

Public Disclosure Authorized

Report No. 53081-BD

Public Disclosure Authorized

Agricultural Insurance in Bangladesh

Promoting Access to Small and Marginal Farmers

June 2010



THE WORLD BANK

**South Asia Poverty Reduction, Economic Management, Finance and Private Sector
Development**

Insurance for the Poor, GCMNB, Finance and Private Sector Development

CURRENCY EQUIVALENTS
(Exchange rate effective December 1, 2009)

Currency Unit = Bangladesh Taka
US\$1.00 Tk 69.04

GOVERNMENT FISCAL YEAR
July 1—June 30

Table of Contents

Acknowledgements	iii
Executive Summary	iv
Context.....	iv
Challenges for the Development of Agricultural Insurance in Bangladesh	v
Options for Consideration.....	viii
Next Steps	xi
Chapter 1: Introduction	12
Importance of Agriculture in Bangladesh.....	12
Government Policy for Agriculture and Climate Change.....	12
Role of Rural Institutions and Farmer Access to Financial and Other Support Services	14
Exposure of Agriculture to Natural and Climatic Disasters	16
Objectives of the Study and Selection of Three Study Districts.....	18
Chapter 2: Review of Farmers’ Financial Protection against Natural Disasters in Bangladesh.....	20
Disaster Relief Programs	20
Bangladesh Insurance Sector	23
Supply of Agricultural Insurance in Bangladesh	27
Demand for Agricultural Insurance in Bangladesh	36
Chapter 3: Agricultural Risk Assessment in Bangladesh	39
Objectives and Scope of Agricultural Crop, Livestock, and Weather Risk Assessment	39
Data Availability for Crop, Livestock, and Weather Risk Assessment.....	39
Agricultural Crop Production in Bangladesh.....	40
Key Climatic Perils and Crop-Area Damage Assessment.....	48
Regional-Level Risk Assessment of Crop Production and Yields	51
Weather-Risk Assessment and Impact on Crop Production and Yields.....	60
Livestock-Risk Assessment	69
Chapter 4: Opportunities for Agricultural Insurance Product Development in Bangladesh.....	75
Potential Crop Insurance Policy Options for Bangladesh.....	75
Named-Peril Crop Insurance (Hail, Frost, Wind).....	77
Multiple-peril Crop Insurance (MPCI)	81
Area-Yield Index Crop Insurance	82
Livestock Insurance	99
Chapter 5: Operational Issues for Agricultural Insurance.....	106
Traditional Named-Peril Crop Insurance and Area-Yield Index Insurance	106
Crop-Weather Index Insurance	110
Livestock Insurance	113

Chapter 6: Institutional and Financial Considerations.....	115
Public-Private Partnerships in Agricultural Insurance: International Experience	115
Public-Private Partnership Options for Agricultural Insurance in Bangladesh	119
Risk Financing and Reinsurance Considerations.....	128
Glossary	131
Bibliography	140

Abbreviations and Acronyms

ADB	Asian Development Bank
AICI	Agricultural Insurance Company of India, Ltd
ASA	Name of a prominent MFI in Bangladesh; the name means “hope”
BASIC	Bank of Small Industries and Commerce
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BKB	Bangladesh Krishi Bank
BMD	Bangladesh Meteorological Department
BSE	Bovine Spongiform Encephalitis
CLDP	Community Livestock Development Program
CoV	Coefficient of Variation
CRAMR	Crop Risk Assessment Model Regional
CRAMU	Crop Risk Assessment Model Upazila (sub-District)
CWII	Crop-Weather Index Insurance
DAE	Department of Agricultural Extension
DMB	Disaster Management Bureau
DHM	Department of Hydrology and Meteorology
DLS	Department of Livestock Services
DoA	Department of Agriculture
DMF	Disaster Management Fund
DRR	Directorate of Relief and Rehabilitation
DSCP	Deprived Sector Credit Program
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
GCMNB	Global Capital Market Non Banking Financial Institutions Division
GFDRR	Global Facility for Disaster Reduction and Recovery
GoB	Government of Bangladesh
GR	Government Relief
HH	Household
HPAI	Highly Pathogenic Avian Influenza
HYV	High-Yield Variety
IRB	Brazilian Reinsurance Institute
IDRA	Insurance Development and Regulatory Authority
IU	Insured Unit
LDCs	Least Developed Countries
MFI	Microfinance Institution
MIME	Microinsurance Mutual Entity
MoA	Ministry of Agriculture
MoF	Ministry of Finance
MoFDM	Ministry of Food and Disaster Management
MoFF	Ministry of Environment and Forests
MoFL	Ministry of Fisheries and Livestock
MPCI	Multiple Peril Crop Insurance
NAIS	National Agricultural Insurance Scheme
NGO	Non-Governmental Organization
NDVI	Normalized Deviation Vegetation Index
OIE	Office Internationale des Epizooties

PCBs	Private Commercial Banks
PKSF	Palli Karma Sahayyak Foundation
PML	Probable Maximum Loss
PPR	Pests de Petits Ruminants
PSCP	Priority Sector Credit Program
RAKUB	Rajshahi Krishi Unnayan Bank
SACCOS	Savings and Credit Co-operatives
SASFP	South Asia, Finance and Private Sector Development Unit
SBC	Sadharan Bima Corporation
SCBs	State-owned Commercial Bank
SHG	Self-Help Group
SIF	Self Insurance Fund
SVD	Swine Vesicular Disease
TEO	Technical Extension Officer
Tk	Bangladesh Taka
TSO	Total Sum Insured
TSU	Technical Support Unit
VO	Village Organization
VVL	Veterinary Vaccine Laboratory

Acknowledgements

This report was authored by a team led by Sadruddin Muhammad Salman (Financial Sector Analyst, SASFP, World Bank) and Olivier Mahul (Program Coordinator, Insurance for the Poor Program, GCMNB, World Bank). The team comprised multidisciplinary specialists with responsibility for specific aspects of the report. These included Minnie Chey (Senior Private Sector Development Specialist, SASFP, World Bank), rural finance and microfinance; Ramiro Jose Iturrioz (Senior Agricultural Insurance Specialist, Insurance for the Poor Program, GCMNB, World Bank), agricultural risk assessment and area-yield index crop insurance; Charles Stutley (Consultant), agricultural risk assessment, livestock insurance, and institutional framework; William Dick (CRMG, World Bank), Ornsaran Manuamorn (Operations Analyst, ARD, World Bank), Joanna Syroka (CRMG, World Bank), Erik Chavez (Consultant), weather-index-based crop insurance; Nihal Fernando (Senior Rural Development Specialist, SASDA), government policy for agriculture; Md. Saif Norman Khan (Consultant), insurance, microinsurance, and microfinance; and Md. Fazlul Haque (Consultant), agricultural crop and livestock database. Bridget Rosalind Rosario (SACBD), Marjorie Espiritu (SASFP), Aza A. Rashid (SASFP), and Sashikala Krishani Jeyaraj (SASFP) provided invaluable administrative support to the team.

