 1-2;

Coverage Level is between a minimum of 50% and maximum of 90% of average yield.

The loss cost obtained by using this methodology was loaded up by a factor of 20% in order to incorporate the risk due to possible uncertainties in terms of the information used for the rating calculation. The use of loading factors is a common in the reinsurance industry to deal with information uncertainties. The loading factor formula is the following:

$$Loss\ Cost = \frac{Loss\ Cost_{YUC}}{(1 - 0.8)}$$

Using Contiguous Zones to Smooth Rates

The area-yield insurance technical rates obtained for each zone are smoothed by utilizing information from contiguous paddy production zones (Skees, 1997). The technical rate for each paddy production zone is calculated as a weighted average of the technical rate for that paddy production zone and the technical rate for each contiguous paddy production zone. The formula to calculate the smoothed technical rate is:

$$Smoothed\ Technical\ Rate_{TU} = Weight_{TU} * Technical\ Rate_{TU} + \sum_{i=N}(Weight_{CUi} * Technical\ Rate_{CUi})$$

The weights are calculated as follows:

$$Weight_{TU} = 0.9 * \left(\frac{Planted\ Area_{TU}}{100,000}\right)^{0.5}$$

Subject to:

$$0.4 <= Weight_{TU} <= 0.9$$

Where, *Weight*$_{TU}$ is the weight assigned to the target zone and *Planted Area*$_{TU}$ is the average acreage planted in the target zone over the most recent 5-year period; and

$$Weight_{CUi} = (1 - Weight_{TU}) * \frac{Planted\ Area_{CUi}}{\sum_i(Planted\ Area_{Cui})}$$

Where, *Weight*$_{CUi}$ is the weight assigned to the contiguous paddy production zone, and *Planted Area* $_{CUi}$ is the average acreage planted over the most recent 5-year period for each contiguous paddy production zone. All weights sum to one.

Loading Technical Rates to Derive Commercial Premium Rates

The adjusted minimum technical rates calculated by the model are then loaded to cover various cost components in order to derive the final commercial premium rates which are paid by growers. The general formulae for developing the final premium rates include:

$$\textit{Technical Rate} = \textit{Pure Loss Cost Rate} + \textit{Catastrophic Load}$$

$$\textit{Commercial Premium Rate} = \textit{Technical Rate} + \textit{Profit Margin} + \textit{Administrative Expenses} + \textit{Adquisition Cost}$$

Under the current study, for the area-yield index study which is still at the planning stage, a final analysis has not been conducted about the possible effect of climatic change on rates, for each coverage level from 90% down to 50% of expected yield.

At this stage, a detailed analysis has still not been performed of the potential interested insurance companies cost structure (acquisition cost, administrative cost, insurers and reinsurers profit margins expectations). For these reasons, the current study, based on the international experience in area-yield index insurance products, assumes a target loss ratio of 65%. Therefore, the derivation of pure premium rates into indicative commercial premium rates is given by the following formulae:

$$\textit{Indicative Commercial Premium Rates} = \textit{Technical rate} * \frac{1}{(1 - 0.35)}$$

The result of the above formulae is equivalent to applying to the calculated pure loss rates a loading factor of 1.54.

It is noted that 65% is a reasonable target loss ratio for an area-yield insurance cover. It is understood that, if the scheme reaches economies of scale, the administrative expenses could be substantially reduced; thus, the target loss ratio could be increased.

The assumptions made for the derivation of the indicative commercial premium rates for area-yield index insurance in the three selected districts are presented as follows:

Reinsurer expenses and profit margin: A load of 15% has been applied to the technical rate to cover insurers and reinsurers profit expectations, given a net rate to reinsurers of 115% of the technical premium.

Ceding commission: the net rate to reinsurers is grossed up by 15% (equivalent to a load of 18%) for ceding commission to cover the insurance company acquisition and administrative expenses. This loading amounts to a total cost load factor on the technical rate of 18% applicable to the technical rate.

Table A.1. Illustrative Build-up of Commercial Premium Rates with Gross-up of 35% (Load Factor: 1.54) Applied to Technical Rates

Cost Item to Apply to the Pure Loss Rate	Type	Loading Factor (Multiplication)	Gross-up	Load Application to the Pure Rate
Final Commercial Premium Rate				**154%**
Ceding Commission	Grossing-up	29%	0.19	
Net Rate to Reinsurer				**125%**
Reinsurer Expenses + Profit	Load	25%	0.2	
Technical Rate				**100%**

Annex 10. Fruit and Vegetables Named-peril Policy Features and Suitability for Guyana

1. This Annex presents further information on the key features of named-peril damage based crop insurance and indemnity products, and is based on Itturioz, 2009[68].

2. Named-peril (damage-based), as the name suggests, provides indemnity against those adverse events that are explicitly listed in the policy. This subclass has a number of distinctive features:

- The sum insured is agreed at the inception of the contract and may be based on production costs or on the expected crop revenue;

- The loss is determined as a percentage of the damage incurred by the insured party as established by a loss adjuster as soon after the damage occurs;

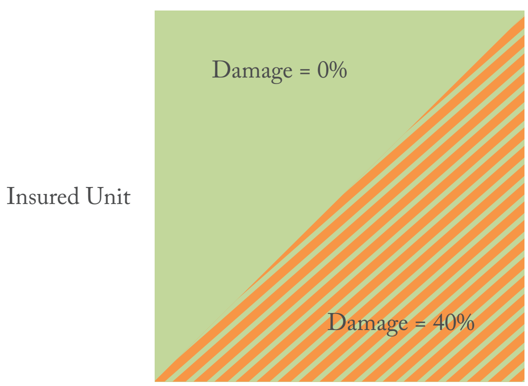
- The indemnity is calculated as the product of the percentage of the damage and the sum insured;

- Deductibles[69] and franchises[70] are normally applied to reduce the incidence of false claims and to encourage improvements in risk management.

An example of indemnity under a named-peril contract is illustrated in Figure 10.1 below.

3. Named-peril is a popular type of insurance and accounts for a significant portion of the agricultural premiums worldwide. From the perspective of the insured parties, it appeals to firms that are located in areas frequently subjected to one of the covered perils; from the insurer's point of view, it is suitable for situations where the damages caused by the named-perils are both measurable and have sudden impact.

Figure 10.1. Example of Indemnity of a Named-peril Insurance Contract



Insurance Contract Conditions:
Insured Peril: Hail
Sum Insured: US$10,000
Indemnity Limit: Full Value
Deductible: **Option A)** 5% of the total sum insured
Option B) 10% of the loss

Loss Adjustment:
- 50% of the insured unit with 0% damage.
- 50% of the insured unit with 40% damage.
Consequently, **Total Damage = 50%*0% +50%*40% = 20%**

Indemnity Calculation:
Indemnity = Damage (%) * Total Sum Insured – Deductible
Option A) 20% * US$10,000 – US$10,000*5% = **US$1,500**
Option B) 20% * US$10,000 – US$10,000*20%*10% = **US$1,800**

Source: **Iturrioz, R. (2009).**

4. Named-peril insurance contracts are used extensively around the world to protect against hail damage, specially in horticulture and floriculture in addition to crops and fruits, but are also used in livestock, bloodstock, aquaculture, forestry and greenhouses insurance.

68 Itturioz, R. (2009): Agricultural Insurance: A Primer. The World Bank, Washington, D.C.

69 A deductible is an amount or a percentage of the loss that is deducted from the indemnity and represents the first portion of the claim that the insured bears. The purpose of a deductible is to reduce moral hazard by encouraging the insured to prevent losses. Deductibles can be either a percentage of the sum insured or a percentage of the loss and can be applied to each and every loss or to the total losses over a specified period, normally the currency of the contract.

70 A franchise is a loss threshold that the insured has to reach in order to be able to receive the indemnity. Once the threshold is reached the amount of any subsequent loss is paid in full. The purpose of a franchise is to reduce claim frequency.

Annex 11. Livestock Insurance Policy Features and Suitability for Guyana

1. This Annex presents further information on the key features of livestock insurance based on Itturioz, 2009[71].

Livestock Insurance

2. Livestock insurance provides insurance products to cover horses, mares, colts, fillies and foals; bulls, cows and heifers; swine; sheep, goats and dogs and, occasionally, wild animals. It is a relatively small segment of the market accounting for 4% of the total agricultural insurance premium written worldwide in 2008.

3. The protection offered under livestock products includes losses arising from death, injury and loss of function as a result of accidents, natural causes, fire, lightning, acts of God, and acts of individuals other than the owner. Cover is extended to forced slaughter of livestock on humanitarian grounds. Additional coverage can generally be purchased for veterinary expenses, transport and non-epidemic diseases.

4. The sum insured is based on the market value of the animal and can be reduced based on the animal's age. Premium rates range from 1.5% to 10% of the sum insured based on the type of animal, its age, location and the tasks it performs. Deductibles range from no deductible to 10 percent.

5. Traditionally, epizootic[72] diseases have been a standard exclusion under livestock policies although some companies have begun to offer cover on a very selective basis. Epizootic insurance coverage is offered to the governments of countries that can demonstrate superior sanitary conditions and effective controls to prevent particular diseases from entering the country. Where it is offered, the insurance covers business interruption and the costs to government of slaughtering animals to curtail outbreaks of the relevant diseases.

6. Livestock mortality index insurance is a relatively new form of livestock insurance that was introduced in Mongolia. It has potential in countries where livestock production is exposed to catastrophic losses[73].

Bloodstock Insurance

7. Bloodstock insurance provides cover for high value animals, mainly equines. It is also a minor business line accounting for 3% of the agricultural premium written worldwide in 2008. Animals are either insured on an individual basis or collectively, such as where a stable of horses is insured. The insured events include mortality, disability, infertility, medical treatment and surgery.

8. The sum insured is based on the market value of the animal. The market value is determined by the prizes that the animal has won or the present value of the future prizes that it potentially could win. Any matter that adversely affects the animal's capacity to win prizes will affect its market value and can result in overinsurance. To deal with the potential moral hazard, it is common practice amongst bloodstock insurers to insure high-value animals for only a portion of their market value.

9. Premium rates vary in the range of 0.5 to 10%. Claims are normally subject to a deductible of 10 percent.

71 Itturioz, R., 2009. Agricultural Insurance: A Primer. The World Bank, Washington, D.C.

72 A disease or condition that occurs at about the same time in many individuals of the same species in a geographic area.

73 Refer to the case outlined in Annex 3.

Annex 11A. Community-run Livestock Insurance Scheme in India

1. Livestock is susceptible to different types of risks, both idiosyncratic and covariant. The death of animals in accidents is not uncommon. Mortality of livestock is one of the principal causes of loan defaults by the poor. In the absence of comprehensive insurance for livestock, many of the poor are exposed to the loss of their livelihood after the death of livestock. This is the background against which loan protection schemes for dairy cows and buffalo were implemented.

Loan Protection Scheme for Dairy Cows and Buffalo

2. The scheme provides relief to the members and family members of the self-help group (SHG) who own the milk cattle, in the case of death of an animal. This is a premium-based scheme under which every individual animal (buffalo/cow) is covered in consideration of an annual premium of 4% of the value of the animal (plus a small entry fee). The value of the animal is estimated by a veterinary. The value decreases with the age of the animal and progressively over the currency of the policy: (i) up to three months from the date of insurance: 90% of the animal's value; (ii) three to six months: 85%; (iii) six to nine months: 82%; (iv) nine months to one year: 80 percent.

3. Policies are for one year and can be renewed. On renewal, the value of the animal for insurance purposes is reduced by 20% from the previous year. The scheme is totally self-managed by the community. Accounting, monitoring and documentation systems are designed and implemented in-house.