The team acknowledges the contributions of all stakeholders, including the Ministry of Finance (Finance Division), Ministry of Commerce (including the Department of Insurance), Bangladesh Meteorological Department, Bangladesh Bureau of Statistics, Water Development Board, Ministry of Food and Disaster Management (including the Department of Relief and Rehabilitation), Ministry of Fisheries and Livestock, Ministry of Agriculture (including the Department of Agricultural Extension), Bangladesh Krishi Bank, Rajshahi Krishi Unnayan Bank, Shadharan Bima Corporation, Pragati Insurance Limited, Green Delta Insurance, Reliance Insurance Limited, Bangladesh General Insurance Company, Bangladesh Insurance Association, PKSF and its partner organizations (TMSS, PMUK, UDDIPAN, Sajida Foundation, Jagoroni Chakro Foundation, RIC, POPI, BEDO, SDI, and Manabik Sahajya Sangstha), BRAC, Grameen Bank, Proshika, International Network on Alternative Financial Institutions (INAFI), Credit and Development Forum (CDF), Bangladesh Rice Research Institute (BRRI), Asian Development Bank (ADB), and Department for International Development (DfID). The team also acknowledges the support of the local stakeholders met during the field visit conducted in Dinajpur, Pabna, and Bogra.

The authors are grateful to the peer reviewers Andrew Goodland (Senior Agriculture Economist, EASCS, World Bank), Aurora Ferrari (Senior Private Sector Development Specialist, ECSPF, World Bank) and Harrie Oostingh (Policy Advisor, Microinsurance, Research & Development, Oxfam Novib). This report has been prepared under the overall guidance of Ellen A. Goldstein (Country Director, Bangladesh), Xian Zhu (Director, Strategy and Operations, SARVP, World Bank), Ernesto May (Sector Director, SASPF), Ivan Rossignol (Sector Manager, SASFP), Simon C. Bell (Sector Manager, MNSD), John F. Speakman (Lead Private Sector Development Specialist, SASFP), and G. M. Khurshid Alam (Senior Private Sector Development Specialist, SASFP).

The team gratefully acknowledges funding support from the Global Facility for Disaster Reduction and Recovery (GFDRR) and the Commodity Risk Management Multi-donor Trust Fund.

Executive Summary

Context

1. The National Agriculture Policy (1999) emphasizes the major role that agriculture can play in poverty reduction in Bangladesh. The Government of Bangladesh (GoB) recognizes a “food for all” policy by taking all possible measures to make Bangladesh self-sufficient in food production by 2013. The policy also recognizes (i) enhancing the level of subsidies for agricultural inputs, agricultural loans, and availability of agricultural inputs to farmers; (ii) ensuring fair prices for all crops and agricultural products; (iii) supporting the ongoing government efforts to attain self-sufficiency in the production of rice, fish, milk, egg, and livestock; and (iv) enhancing efforts directed to exporting surplus products after meeting domestic requirements. Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2008 has identified “insurance” as an effective disaster management tool and one of the 37 programs that various ministries/agencies will lead toward combating the adverse effects of climate change in Bangladesh.

2. ***Bangladesh is ranked as the world’s fifth most exposed country to natural disasters, including floods, cyclones, and droughts.*** Production losses of major cereal crops due to natural disasters over the past 29 years have been equivalent to an average of 6.4 percent of the national crop production every year. It is estimated that during a major disaster year, occurring once every 100 years, 23 percent of the national paddy and wheat production would be lost due to adverse weather. These annual crop losses could increase even further in the context of climate change. Agricultural production can be increased if the vagaries of nature and the risks associated with it can be better managed. Given the scarcity of affordable and suitable risk-management tools, when exposed to adverse shocks low-income households may be forced to reduce food consumption, take their children out of school, and sell productive assets, which then jeopardize their economic and human development prospects.

3. ***The purpose of this study is to investigate the viability of agricultural insurance in Bangladesh, particularly for small and marginal farmers and to present the GoB with a set of options for the future development of agricultural insurance in the country.*** The World Bank study *Increasing Access to Rural Finance in Bangladesh: The Forgotten “Missing Middle”* (2007) highlighted that a high proportion of farmers with small and medium-size farms do not have access to formal credit through the banks and microfinance institutions (MFIs) and that crop insurance could play an important role in encouraging the banking sector to lend to these farmers by reducing their exposure to crop failure and farmers’ inability to repay their loans. The current study aims to identify an overall framework for the development of sustainable market-based agricultural insurance in Bangladesh. It also reviews the technical, operational, financial, and institutional issues and options for the introduction of traditional crop and livestock insurance products and for new crop-index products that are suitable to Bangladeshi farmers. This report presents a series of practical guidelines and options for GoB and other interested parties to consider for the future development and implementation of crop, livestock and aquaculture insurance in Bangladesh.

4. The Districts of Dinajpur, Bogra and Pabna were selected for this analysis because they are important agricultural zones and exhibit exposure to a wide range of weather perils, including flood, drought, excess rain and hail. They are also the home of active MFIs lending to rural clients and of weather stations.

5. This study builds on the agricultural insurance framework developed by the World Bank, which covers the following components:

- **Review of agricultural insurance provision in Bangladesh:** The formally regulated insurance sector is underwriting hardly any agricultural insurance products or programs at present. Some nongovernmental organizations (NGOs) and MFIs are involved in the provision of livestock insurance, usually linked directly to microfinance operations.
- **Agricultural risk assessment:** A formal crop and livestock risk assessment was conducted to assist policy makers and insurance practitioners in the design and rating of crop and livestock insurance. This assessment was conducted at a national level and for the three selected Districts.
- **Agricultural insurance product development:** Prototype agricultural policies are designed and indicative premium rates are presented. Such products could be further developed and tested in a future pilot implementation phase.
- **Operational issues for agricultural insurance:** Operational requirements for the development and implementation of the proposed agricultural insurance products are discussed, including underwriting, distribution, and loss assessment systems and procedures.
- **Institutional framework and challenges for agricultural insurance:** The emergence of a sustainable market-based agricultural insurance program in Bangladesh is likely to require some form of public-private partnership. An institutional framework, organizational structure, and specific roles and options for the potential stakeholders are presented.

6. **This report draws heavily on international experience.** International experience on agricultural insurance is vast, as agricultural insurance is currently being implemented in more than 100 countries around the world. This study benefits from this international experience (for example, the Indian area-yield and weather-index crop insurance schemes, a Mexican agricultural mutual insurance program, and a Mongolian livestock-mortality index insurance program), which is tailored to the local economic and social context of Bangladesh.

Challenges for the Development of Agricultural Insurance in Bangladesh

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

Institutional Challenges

8. **Limited agricultural insurance provision:** During the 1980s and 1990s, agricultural insurance was exclusively provided through the state-owned insurance company, Shadharan Bima Corporation (SBC). SBC offered an individual-grower multiple peril crop insurance product as well as livestock mortality and aquaculture insurance. However, on account of poor underwriting results and lack of demand, SBC has almost ceased to underwrite agricultural insurance today. Livestock insurance provision is very limited and currently available only through a small number of NGOs/MFIs as part of their livestock loan protection schemes. In 2008 several thousand head of cattle were insured under these informal schemes.