Claim Procedure

4. Upon the death of an insured animal, the claim form is sent to the Village Organization (VO). A member of the sub-committee verifies the claim by visiting the village. After discussing the issue with the sub-committee, the claim is either settled or rejected. The settled claim is given to the VO by way of a check. The VO pays the claim amount to the beneficiary.

Performance

5. The community-based animal insurance scheme is among the first of its kind in India. The scheme is community-based and relies on peer monitoring. The number of animals insured increased from 3,500 in 2005 to 25,500 in 2008. Premium collected increased from US$3.7 million in 2005 to US$8 million in 2008. The claims ratio has been stable, at around 2.6%. This makes this scheme financially viable. Operating costs represent 12% of the premium income. It is essential to keep the operating costs (e.g. underwriting cost, loss assessment costs and claims processing costs) at a minimum to ensure the sustainability of the scheme. Peer monitoring is critical to the success of the scheme in preventing false claims being paid. Community supervision and vigilance has been very effective.

Annex 12. Aquaculture Insurance Policy Features and Suitability for Guyana

1. **This Annex presents the basic design features for the implementation of aquaculture insurance policies for shrimp and tilapia production in Guyana.** The objective of this Annex is to provide an overview of the design and possible applications of aquaculture insurance in Guyana. The Annex starts with a description of the main features of aquaculture insurance policies. Then, it describes the preconditions required for its implementation. Finally, the Annex analyzes the aquaculture insurance suitability for its implementation to cover risks on shrimp and tilapia production in Guyana.

2. **Aquaculture insurance is widely practiced throughout the world.** The main aquaculture-producing countries have aquaculture insurance programs in place. In the Asian region, China, India, Japan and Vietnam have well developed aquaculture insurance programs. In Europe, France, Italy, Norway, Spain and the United Kingdom are at the vanguard of the use of this risk transfer instrument to protect their aquaculture productions. This insurance product is also widely distributed for salmon production in Chile and for shrimp production in Mexico. This insurance product is also widely practiced in the United States and Canada, Africa and Oceania (Australia and New Zealand).

3. **The supply of the aquaculture reinsurance market includes few specialized insurers and reinsurers.** Locally, very few insurance companies have developed the expertise to write aquaculture insurance. The underwriting of such risk is often done by using the advice of specialized professionals or delegated to international aquaculture underwriting agencies. To spread the risks, insurance companies often aim to reinsure a part of them. The insurance market is dominated by a few large reinsurance institutions, which include Lloyd's of London, SwissRe, MunichRe, PartnerRe, SCOR, MapfreRe and HannoverRe. A great number of aquaculture policies are reinsured through these institutions.

Features of Aquaculture Insurance Policies

4. **Aquaculture insurance policies are fairly standard.** When looking at the policy wording of aquaculture insurance policies, a fair amount of standardization can be found in terms of terminology, procedures and cover against perils. However, the great variety in species, growing systems and premium setting methodology, risks assessments, policy conditions, product prices and compensation for claims make it difficult for aquaculture firms to compare services from different insurance companies.

5. **Aquaculture insurance policies can be categorized into two types: (i) named-peril insurance policies, and (ii) all-risk insurance policies.** The most common type of aquaculture insurance policies is the named-peril policy. Under a named-peril aquaculture insurance scheme, the policy covers the policyholder against the sudden and unforeseen damage arisen from the risk expressly named in the policy wording; that is, that those risks that are not mentioned in the policy wording are not covered. The second type of aquaculture insurance scheme, the all-risk policy, covers a wide spectrum of risks affecting aquaculture production that are not necessary listed in the policy wording. In other words, "all-risk" policies cover all the risks faced by aquaculture production except for those that are expressly excluded in the policy wording. "All-risk" aquaculture insurance policies are offered on a very limited basis.

6. **Aquaculture insurance policies cover a spectrum of perils faced by aquaculture production.** The perils covered by aquaculture insurance policies vary according to the species, the risk location, the production system, and whether or not the insured farm is situated on-shore or off-shore. The most common perils covered by the aquaculture insurance, which might be relevant for aquaculture production in Guyana, are: (i) pollution from external sources; (ii) aircraft and other aerial devices or articles dropped from the sky; (iii) malicious acts; (iv) predation; (v) floods, inundations and tidal waves; (vi) storm damage; (vii) structural failures (e.g. of dykes), breakage or blockage of any part of the water supply system; (viii) drought, fire, lightning, explosion; (ix) mechanical breakdown or accidental damage to machinery and

other installations; (x) electrical breakdown, failure or interruption of the electricity supply, and electrocution; (xi) de-oxygenation and other changes in the concentration of the normal chemical constituents of the water that cause damage; (xii) de-oxygenation due to competing biological activity or to changes in the physical or chemical conditions of the water, including upwelling and high water temperatures; (xiii) other changes in the concentration of the normal chemical constituents of the water, including pH or salinity; (xiv) additional cover for known diseases; and (xv) algae bloom. Additionally, insurance companies offering coverage for biomass stock also offer coverage for on-shore aquaculture equipment, boats, and other transport and off-shore equipment. Aquaculture livestock in transit is also currently insured by some insurance companies on a very limited basis. Theft, riots, strike, war and similar disturbances are generally not covered, nor is damage caused by negligence of the policyholder.

7. **The insurance industry is very selective on the type of aquaculture production systems it insures.** Most aquaculture insurance companies insure on-shore culture in ponds, raceway systems and recirculation systems. Most of the intensive and semi-intensive culture systems can be considered for insurance. Extensive or improved extensive systems are less likely to be insured. Some improved extensive pond production is insured, but only in a few selected countries. Hatchery and nursery production is only insured on a very limited scale. Not many insurance companies are eager to step into shrimp hatchery production insurance.

8. **Owing to moral hazard and exposure problems, aquaculture insurance policies have very strict conditions.** The use of insurance deductibles and aggregate indemnity limits is a common practice in aquaculture insurance. While the reason for using insurance deductibles is to avoid moral hazard problems, the reason for the use of aggregate limits to the coverage is to control risk exposure. The level of insurance deductibles varies according to the covered risk, species and production system. Those risks that are frequent or are considered to be more in connection with aquaculture management and/or husbandry practices have higher deductibles than those which are considered to be unforeseen or not in connection with management and/or husbandry practices. For example, disease perils have higher deductibles than storm perils. Intensive aquaculture production systems, since their performance is more influenced by aquaculture management practices, use to have higher deductibles for certain perils than the semi-intensive production systems. The use of aggregate indemnity limits for underwriting aquaculture risks is also widely practiced by the insurance industry, in particular, for those perils of catastrophic nature. The indemnity limits can be established per event or in the annual aggregate.

9. **Loss adjustment is a key aspect of aquaculture insurance.** In aquaculture insurance, independent loss adjusters are used for assessing claims against policies, following damage or losses. Aquaculture loss adjustment is a very complex and specialized type of activity. There are few loss adjusters specialized in aquaculture around the world. In some countries where aquaculture insurance is well established (e.g. the United Kingdom, Chile, Norway and New Zealand), the insurance companies often have in-house, experienced loss adjusters. In other countries, where the aquaculture industry is less developed, insurance companies rely on the services provided by independent loss adjusters that are brought from overseas in case of claims affecting their aquaculture portfolio. Risk mitigation procedures are also very important in aquaculture insurance. Insurance companies consider of utmost importance that damage to or losses of insured aquaculture stock are reported immediately to the insurance company. The policies often provide guidance on the reporting procedures. Generally, events that might result in losses must also be reported so that the insurance companies receive information before the losses occur. This greatly facilitates their loss adjustment and enables the insurance companies to provide immediate, specialized assistance to mitigate or prevent losses.

Preconditions for Aquaculture Insurance

10. **The implementation of good risk management practices by the aquaculture farmers is a precondition to gain access to aquaculture insurance.** Aquaculture insurance schemes are designed to promote "good" behavior, that is,

aquaculture farmers should try to minimize the risks involved for themselves, the environment and their insurance companies. Several insurance companies involved in aquaculture insurance include preconditions before policies are issued and almost always include best practices and contingency protocols in their policies. Preconditions can include access to clean water sources for land-based ponds. Best practices listed may be the frequent monitoring of water quality, purchase of certified disease-free fingerlings, and farm record-keeping. Contingency protocols (e.g. anticipated harvest) involve detailed action plans that will be in force at the time when the covered event occurs. Risk management surveys are almost always requested as a precondition to write aquaculture risks. These risk management surveys are generally not limited to risk assessment surveys. The latter are used by insurance companies to obtain more information in addition to the commonly used proposal forms that have to be filled by those who apply for aquaculture insurance. These surveys include the assessment of the site, its management and a biological survey. The risk management surveys are regularly carried out by insurers' local aquaculture experts, if they are available in the country, and/or experienced general insurance surveyors to inspect fish farm sites. In the case of non-existence of qualified local aquaculture insurance surveyors, insurance companies may bring in surveyors from outside with particularly specialized experience.

11. **The availability of a reliable market and the existence of the adequate market infrastructure for aquaculture production are also considered by the insurance industry as a precondition to write aquaculture risks.** In order to make the decision about whether or not to write aquaculture risks, an insurance company will also bring into consideration other issues that are beyond the aquaculture farm boundaries. Aquaculture underwriters will request the existence of a reliable market to commercialize the aquaculture production. In this regard, issues like how close is the farm to the target market (e.g. distance to the export market, cooling and transportation facilities, final prices, threats from potential competitors) and how strong is the linkage of the local aquaculture market with the target markets (e.g. long-term and formal relationships with the markets are preferred over those which are opportunistic) are assessed by the insurance industry at the moment of writing aquaculture risk. Aquaculture underwriters will also assess the current state-of-the-art market infrastructure for aquaculture production on the country or region on which the risk is situated. Aquaculture underwriters will assess the sources of raw materials utilized by the aquaculture firm. Issues like the quantity, quality and availability of fingerlings, fodder, and other inputs of aquaculture production are appraised at the moment of making the decision about whether to write an aquaculture risk in a certain location. The existence of health care programs and contingency protocols in case of transmittable diseases on aquaculture is also evaluated. Last, but not least, the insurance industry will also require the existence of a reliable network of ictopathology laboratories in the country.

Aquaculture Insurance Suitability for Guyana

12. **There are opportunities for the development of aquaculture insurance in Guyana in the short and medium term.** Although this industry is on its initial stages and the sources of risk are high, the industry seems to be well organized and most of the risk management measures are in place. Specialized reinsurers may be willing to analyze aquaculture insurance proposals to cover against natural perils; nevertheless, it is important to take into consideration that they will include, as a precondition to write these risks, the implementation of risk surveys by designated risk surveyors and the designation of their own loss adjusters. These two factors may increase the asked price for the coverage.

13. **The precondition for the development of aquaculture insurance is the development of local expertise.** Currently there is no local expertise in Guyana, either to write or to adjust losses in aquaculture insurance; therefore, in case that the local insurance industry decides to develop aquaculture insurance in the country, this expertise should be brought from overseas. To import aquaculture underwriting and loss adjustment expertise from overseas would imply a significant cost in the premiums to be paid by the aquaculture farmers in the initial stages of the aquaculture industry development in the country.

Annex 13. Crop Weather Index Insurance Features and Suitability for Guyana

1. **This Annex outlines the preconditions needed for Crop Weather Index Insurance (CWII) implementation in Guyana.** The objectives of this Annex are to illustrate how index-based insurance products could help in mitigating the financial impact of weather on the agricultural sector, and to provide a comprehensive overview of the design. The Annex starts with a CWII product description, and its advantages and disadvantages in comparison with traditional products. Finally, the Annex analyzes whether CWII implementation is suitable to provide farmers protection against weather events or whether mechanisms already exist from which a risk management program could be designed. The analysis is based on previous sections such as: Climatic Risk Exposures of Agriculture (Annex 1), Agricultural Production Systems (Annex 2), Crop Weather Risk Assessment (Annex 4), the information provided, and the interviews conducted.