9. ***Farmers have limited awareness of agricultural insurance.*** There is a very low level of awareness and knowledge among Bangladeshi farmers on the role of agricultural insurance. There may be, however, a potentially strong demand for crop insurance, as demonstrated by the findings of recent demand studies.

10. ***Lack of a national framework for agricultural insurance:*** There is no clear policy framework for agricultural insurance in Bangladesh, including a lack of clarity on the role of government in supporting agricultural insurance through the private insurance sector. The commercial insurance companies have not been willing to take a lead in developing crop or livestock insurance products. The only agricultural insurance initiatives to date in Bangladesh have been through the public-sector insurer and reinsurer, SBC, and some NGOs/MFIs. However, most of these initiatives are at a local as opposed to a national level and penetration rates are currently very low. One major challenge is to define an appropriate agricultural insurance strategy relying on strong public-private partnerships which would include both the private commercial insurers and the NGOs/MFIs (and possibly mutual or cooperative insurers) and other rural service organizations.

11. ***The current insurance legislation does not recognize the informal livestock insurance programs implemented through the NGOs/MFIs.*** Current legislation does not permit MFIs to act as insurance companies and does not recognize the loan-protection products and services they are offering to small farmers. This in turn acts as a major barrier to collaboration between the NGOs/MFIs and the private commercial insurers in order to identify ways of (i) strengthening and standardizing agricultural insurance product design and rating so that these conform to the technical and legal requirements of the insurance industry; (ii) developing an integrated risk-financing strategy for crops and livestock based on a public-private partnership with public and private insurance companies, NGOs, MFIs, and the government; and (iii) collaborating in the marketing of agricultural insurance products, thereby reducing the costs to both parties, and collaborating on other operational areas (underwriting, premium collection, loss assessment and claims settlement).

12. ***The Insurance Act 2010 allows NGOs/MFIs to register as insurance intermediaries and to act as potential delivery channels for agricultural insurance products to their members.*** Previous insurance regulations did not permit agents or brokers and payment of commissions to intermediaries. Therefore each insurer has had to establish its own branch offices and direct sales outlets, and this has added huge overhead administrative and operating expenses to the insurer's premiums. The 2010 Act permits independent insurance brokers to operate in the market. This would allow an NGO/MFI to register with the Insurance Development and Regulatory Authority (IDRA), the proposed Authority as stipulated in the IDRA Act 2010, as an insurance broker or agent acting on behalf of a private commercial insurer.

13. ***The special case of index-based insurance is not considered under the current insurance legislation.*** The Insurance Act does not mention whether index-based agricultural insurance (for example, crop-weather index insurance or area-yield insurance) is authorized in Bangladesh. There may also be a case for specific agricultural insurance legislation to regulate traditional indemnity based products and new index-based products.

Technical Challenges

14. ***Lack of exposure to international agricultural insurance practice:*** The private insurance companies in Bangladesh have had little or no exposure to international practice in agricultural insurance. They lack knowledge and awareness in the design, rating, and implementation of agricultural insurance. The cooperatives and MFIs also have very limited

experience with livestock insurance. However, the public insurer and reinsurer SBC has some experience in underwriting this class of business. This local experience could be shared with other stakeholders in the development of market-based insurance products.

15. ***Limited supply of agricultural insurance products:*** In 2009 there was no crop insurance in Bangladesh, and the range of livestock insurance products available is restricted to the loan-protection policies offered by the MFIs. These products need to be strengthened and brought into line with international standards. There is also a need to develop new crop and livestock insurance products tailored to the needs of Bangladeshi farmers in the different agro-climatic regions.

16. ***Data and information*** are critical to the design and rating of any crop and livestock insurance program. Bangladesh has relatively high quality time-series crop production and yield data and meteorological weather data needed to design traditional indemnity-based crop insurance products and weather-index products. However, the density of weather stations is very low and very few stations are automated. In addition, livestock production and mortality statistics do not seem to be available.

Financial Challenges

17. ***Private commercial insurance companies in Bangladesh have limited financial capacity*** and are in general reluctant to take a lead in investing in agricultural insurance staff, the design of products and policies, systems and procedures as this is considered to be a high-risk class of insurance. Commercial insurers are also concerned about their limited access to international agricultural reinsurance capacity.

18. ***NGOs/MFIs have limited financial capacity needed to operate agricultural insurance, and none of their microinsurance programs are currently reinsured.*** The MFIs usually have very limited financial reserves and none of the livestock credit protection insurance programs reviewed under this study are protected by reinsurance. The lack of access to formal reinsurance mechanisms leaves the MFIs very exposed to catastrophe losses (for example, epidemic diseases, drought, flood, and wind), which could jeopardize not only their insurance business but also their microfinance business if excess insured losses would have to be paid out of their members' savings and deposits.

Operational Challenges

19. ***Private commercial insurers do not have rural branch networks to underwrite smallholder crop and livestock insurance policies, and they currently operate under high transaction costs.*** Conversely, the NGOs/MFIs are working directly with small crop and livestock producers, and there is a well-established rural microfinance network through which insurance products and services could also be distributed and administered by the MFIs at lower cost. There is a major new opportunity for the private commercial insurers to market their products through the MFIs to their microfinance clients at lower cost, under the 2010 Insurance Act that permits insurance intermediaries (brokers) to operate in the market.

20. ***High administrative costs of agricultural insurance for small farms:*** The very small size of many farms—less than one hectare—and small average herd size of two to three animals means that the costs of insurance delivery, underwriting, and claims administration can be prohibitively high. Individual farmer policy sales needs careful consideration, and there is a need to identify opportunities for group sales, such as sales linked to input supply or to seasonal production loans.

21. **Poor animal health services:** Inadequate veterinary services are one of the major obstacles for livestock development in Bangladesh. In 2003, only 5 percent to 10 percent of farm animals received routine vaccination against diseases. However, several of the larger NGOs/MFIs, including BRAC, Proshika, and Grameen Bank, have invested heavily in their own livestock extension and veterinary services for members.

Options for Consideration

Developing an Enabling Agricultural Insurance Framework for Bangladesh

22. **No one size fits all.** Any agricultural insurance programs in Bangladesh are likely to be location specific and will need to reflect the local risk exposures and take into account infrastructural constraints and the presence of local service organizations.

23. **Each type of Bangladeshi farmer needs tailor-made agricultural insurance solutions.** Traditional crop or livestock insurance will not benefit subsistence farmers. The NGOs and MFIs are already assisting with livestock insurance for landless and small rural households and these initiatives should be built-upon. Insurance through the cooperatives/microfinance institutions, and wherever possible the private-sector insurance should be initiated for Bangladeshi small and medium farmers and commercial producers.