2. **Index-based insurance products follow all basic principles of traditional insurance contracts.** Index products provide details regarding the risk that would be covered and specify those that would be excluded. The contract could be designed to offer protection at all levels[74] from which the policy contract payment scheme and mechanism, in case there is an insurance event, will be defined. However, it is worth mentioning that weather index insurance products, unlike traditional products, make indemnity payments based not on an assessment of the policyholders individual loss, but rather on measures of an index that is correlated with losses and serves as a proxy for actual losses. The insurance is structured to pay out whenever the weather parameter is likely to cause damage to crop yields by being too high or too low. It means that the payout is made to the insured based upon values of the index exceeding pre-determined thresholds. Variations on the structure of crop weather index insurance contracts could be designed for specific weather risks, particularly seed crop characteristics and crop phenology stage, or it could be adjusted according to the length of the crop cycle. The contract design process, however, should guarantee that the index satisfies clients and regulatory requirements (i.e. that contract payouts are similar to crop losses, and that there is an insurable interest[75]). Box 13.1 provides a list of advantages and disadvantages of index-based insurance contracts.

Common key features and characteristics on all index-based insurance contracts include:

- **The Index:** details of index construction and weather parameters are given.
- **The Protection Period:** it specifies the start and end of the contract as well as all the stages that comprise the policy.
- **Trigger Levels:** the triggers are defined as the levels at which the policyholder starts receiving indemnity payments due to weather coverage.
- **Payout Rate or Ticks:** refers to the fixed payout that a policyholder receives once the trigger level has been passed.
- **Maximum Payout:** refers to the maximum payout in each risk protection period that the insurer includes in the contract to prevent excessive losses.

3. **The policyholder of an index-based insurance contract may receive an indemnity payment without having experienced any farm-yield loss and vice versa;** therefore, the effectiveness of index insurance as a risk management tool depends on how positively correlated actual losses are across a large geographic area with the underlying weather index. The risk of facing a potential mismatch between contract payouts and the actual losses experienced

74 The inherent flexibility on index-based insurance products allows the insurance companies to provide protection ranging from the risks faced by individual farmers to those of financial institutions, and even the risks faced by a government or international organizations.

75 Someone has an insurable interest in something when the partial or total damage of it would cause that individual or organization to experience a financial loss. The regulator will not allow any product from which the policyholders could have the chance to gain from speculating on an event occurring; such speculators are driven by a gambling motive rather than by a risk management motive.

Box 13.1. Crop Weather Index Insurance: Advantages and Disadvantages

ADVANTAGES

1. Small list of information requirements.
Risks assessment is done by analyzing historic weather data to evaluate the impact and frequency of a specific event on crop production.

2. Moral hazard and adverse selection are minimized.
Neither policyholder nor insurance companies can increase the likelihood of receiving a payment because indemnities are based on a pre-specified threshold for a specific parameter. In addition, index insurance is based on information that is widely available reducing the case in which the insured exploits it to self-select whether or not to purchase insurance.

3. Low administrative cost and transparent structure.
The cost to the insurer could be significantly less because there is no need for individual risk assessments or loss adjustment. Index-based insurance contracts could be designed on a simpler and uniform format; this facilitates the contract wording process and its understanding by the insured in comparison with traditional insurance policies.

DISADVANTAGES

1. Basis risk issues.
Index-based insurance will not work in areas dominated by micro-climate conditions and where there is no positive correlation between the index and the crop loss.

2. Requires access to long, cleaned and consistent historic data.
The index-based insurance will fail if data used to establish indemnity payments cannot be trusted or is inaccurate.

3. The index must be measured reliably and consistently.
Index-based insurance programs, based on a weather station network, need sufficient weather stations located near productive areas to reach commercial premium volumes. However, this may not be available for many developing countries.

by policyholders could be minimized by improving contract design with the use of sensible indexes, covering just extreme risks that cause severe losses to all crops over a geographic wide area, or designing insurance products at the meso-level or macro-level for rural financial institutions or government entities. However, it is important to mention that despite of having new innovations in technology that could lead the insurance industry to expand the number of locations where weather index could provide coverage against weather events, not all weather events are insurable (i.e. hail, which is a localized meteorological phenomenon) and not always crop weather index insurance can be developed to protect individual farmers unless the contract designers overcome the basis risk and lack of information needed for risk quantification, pricing and contract implementation.

4. **Flood has been identified as one of the main causes of crop losses in Guyana.** The rainy season is the period where farmers are more susceptible to flooding. The types of flood risk that are most common are: (i) river flooding, which may occur due to sustained rainfall caused by tropical depressions or similar phenomena, or sudden release of considerable amount of water from an upstream impoundment created behind; (ii) flash flooding, resulting from concentrated rainfall over a particular area. The flood impact of intensive rainfall is more severe when rainfall accumulates across a surface that is already saturated; therefore, a cumulative impact is obtained due to sequential intense rainfall.