24. **The ability of the private commercial insurance sector to assume direct responsibility for underwriting smallholder agricultural insurance may be limited in the short term.** In the short term, the Bangladeshi private commercial insurance sector appears to lack the underwriting capability and rural infrastructure to implement and administer smallholder agricultural insurance. They are therefore unlikely to get directly involved in individual farmer crop or livestock insurance, although there could be exceptions either under a carefully designed pilot crop index-based insurance cover or for larger commercial livestock operations. In the short term, an important role of the private insurance sector could be to provide pooled reinsurance protection for the NGO/MFI agricultural insurance programs.

25. **The role of the public insurance company SBC in the provision of agricultural insurance should be clarified within a public-private partnership.** SBC could play an important role in future as a reinsurer of (i) the domestic private insurance sector and (ii) NGOs/MFIs and possibly cooperative crop and livestock insurance schemes in Bangladesh. SBC could provide both technical assistance and financial capacity to the local agricultural insurance market through a public-private partnership.

26. **The current livestock-credit protection initiatives through the NGOs/MFIs appear to offer considerable potential for replication and scaling-up in Bangladesh.** These initiatives should be promoted and strengthened by creating some form of pooled excess of loss reinsurance. Ways of establishing a linkage between the MFIs and the private commercial insurance companies need to be further explored and one option may be for the MFIs to act as insurance agents.

27. **The role of the Government, with the assistance of the donor community, is essential for the development of agricultural insurance in Bangladesh.** It should focus on stimulating crop and livestock insurance through the cooperative and rural banking/microfinance sectors. The GoB could facilitate a review of existing insurance legislation with a view to bringing cooperative and MFI insurance practices and regulations into line with those of the private

commercial insurance sector and to legitimize insurance through these organizations. This review should be considered under the umbrella of microinsurance.

28. ***There is a need for technical assistance in the design and implementation of agricultural insurance products.*** Technical assistance would be required to enable Bangladeshi insurers, MFIs, and their partners to develop agricultural risk-assessment methodology; develop rate-making methodology; develop crop and livestock products; develop loss-adjustment procedures; train underwriters and sales agents; train field assessors and loss adjusters; and to educate farmers and livestock producers on the role and functions and benefits of risk transfer/insurance. The GoB, with the help of donors, could support the creation of a technical support unit, to provide technical assistance to the insurance companies.

29. ***The Government could act as a reinsurer of last resort against agricultural catastrophic losses.*** The GoB could play an important role in providing catastrophe reinsurance if local insurers and/or international reinsurers are unwilling to provide excess-of-loss reinsurance protection for the cooperative/microfinance agricultural crop and livestock insurance initiatives. GoB could delegate this role to the public insurer SBC.

30. ***The fiscal impact of any public agricultural insurance premium subsidy program should be carefully analyzed.*** Should GoB 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 percent premium subsidy program on an area-yield crop insurance scheme, with a 20 percent penetration, might cost about US\$35 million per annum for an estimated total sum insured of US\$940 million. 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 subsidy program should be carefully devised (with a clear exit strategy) to provide the adequate financial incentives, and its costing should be carefully analyzed to avoid unsustainable public costs.

Developing Agricultural Insurance Pilots

31. ***Should the Government of Bangladesh be interested, the possible next step would be the design and implementation of selected pilot projects based upon the findings and recommendations of this report.*** Table 1 provides a summary of the potential agricultural insurance products that could be piloted in the start-up phase of new market-based pilot crop and livestock and aquaculture insurance programs in Bangladesh.

32. ***There appears to be considerable demand for and a potential to develop crop-hail insurance, particularly for Rabi season crops.*** Hail is a major cause of crop damage in northwestern Bangladesh, especially during the period March to May, which coincides with the harvest of Rabi season crops including Boro paddy, wheat, mustard, vegetables and fruit, and horticultural crops. Crop hail insurance is technically feasible for Bangladesh, but given the very small farm size key issues need to be addressed, including the design of low-cost operating systems and procedures.

33. ***There may be possibilities to pilot test an area-yield index program, where payouts are based on an aggregated crop-yield index,*** in which the following conditions are met: (i) there is an objective, accurate, and independent method for area-yield measurement using crop-cutting, at the *upazila* (sub-District) level; (ii) there are areas of homogeneous rain-fed or irrigated cropping; and (iii) farmers use similar varieties, crop husbandry, and technology levels. This may apply especially to paddy rice (Boro and Aman) grown in flood- and drought-prone areas of the western

region. However, the main challenge relates to the method of establishing average yields for the insured crop in the selected insurance units.

34. ***Weather-based crop insurance, in which payouts are based on parametric indices such as cumulative rainfall levels, could offer potential for introduction into Bangladesh*** under a carefully designed pilot program for one or two selected crops grown under rain-fed conditions and where coverage would initially be provided for excess rainfall or rainfall deficit (drought). Potential pilot programs for weather-index insurance in Bangladesh might include dry spell, excess rainfall, and rainfall deficit for rain-fed paddy rice. However, further research and development work is required before drawing any firm conclusion on the viability of these products at the individual farmer level or at meso/macro level.

Table 1. Potential Agricultural Insurance Products for Bangladesh

Coverage	Sector	Trigger	Pilot Area
Crop-Hail	All Rabi crops	Traditional damage-based assessment	Northwestern Region
Multiperil crop insurance	Boro paddy, Aman paddy	Area-yield index (at Upazila/Union level)	Northwestern region
Dry spell (April-May), deficit rainfall, excess rainfall	Boro paddy, Aman paddy	Rainfall parametric index	Northwestern region
Livestock mortality	Cattle, dairy cattle	Traditional individual animal mortality cover	Any region where community-based and/or NGO/MFI involved in livestock microfinance
Mortality cover (flood, cyclone, disease)	Aquaculture (shrimp)	Traditional Individual (farm) loss assessment	Coastal region

Note: The recommended pilot areas are based on case studies in Pabna, Bogra, and Dinajpur Districts.