5. **Flooding is a very challenging risk on which to base an insurance contract.** With regard to the design of flood indices, which are more complex than drought crop weather indices, a combination of different sources of information (i.e. river gauge, water tables records at the conservancies, rainfall data, flood plain modeling, agro-meteorological modeling, remote sensing and related geo-information technology) is needed in order to accurately design a contract that could be a proxy of crop losses. Although a flood index could be estimated, it is technically challenging because:

i. The financial impacts that are caused by floods will depend on flooding typology (i.e.

fast floods which destroy crop plantations because of water runoff or the ones caused by dam breakage) and on the available terrain to allow a rapid water dissipation. Besides, flooding characteristics such as the level and duration of inundation will determine the types of damage that are caused[76]. In addition, crops respond differently to floods even within the same species. For example, vegetables are very susceptible to crop losses and suffer from product quality damages due to excess of water on the terrain; on the contrary, rice (depending on the phenological stage) and banana can stand flooding for about two days without suffering significant damages.

ii. Terrain and hydrological characteristics of the region of interest are needed to run models to produce estimates of the likelihood and severity of flooding. Although there are new techniques on meteorology and hydrology for data reconstruction and flood assessment that could facilitate the conduction of a modeling study, the quantification of crops losses varies according to the phenological or agronomic stage which is impacted due to flooding effects. In general, crops do not suffer major losses due to flooding during the development stage; on the contrary, the most vulnerable periods could be during flowering and ripening

iii. Investment on improving the drainage and irrigation infrastructure can mitigate flood damages to some extent. The reinsurance market, as well as insurer players, will not be interested in providing any coverage without having the certainty that the drainage and irrigation system works properly and there is a consistent annual plan for its maintenance. Furthermore, to set the payment rules for any insurable option, the risk taker will also demand data collection security to evaluate the risk and exposure of potential clients.

76 Flood damages could be direct or indirect. Direct losses refer to the direct physical damage to assets arising from flood; meanwhile, indirect losses are associated with business interruption or its effects on the following cropping cycle (i.e. annual crops) or costs associated with plantation reestablishment (i.e. perennial crops).

6. **The complexity of designing a flood index that fully describes an event will require, in comparison with simpler indices (i.e. rainfall or temperature), the combination of various measurable parameters,** such as timing of flood, peak flows, duration of discharge, volume of discharge, depth of inundation, and others. Although nowadays it is possible to use advanced hydrology modeling techniques to improve the accuracy from which flood risk could be assessed, it is relevant to mention that most of these methods assume, for statistical purposes, that flooding characteristics do not vary over time. However, an increase in the frequency and magnitude of floods events due to alterations on local and global environmental conditions has been registered, thus, affecting the initial estimates with regard to the magnitude of the event. Consequently, flood risks assessment based on standard methodologies should not be considered as the only approach for describing a flood. For example, remote sensor techniques can be a second source of information to better determine those land areas which are under water and where floods were not originally identified to occur. In this regard, the operation of a flood index insurance program will require to: (i) define the areas with similar flooding characteristics and from which premium prices will be calculated (hydrological models[77] outputs can be used as a basis to accomplish this objective); (ii) plot farmers' information (i.e. location, farmers´ names, covered area, crop, etc.) under a GIS database so that they can be grouped and treated according with the flooding homogeneous areas where they are located by the time a flood event occurs.

Conclusions

7. **Given that there are several preconditions that still need to be met in Guyana for the development of flood index insurance, its implementation cannot be reached in the short term.** The limitations that the Government needs to address for flood index insurance implementation can be summarized as follows:

i. There is limited weather/hydrology information about the catchment areas that could be used

77 Hydraulic models used for flood modeling can be divided into one dimensional, quasi-two dimensional, and combined models.

to analyze storms and perform a flood risk assessment by modeling. Data collection, data processing and technical capacity are needed to provide inputs for flood modeling and to support insurers in setting premiums.

ii. Drainage and irrigation infrastructure needs to be rehabilitated to guarantee the system's functionality and efficiency. The inadequate current physical conditions of the system can affect further flood modeling estimations about the size and frequency of the flood flows and the determination of inundation depth. As a result of this, the information needed for pricing will be imprecise (i.e. frequency of events and flood risk quantification) and inadequate.

iii. There are few or no formal rules under which the National Drainage and Irrigation Authority (NDIA) decides to provide water for crop irrigation in the coastal regions, as well as when it is imperative to inundate such productive areas. A flood event caused by arbitrary decisions will affect the credibility of any flood index insurance program that could be implemented because the policyholder, despite having suffered from crop losses, will not receive any payment since these are triggered by a pre-defined parameter threshold which in this case was not reached.

iv. There is no technical capacity to conduct loss adjustments that can estimate crop losses or provide figures with regard to the economical impact suffered after the occurrence of a flood disaster.

v. Except from traditional crops (i.e. rice and sugar cane), there is no clear definition of farmers' typology, number, location, planted area and planting calendars from which any flood index insurance program can be designed.

Annex 14. Bank and MFI Lending to Agriculture

1. **This Annex presents and overview of the banking and MFI sector lending to agriculture in Guyana.** The objective of the Annex is to provide an overview of the financial sector in Guyana, particularly, of those institutions lending to the agricultural sector in the country. The Annex is divided into two parts. The first one presents the description of the financial system in Guyana. The second one presents the main sources of finance to the agricultural sector in the country.

Overview of the Financial System

2. **The financial sector has experienced significant changes over the last decade, both in terms of its ownership structure and regulation.** Privatization of state-owned financial institutions was a major part of the reforms. Today the domestic financial system consists of institutions that can be divided into two subsystems: deposit taking institutions, comprising commercial banks and "near banks" which take certain deposits and make loans (including credit unions and the New Building Society), and the non-bank financial system, which includes insurance companies, securities firms, small money lenders, and pension funds.

3. **The financial system is dominated by banks, although non-bank institutions have grown in recent years.** Currently, there are six commercial banks and seven non-financial institutions authorized to operate in the country. The banking system is still concentrated. The largest two banks hold about half of the banking assets. The financial system is under the supervision of the Bank of Guyana through its Bank Supervision Department.

4. **Owing to structural reasons, banks' portfolios and ownership are concentrated and, thus, inherently riskier than in larger, more diversified economies.** In recent years, there has been progress regarding the regulatory framework for supervision. While prudential requirements are broadly aligned with international standards (including capital adequacy, loan classification, and supervisory methods), weaknesses remain in risk management and other specific provisions.