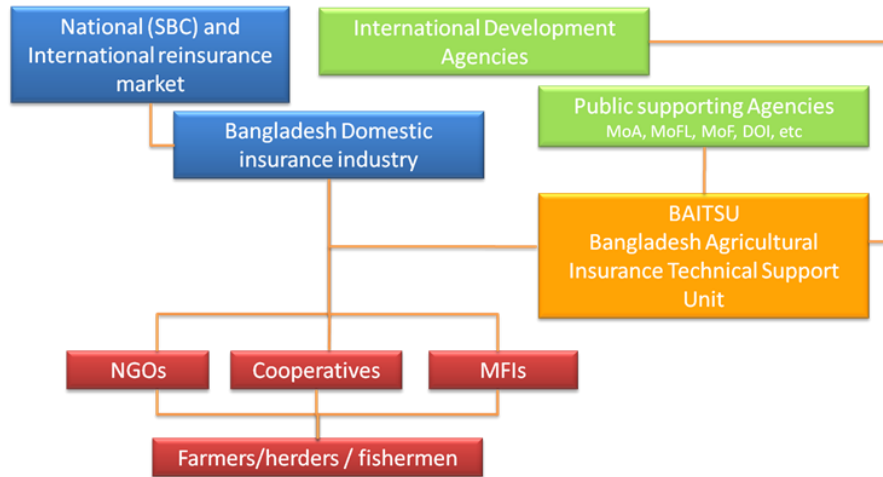
35. ***Livestock insurance programs.*** None of the NGO/MFI livestock credit-protection insurance programs in Bangladesh are currently reinsured, and they are therefore very exposed to catastrophe losses, particularly epidemic diseases of livestock. The following strengthening of the existing livestock policies could be considered: (i) introduction of simplified and standard livestock accident and mortality policies for cattle and buffalos, which specifically excludes all Class A and B contagious diseases; (ii) technical review of the premium rates; (iii) introduction of standard policy wording(s) across all NGOs/MFIs, to agree on standard rates and discounts and uniform risk acceptance, loss notification, and loss assessment procedures; (iv) options for larger livestock owners to include herd cover with explicit deductibles.

Creating a Dedicated Technical Support Unit for Agricultural Insurance

36. ***The GoB could consider the creation of a Bangladesh agricultural insurance technical support unit (BAITSU), 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) the design of operating systems and procedures, most notably underwriting and claims control and loss assessment procedures; (v) training for insurance companies, MFIs, farmer cooperatives, and farmer groups; and (vi)

awareness campaigns. BAITSU would form direct links to provide technical support to those insurer(s) or their partners, such as MFI(s), which commit to champion the development of agricultural insurance in Bangladesh. BAITSU would be staffed by two or three agricultural insurance specialists and report to a steering committee of public and private stakeholders. BAITSU would act as the focal point for external technical assistance programs and would run under overall guidance from IDRA.

Figure 1. Proposed Bangladesh Agricultural Insurance Technical Support Unit



Next Steps

37. A series of dissemination activities has been proposed, to be held in Bangladesh with the public and private stakeholders involved in agricultural insurance: Ministry of Agriculture, Ministry of Finance, Insurance Development and Regulatory Authority, domestic private insurance companies, the state-owned insurance company SBC, NGOs, MFIs, rural banks, and so forth. The dissemination would aim at presenting the main findings and options of the World Bank study and discuss possible next steps, including the creation of the proposed BAITSU and the selection of pilot crop and livestock insurance projects for detailed design and implementation. This study and the proposed dissemination could contribute to the ongoing debate on the development of agricultural insurance in Bangladesh.

Chapter 1: Introduction

Importance of Agriculture in Bangladesh

1.1. ***The Bangladesh economy is based primarily agriculture, which contributes about 22 percent of total gross domestic product (GDP) and employs about 48 percent of the labor force aged 15 years and above.*** Bangladesh is one of the most densely populated countries in the world, with a land area of 147,500 km² and a population of about 142 million, or nearly 1,000 persons per km².¹ Bangladesh is classified as a low-income economy with 2008–09 per capita GDP of US\$621.² According to the 2001 population census there were 25.5 million households (HHs) in Bangladesh, of which 19.5 million, or 76 percent of total, were rural HHs. The net cultivated area is nearly 20 million acres, and with up to three annual crops being grown, the cropping intensity is about 170 percent.³ Average farm size is small with about 1.2 acres per HH. More than 50 percent of rural HHs are classified as being landless as they own less than 0.5 acre; 45 percent of HHs are classified as marginal, small, and medium (owning between 0.5 and 7.5 acres of land); and less than 2 percent of HHs are large farmers, owning more than 7.5 acres.⁴ There is a major challenge to design and implement agricultural crop and livestock insurance products which are tailored to the needs of Bangladesh's predominantly landless sharecropper or tenant farmer and marginal and small land owners.

1.2. ***Paddy (rice) is the most important crop grown in Bangladesh,*** with up to three crops per year, including the summer monsoon or *Aman* crop which currently accounts for about 13.4 million acres (74 percent of net cultivated area); a winter or *Boro* season rice crop, which is grown under irrigation and accounts for 10.0 million acres; and finally *Aus* rice, which is grown on a much smaller scale (2.3 million acres) prior to the summer monsoon *Aman* crop. Other important crops include wheat, jute, and potatoes. Minor crops include a wide range of horticultural and vegetable crops.

1.3. ***Average yields are fairly low*** and range from 0.9 metric tons (MT) per acre for high-yielding variety (HYV) Aman paddy, 1.5 MT/acre for Boro HYV paddy, and 1 MT/acre for winter wheat. Livestock including dairy cattle (average 0.9 cows per HH), goats (0.62 head/HH), poultry, and aquaculture play a very important role in Bangladeshi farming systems as a source of employment, cash income, and improved nutrition, particularly for landless households and female farmers.

Government Policy for Agriculture and Climate Change

1.4. ***The Government of Bangladesh recognizes food security coupled with sustainable and profitable agriculture production as a major policy goal.*** GoB policy for agriculture has been spelled out in several policy documents approved by the Government since 1999 and the election manifesto of the ruling party of the Government announced in late 2008 prior to the national elections held in December 2008. Accordingly, the main driving vision of GoB in the agricultural sector has been to ensure sustainable food security.

¹ BBS 2009, Statistical Pocket Book of Bangladesh 2008

² BBS 2009

³ BBS 2007, Bangladesh Data Sheet, based on 2004-05 crop statistics

⁴ World Bank 2007, data taken from Agricultural Census of Bangladesh 1996/97

1.5. The current government's election manifesto recognizes "food for all" policy by taking all possible measures and to make Bangladesh self-sufficient in food by 2013. The policy also recognizes (i) enhancing level of subsidies for agricultural inputs, agricultural loans, and availability of agricultural inputs to farmers; (ii) ensuring fair price for all crops and agricultural products; (iii) supporting the ongoing government efforts to attain self-sufficiency in the production of rice, fish, milk, egg, and livestock; and (iv) enhancing efforts directed to exporting surplus products after meeting domestic requirements. The Agriculture Extension Policy recommends an efficient, decentralized, and demand-led agriculture extension services to crop, diary, poultry, and fish farmers; enhanced budget support for agricultural research; and strong research-extension-market linkages. The GoB also recognizes the need for developing value chains and market linkages for commercially profitable agricultural commodities. The ongoing National Agriculture Extension Project (NATP) funded by the World Bank supports these objectives and long term goals of the Government.

1.6. **The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2008 is the main basis of government's efforts to combat climate change.** There are 37 programs planned in the Action Plan. One of these programs envisaged to create an effective insurance regime, by which the Government will partner with the insurance industry and NGOs to develop new insurance products for people, households, and enterprises against climate related losses. The details of the program are presented in figure 1.1:

Figure 1.1. Comprehensive Disaster Management Program Under Bangladesh Climate Change Strategy and Action Plan 2008

Programme – T2P4

Theme	T2. Comprehensive Disaster Management
Programme	P4. Risk management against loss of income and property
Objective	To put in place an effective insurance system for risk management against loss of income and property
Justification	Climate change is likely to result in loss of income and property to people, households, enterprises, and infrastructure. Communities and families try to climate proof in several ways (e.g., raising the mounds on which they build their houses to protect them from floods and the use of adapted varieties of crops). In addition, insurance against climate-related losses may also be an effective risk reduction mechanism. The Government will partner with the insurance industry and NGOs to develop new insurance products for people, households and enterprises against climate related losses
Actions	<p>A1. Devise an effective insurance scheme for losses in property due to climate change impacts</p> <p>A2. Develop an effective insurance scheme for loss of income from various sources to persons, households and enterprises</p> <p>A3. Pilot the insurance schemes and if successful, establish insurance systems for lowering risk of adverse impact of climate change</p>
Timeline	Medium to long term
Responsibility	Ministry of Finance and other line ministries, and the insurance sector and NGOs

Source: Bangladesh Climate Change Strategy and Action Plan 2008, Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, September 2008

Role of Rural Institutions and Farmer Access to Financial and Other Support Services

1.7. *Agricultural land is a limiting factor in Bangladesh* and therefore productivity and income gains can be achieved only through a combination of (i) higher use of purchased inputs including HYV seeds, fertilizers, and plant protection chemicals; (ii) investment in irrigation technology; (iii) diversification out of food crop production into cash crop and livestock enterprises; (iv) development of value chains for commercially profitable agriculture commodities; and (v) support to organize farmers into producer groups and producer organizations and linking them with markets through the value chains. In order to finance these improvements, Bangladesh's farmers (owners tenants/sharecroppers) of marginal, small, and medium-sized farms need access to short-term production credit and medium-term investment credit.

1.8. According to the World Bank's (2008) study titled *Harnessing Competitiveness for Stronger Inclusive Growth: Bangladesh Second Investment Climate Assessment*, nearly half of metropolitan firms (47.1 percent) and 23 percent of non-metropolitan firms consider access to and cost of financing to be a major obstacle to doing business. Although the government had

established several rural development banks, including Bangladesh Krishi Bank (BKB) and Rajshahi Krishi Unnayan Bank (RAKUB), specifically to address this issue, these banks were heavily indebted and finally, although the NGO/MFI sector was a major source of rural microfinance, their target audience was the landless and rural women and marginal, and therefore owners of small and medium-sized farms were not the primary beneficiaries of microfinance.

1.9. *The main source of agricultural credit is through the eight public-sector banks/organizations*, including four state-owned commercial banks (SCBs), two specialized development banks (BKB and RAKUB), and two cooperative networks (Bangladesh Samabaya Bank Limited and Bangladesh Rural Development Board). In 2008–09 the combined lending targets to agriculture of these eight public banks/organizations amounted to Tk 73,312 million (US\$1.01 billion). These banks/organizations currently have outstanding loans totaling Tk 163,202 million (US\$2.4 billion) owed by 14.75 million borrowers and with an average size of loan of Tk 4,232 (US\$62). The overall recovery rate for these banks/organizations is very low—40.5 percent at end February 2009.⁵

1.10. Private commercial banks (PCBs) are being encouraged to lend to agriculture, and in 2008–09 they have a target allocation of Tk 20,480 million (US\$301 million) or nearly 22 percent of total bank lending to agriculture, with important contributions to irrigation equipment, investment in livestock and fisheries, and grain storage and marketing. At end February 2009, the total outstanding agricultural credit loans of the PCBs stood at Tk 21,705 million with an overall recovery rate of 89 percent and less than 2 percent of loans classified as overdue.⁶

1.11. Microfinance institutions (MFIs) are a very important source of credit for poor households in Bangladesh. The microfinance industry encompasses a total of over 4,200 entities, with the vast majority of financial services delivered through branches and in cash. Dedicated microfinance institutions (NGOs, MFIs and Grameen Bank), as well as banks and government programs, were serving 32 million poor households across the 64 Districts as of December 2007. The 31 largest institutions (with more than 50,000 customers each) had 91 percent of the industry's deposits and provided 90 percent of the outstanding loan volume.⁷ The four largest institutions (Grameen, ASA, BRAC, Proshika), each of which is comparable in size to a small- or medium-sized bank, served 73 percent of all members. No sector data are available on MFIs' lending to owners of marginal, small and medium-sized farms are available, but according to the World Bank 2007 Rural Finance study, in 2006 only 1 percent of Palli Karma Sahayyak Foundation's (PKSF's) microfinance lending (by volume) was disbursed to these farmers, for a total of 79,000 loans valued at Tk 579 million. The same study noted that in recent years some MFIs have started targeting the missing middle farmers in response to demand from these farmers. The MFIs are increasingly bundling their microfinance products with microinsurance credit protection, life and health cover, and in a few cases livestock credit-protection insurance cover, and given their vast outreach to the rural poor, they could in future play an important role in agricultural insurance provision in future.

1.12. Annex 1 provides further information on the agricultural credit operations of the public and private banks in Bangladesh.

1.13. Other important organizations serving the rural and agricultural sectors in Bangladesh include (i) the Ministry of Finance (MoF), which regulates the banking and insurance industries;

⁵ Bangladesh Bank, Agricultural Credit and Special Programs Department, agricultural credit position, 1st July 2008 to 28 February 2009.

⁶ Ibid, Bangladesh Bank 2009

⁷ Calculation based data from Credit & Development Forum (CDF) and Microcredit Regulatory Authority (MRA); data as of December 31, 2007

(ii) the Ministry of Agriculture (MoA) and its Directorate of Agricultural Extension (DoAE), which has over 13,000 field-level agricultural extension workers who are involved in farmer education and technology transfer in the crop sector; (iii) the Ministry of Fisheries and Livestock (MoFL) and Directorate of Livestock Services (DLS) and Directorate of Fisheries (DOF), which are involved in livestock husbandry extension and vaccination and fisheries extension programs respectively; (iv) Bangladesh Agriculture Development Corporation (BADC), which is responsible for the manufacturing, importing and distribution of fertilizer and production and distribution of seeds; (v) the Horticultural Export Development Foundation (Hortex) under the MoA, which is responsible for supporting horticulture export; (vi) the Bangladesh Bureau of Statistics (BBS), which is the principal organization for conducting agricultural census and survey work and for annual reporting of crop production and yields, and (vii) the Ministry of Food and Disaster Management (MoFDM), which coordinates the national natural disasters relief program and implements the food procurement, storage, and distribution activities. Potentially some of these organizations could have an important role to play in the development of agricultural crop and livestock insurance in future. The newly created Bank and Financial Institutions Division of MoF is responsible for overseeing and monitoring the insurance sector.