5. **The financial sector in Guyana has a risk adverse behavior; there is an apparent unwillingness of financial institutions to take credit risk.** While the ratio of banking system deposits to GDP is higher than in other small, low-income, commodity-based countries, the banks' private credit to deposit ratio in Guyana is low compared to those countries. Other indicators of the financial sector unwillingness to take credit risk are the large interest rate spreads and the excess liquidity. Both of them indicate that some form of bank credit rationing is taking place in the country. The commercial banks' interest rate spreads between the small savings rate and the prime lending rate was 11.76% at the end of June 2009. Institutional deficiencies are part of the explanation for the low rate of transformation of savings into private credit. Due to the lack of credit information systems, audited financial statements, bankable business plans, and problems with collateral collection, banks impose high costs for finance and have stringent collateral requirements. In particular, this discourages lending to smaller enterprises and lower-income households due to the high relative cost of obtaining this information for small loans.

6. **Recently, the banking system recovered from an exposure to loan defaults in the mid-2000's following stagnant growth, lower export prices and big floods.** Credit demand used to be limited in the mid 2000's due to the low overall growth. Banks have been more risk averse and reluctant to lending in the wake of the large share of loans to the agricultural sector that were not honored in the late 1990's. This factor, together with institutional rigidities, has contributed to the persistence of high lending spreads. The weak credit information infrastructure, where financial reporting is not always reliable and its availability is mostly restricted to large corporate borrowers, has led to banks relying heavily on physical and "reputational" collateral.

7. **Commercial banks are the main source of finance in the country.** Banks account for about 70% of financial assets. Loans and cash advances to the private sector during 2009 reached G$60.48 billion (US$302.5 million) remaining almost invariable in comparison to 2008 and increasing by 21% in comparison with 2007. Commercial banks continue to hold a significant part of their investment portfolio in government securities with

treasury bills amounting to G$53.63 billion (US$268 million), a 21% increase from G$44.24 billion (US$221 million) in 2008. Loans and advances to the private sector have been growing during the last six years. While the loans and advances to the private sector amounted to G$34.77 billion (US$174 million) in 2004, the loans and advances to the private sector at the end of 2009 were amounting to $60.48 billion (US$302 million); this represents a 74% increase during the analyzed period. This growth was due primarily to the improved macroeconomic conditions in the country. The ratio of banks credit to resident deposits currently accounts for 0.31%. The commercial banks' major exposures to the private sector were 27% to real estate, 21% to personal, 14% to distribution, 13% to manufacturing, 10% to services, 8% to the 'other' category, 5% to agriculture, and 2% to mining.

8. **Finance companies, building societies and trust companies have also an important role in the financial sector.** These companies belong to the non-bank financial institution sector which includes depository and non-depository, licensed and unlicensed financial institutions. Finance companies include micro finance companies such as the Institute of Private Enterprise Development (IPED), the Small Business Development Trust (SBDT) and Development Financing Limited South America (DFLSA) which provide micro credit. The main objective of the building societies is to provide mortgage and savings products. Trust companies compete with the commercial banking sector for deposits and loans. During 2008, the financial resources of finance, building societies and trust companies reached G$62.51 billion (US$312.5 million). Total resources of the New Building Society (NBS) reached G$36.82 billion (US$184 million); the financial resources of finance companies reached G$16.86 billion (US$84.3 million); and trust companies reached G$8.81 billion (US$44 million).

Rural Finance in Guyana

9. **The flow of financing to the agricultural farming sector is not adequately supportive of the development of this sector of the economy.** Currently, most of the commercial banks and one micro finance institution – the IPED - are lending to the rural sector; however, the amount of rural credit available and the accessibility by the farmers is very limited and expensive. As of 2009, the total agricultural farming lending portfolio in Guyana amounted to G$6.76 billion[78]. Commercial banks total lending portfolio to the agricultural farming sector amounted to G$5.54 billion (additionally, G$2.96 billion are lent to rice millers and sugar molasses producers), which represented 8.8% of the total bank lending in the country. Micro finance institutions – the IPED – agricultural loan portfolio during the same year amounted to G$1.23 billion. Loan maturity periods are no longer than 6 months and the interest rates for rural lending are extremely high ranging from 15% up to 26%. Additionally, collateral requirements to access rural credit are extremely high.

10. **The total bank financing to the agricultural farming sector has been diminishing during the last decade.** The banking sector financing to the agricultural farming[79] sector has diminished by 35% during the period up to and including 2009, from G$8.67 billion in 2000 to G$5.54 billion. As a percentage of total bank financing, agriculture farming accounted for 8.8% in 2009, relative to 16% in 2000. While as of 2009 lending for rice farming was G$1.15 billion, as of year 2000 the figure for rice farmers was G$5.73 billion. Conversely, while as of 2009 lending for sugar cane crops was G$2.09 billion, as of year 2000 the figure for sugar cane crops was G$456 million. Lending to the livestock sub-sector was G$598 million at 2009, relative to G$890 million at 2000; while lending to the shrimp and fishing sub-sector was G$1.18 billion at 2009, relative to G$995 million at 2000. Several factors have contributed to the reduced bank lending to the agricultural sector over the last decade. From the banking sector side: (i) banks have become more urban oriented in their lending; (ii) banks became more bottom-line focused within the short term; (iii) banks distribute their assets in favor of investment, rather than in lending; (iv) banks are not adequately staffed for lending to agriculture; (v) bank lending policies became inflexible enough to accommodate long-term loans to the agriculture sector (securing a loan takes 3-6 months, while realizing security can take up to ten years); (vi) lack of a structure of contracts for both internal and external transactions, which impedes access to pre- and post-crop financing based on the assigning of proceeds;