Exposure of Agriculture to Natural and Climatic Disasters

1.14. ***Bangladesh is ranked as the world's fifth most exposed country to natural disasters, including floods, cyclones, droughts, and earthquakes.*** Eighty percent of the country consists of low-lying flood plains bisected by three major rivers: the Ganges, the Brahmaputra, and the Megna. Flooding is a recurrent event and up to 30 percent of the country is subject to annual flooding during the summer monsoon season, which is generally beneficial to agriculture. Major flood events can, however, affect more than 60 percent of the country and cause extreme damage to infrastructure, loss of life, and loss of crops and livestock. Recent major floods occurred in 1988, 1998, 2004, and 2007. The 2007 floods directly affected 46 Districts and over 14 million people, caused 970 human deaths, affected 2.2 million acres (0.89 million hectares) of agricultural land, and caused 1,459 livestock deaths and damage to over 1 million houses and to nearly 31,000 km of roads.⁸

1.15. ***Bangladesh is very exposed to tropical cyclones*** that originate in the Bay of Bengal and that are usually associated with storm, surge which can lead to major casualties in the coastal regions as evidenced by the death toll of 300,000 persons in a 1970 cyclone. Cyclones also cause major damage to agriculture, and under Cyclone Sidr of 2007, a total of 0.69 million hectares of land were partially or totally destroyed and over 460,000 head of livestock and poultry were killed.⁹

1.16. ***Bangladesh is also vulnerable to recurrent droughts,*** and between 1949 and 1991 droughts occurred in Bangladesh 24 times with 11 very severe drought years, with a worst drought year in 1979 when 42 percent of the area of the country was affected.¹⁰ The western regions of Bangladesh are most susceptible to drought. In addition, there is an appreciable hail exposure to agriculture in much of the country, especially at the time of harvest of winter season (Boro) crops. Other perils include excess temperatures, low temperatures, and crop and animal pests and diseases.

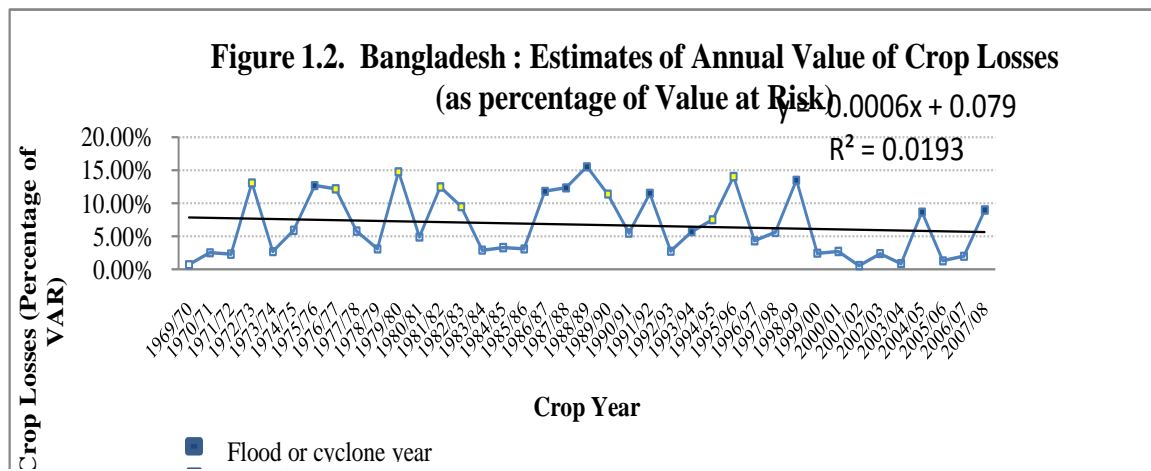
⁸ DMB/MoFDM, May 2008, National Plan for Disaster Management 2008-2015.

⁹ DMB/MoFDM 2008, *ibid*

¹⁰ DMB/MoFDM 2008, *ibid*

1.17. *Climate change is identified as a critical factor, which will impact negatively on agricultural crop production and yields in Bangladesh over the next 40 years.* In 2009 the World Bank conducted a study into the effects of climate change on the production of aus, aman, and boro paddy crops in Bangladesh.¹¹ Over the period to 2050, average CO₂ levels, temperatures and precipitation will increase in the monsoon season, and this will have positive effects on Aus and Aman paddy yields. However, increased precipitation will result in an increased exposure to catastrophic flood events and the overall impact will be to reduce Aus and Aman paddy cultivated area and rice production. The biggest negative impacts of climatic change will be on the production and yields of boro paddy. Sea level rises will also result in lost crop production particularly in southern Bangladesh. The study estimates that overall agricultural GDP will be 3.01 percent lower each year as a result of climate change (US\$8 billion in lost value-added).

1.18. *Production losses of major crops due to natural disasters on average are equivalent to 6.4 percent of the national crop production.* The crop-risk assessment conducted under this study suggests that in a normal or average year the losses in paddy and wheat production and yields due to natural perils are equivalent to 6.4 percent of the value of national production of these crops, or Tk 25.5 billion (US\$375 million). In the worst flood loss year, 1988–89, losses were as high as 15.5 percent of the value of national crop production (Tk 62 billion, US\$910 million). In recent years there has been a slight but statistically insignificant trend for reduced crop losses and which may be related to the major investments made by GoB in improved flood control and drainage and crop irrigation infrastructure (figure 1.2).



Source: Authors analysis of BBS 39-year yield data.

1.19. *There are currently no formal commercial-sector crop or livestock insurance products or schemes in Bangladesh to protect farmers against natural disasters.* A public-sector pilot crop and livestock insurance program was started in the 1980s, but this program was not successful and was subsequently terminated. To date the private commercial insurance sector has not offered any crop or livestock insurance products or services. There are, however, some isolated examples of NGOs/MFIs having developed and implemented livestock-credit protection insurance, which compensates against death of the animal during the loan period. Currently both the public and private insurance sectors are typified by a lack of technical expertise in the design

¹¹ World Bank 2009a, Implications of Climate Change Risks on Food Security in Bangladesh, (draft final), South Asia Region, Sustainable Development Department, ARD, 10 June 2009.

and implementation of agricultural crop and livestock insurance and a belief that these classes of insurance are too risky to be underwritten profitably.

1.20. *In the absence of affordable and suitable risk-management tools, Bangladesh's farmers are very exposed to natural disasters*, which may force them to reduce food consumption, take their children out of school, and sell productive assets, which then jeopardizes their economic and human development prospects.

1.21. *There is a potential demand for crop insurance in Bangladesh*. A recent farm-level study¹² in Bangladesh identified a high level of potential demand by farmers for crop insurance (in this case a flood cover). It would therefore appear that there is an important need for the public and private commercial insurance sectors and the NGOs/MFIs to address the supply constraint and to develop appropriate agricultural insurance products and schemes for Bangladesh's farmers.