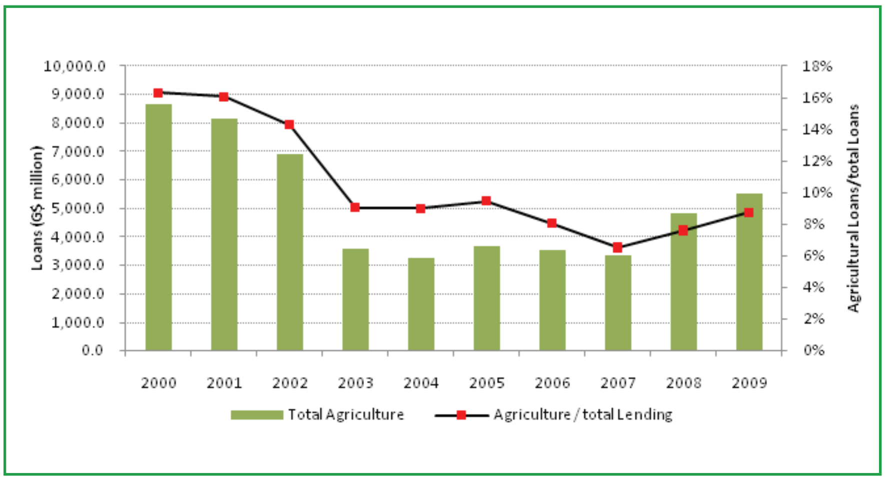
78 Bank of Guyana. Banking System Statistical Abstract, February, 2010 and IPED, 2008.

79 Applicable only for agriculture farming. Agroindustry is excluded.

and (vii) agriculture assets lack adequate resale value – since they are of a specialized nature, and entry for new players is restrictive. From the agricultural sector side, the main causes which contributed to impeding finance were the erosion of the margins obtained by agricultural producers (as a combination of the decrease of commodity prices and an increase on input prices), and land tenure problems. The evolution of banking system agricultural loans, as well as its participation on the total banking loan portfolio in Guyana for the period from 2000 and up to 2009, is presented in Figure 14.1.

11. **Larger farmers are able to access loans from commercial banks and banks rarely lend directly to the small farmers.** A credit survey of rice farmers in 2008 (Table 14.1) indicates that less than 8 % of the small farmers had access to bank loans, while almost 50% of the large farmers are able to access bank loans. 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 micro finance institutions). Rice millers provide some inputs to farmers via credit (primarily fertilizer) but require farmers to exclusively deliver their rice paddy to the lending processor at harvest, sometimes at less competitive prices.

Figure 14.1. Guyana. Evolution of Commercial Banks Agricultural Loans, Period 2000-2009



12. **Micro finance Institutions play a key role in financing the rural farmers in Guyana.** The Institute for Private Enterprise Development (IPED) is leading the process of lending to rural farmers. The IPED has a revolving fund of US$7 million which is used to lend to small entrepreneurs operating in potentially successful sectors of the economy. Currently, much of its lending is to the agricultural sector, about half of which is to rice farmers. The IPED is the main sole financial institution financing rice farmers. As of 2008, the IPED was financing G$600 million to 1,173 farmers in the rice sector, representing 15.38% of the total credit to the agricultural sector and 55% of the total rural lending to rice farmers[80]. Apart from rice, the IPED also finances other crops. As of 2009, the IPED was financing G$75.8 million to 369 farmers of other crops. As of 2008, the IPED was financing G$181.4 million to the livestock sector in the country, accounting for 25% of the loans given to this agricultural sub-sector.

13. **In general, the banking and MFI sectors welcomed the possibility of implementation of agricultural insurance in Guyana.** Many of the bankers perceive that agricultural insurance, although it will not provide a full guarantee over the loans given to farmers, can be used as a partial collateral for the securitization of the default risk faced by the banks in rural lending. Most of the banks interviewed during this mission mentioned that, in case the farmers have good collateral on the production risks, they would analyze sharing part of the cost of the insurance by reducing the interest rates they are requesting for rural lending. The IPED is interested in bundling its crop loan portfolio to rice producers with area-yield crop insurance for rice and would consider reducing its fixed interest rate for rice of 20% per year to reflect the transfer of climatic risk exposure to the insurance policy.

14. **The financial sector can also act as a potential delivery channel for an eventual agricultural insurance product in Guyana.** Both commercial banks and MFIs have branch networks in

80 According to the IPED, in 2009 this institution accounted for 24.7% of all loan balances to the rice sector and 66.1% of all loans made to other (non-rice or sugar cane) crops.

Table 14.1. Credit Survey of Rice Producers

Cultivated Area	No. of Active Farmers	Producers with Access to Bank Loans	Producers that Are Interested in Bank Loans
Less than 10 Acres	2,025	7.7%	23.1%
10.1 - 20 Acres	1,192	6.4%	34.0%
20.1 - 50 Acres	1,148	25.4%	60.3%
50.1 - 100 Acres	368	45.9%	95.8%
More than 100 Acres	240	68.8%	100%
Total	**4,973**	**17.2%**	**43.4%**

Source: **Business and Credit Requirements of the Rice Sector (2008).**

all the agricultural areas in the country. The eventual implementation of an agricultural insurance scheme must take advantage of the opportunity to rely on this network in order to reach the potential users of the product. Relying on this network, besides helping to promote the product, will also reduce the transaction cost of insurance since it will share the delivering infrastructure with credits.

Conclusions

15. **Rural financing in Guyana is very limited.** Commercial banks are unwilling to lend to the agricultural sector. This unwillingness is mainly due to the banking sector risk-aversion attitude towards the risk faced by the agricultural sector, the lack of agricultural expertise in the banking sector, and the difficulties to realize the securities.

16. **Agricultural insurance can help to partially solve part of the concerns that financial institutions have in order to lend to the rural sector.** Agricultural insurance, although it does not provide perfect coverage against all the risks faced by agricultural production, can be used as collateral for the loans given to the agricultural sector. The use of agricultural insurance collateral for agricultural loans will, at least, solve the risk of default of these loans due to production risks. At the same time, using agricultural insurance as collateral for rural lending will simplify the securitization of rural credit. An agricultural insurance policy used as collateral is easier and faster to execute than a mortgage. This would help to reduce the transaction cost and the risk premium loadings in the interest rates applied for rural lending.

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