Objectives of the Study and Selection of Three Study Districts

1.22. *This work builds on recent World Bank studies on access to rural finance*. This study follows on from two recent studies conducted by the World Bank, including World Bank (2007) *Increasing Access to Rural Finance in Bangladesh: The Forgotten "Missing Middle"* and World Bank (2006) *Bangladesh Index-based Insurance*. The access to finance study identified the fact that a high proportion of owners of marginal, small, and medium-sized farms do not have access to formal credit through the banks and MFIs and that crop weather-index insurance could play an important role in encouraging the banks/MFIs to lend to these farmers by reducing their exposure to weather-induced crop failure and farmers' inability to repay their loans. The 2006 study examined the potential to introduce two types of individual farmer weather-index insurance against the risk of (i) rainfall deficit (drought) and (ii) flood. The 2006 study concluded that while drought-index insurance was likely to be technically feasible for Bangladesh and was a proven product in other countries including India, flood-index insurance was a new technology that was more complex to design and implement than a drought index. It noted that microflood-index insurance for individual farmers had not been tested in other countries and that considerable further research and development would be required.

1.23. *The purpose of this study is to investigate the viability of agricultural insurance in Bangladesh, particularly for small and marginal farmers*. The current study aims to build on the findings of the two earlier studies and is intended to identify an overall framework for the development of sustainable market-based agricultural insurance in Bangladesh and to present an in-depth assessment of the technical, operational, financial, and institutional issues and options for the introduction of traditional crop and livestock insurance products and for new crop-index products suitable to Bangladeshi farmers. The Districts of Dinajpur, Bogra, and Pabna were selected for this in-depth assessment because they are important agricultural zones and exhibit exposure to a wide range of weather perils including flood, drought, excess rain, and hail.

1.24. Following the agricultural insurance framework developed by the World Bank, this study covers the following key components:

¹² Akter, S. and R Brouwer, 2007, Demand Assessment and Test of Commercial Viability of Crop Insurance in Bangladesh. This "flood-insurance" demand study was conducted in 2006 with 3,600 farmers in riverine and coastal areas of seven Districts of Bangladesh.

- ***Review of agricultural insurance provision in Bangladesh:*** The supply of agricultural insurance was extremely limited in Bangladesh in 2008. While the formally regulated insurance sector currently does not offer agricultural insurance products, some NGOs/MFIs are involved in providing insurance protection, usually linked directly to public or private credit and microfinance operations and features of these programs are reviewed. Under the scope of the current study it was not feasible to conduct a formal farmer-demand assessment study for agricultural insurance, and it is stressed that such a study would need to accompany the introduction of any future crop or livestock pilot projects. A review is, however, also included of a recent 2007 farmer-demand survey for crop insurance in Bangladesh.
- ***Agricultural risk assessment:*** A formal crop and livestock risk assessment is presented. It is intended to assist policy makers and insurance practitioners in the design and rating of crop and livestock insurance. This assessment is conducted (i) at a national level and (ii) for the three selected Districts of Dinajpur, Pabna, and Bogra. Risk assessment is a precursor to developing any viable agricultural insurance product(s).
- ***Agricultural insurance product development:*** For the identified crops and livestock and insurance product types, prototype policies are presented along with indicative risk rating analyses. Such products could be further researched and developed and piloted in a second phase.
- ***Operational issues for agricultural insurance:*** Operational requirements for the development and implementation of the identified agricultural insurance products are discussed, including underwriting, distribution, and loss assessment systems and procedures.
- ***Institutional framework and challenges for agricultural insurance:*** The emergence of a sustainable market-based agricultural insurance program in Bangladesh is likely to require some form of public-private partnerships. This component of the study draws on the World Bank's international experience of public and private agricultural insurance models coupled with the findings of the discussions with Government of Bangladesh, private commercial insurers and NGOs/MFIs, and farmers and presents an institutional framework, organizational structure, and specific roles and options for the potential stakeholders to consider.

1.25. The report consists of seven chapters, starting with this introduction. Chapter 2 provides a review of agricultural insurance in Bangladesh. Chapter 3 presents a detailed risk assessment of the main crops and livestock in Bangladesh. Chapter 4 identifies the suitable crop and livestock insurance products that could be developed and piloted in a second phase. Chapter 5 discusses the operational challenges in the design and implementation of an agricultural insurance program. Chapter 6 focuses on the institutional challenges in the development of an agricultural insurance program, and discusses public-private partnerships in agricultural insurance. Finally, chapter 7 presents conclusions and recommendations. The report ends with eleven technical annexes, provided for reference purposes.

Chapter 2: Review of Farmers' Financial Protection against Natural Disasters in Bangladesh

2.1. This chapter provides a review of the agricultural risk-transfer and insurance mechanisms currently available to crop and livestock producers in Bangladesh including, (i) public-sector and private-sector natural disaster relief programs, (ii) formal commercial insurance products and services provided through the public and private insurance companies, and finally (iii) the nonregulated insurance products and services available through the NGOs/MFIs. The issues and challenges for crop insurance are identified at the end of this chapter, and these themes are then dealt with in detail in subsequent chapters of the report.

Disaster Relief Programs

Agricultural Disaster Relief Programs

2.2. Bangladesh has an elaborate system of public-sector natural disaster management designed to ensure effective planning and coordination of disaster management and implementation of post-disaster emergency relief and reconstruction. Currently GOB relies heavily on external assistance to finance post-disaster losses.

2.3. *The Ministry of Food and Disaster Management (MoFDM) through its natural disasters division, the Disaster Management Bureau (DMB), is responsible for coordinating Bangladesh's national disaster management plans* and programs across all ministries, agencies (including NGOs), and sectors. The Directorate of Relief and Rehabilitation (DRR) under MoFDM assists the Ministry of Food and Disaster Management on policy formulation and implementation of programs/ policies. Disaster risk reduction planning and post-emergency management and rehabilitation is coordinated at all levels from national, regional, and District (*Zila*) levels down to the sub-District (*Upazila*) and Union (*Thana*) levels. The DMB/DRR/MoFDM has its own budget for short-term disaster relief immediately after a major event. The main forms of MoFDM disaster relief include: food aid (GR rice), cash provision to families for deaths and injuries (GR cash), cash assistance for rebuilding damaged houses, food for work programs (VGD) and vulnerable group feeding (VGF), and a money-for-work program. Table 2.1 summarizes details of the MoFDM's disaster payments for the period 2003–04 to 2005–06. The largest component is the Money for Work Program, which in 2005–06 disbursed Tk 2.2 billion (US\$32.5 million).

Table 2.1. MoFDM Disaster Relief Spending 2003–04 to 2005–06

Program	2003–04	2004–05	2005–06
Food for Work (Total Spending, Tk 000)	96,024.4	37,039.7	
Loan (Tk)			
Money for Work (Total Spending, Tk 000)	1,213,791.6	2,229,220.3	2,215,011.7
Relief			
G.R. Rice (Metric Tons)	28,737	61,616	234,919
G.R. Fund (Tk 000)	247,789.0	67,904.0	38,773.0
House reconstruction (Tk 000)	202,328.0	19,726,000	25,291.0
VGD:			
Total allotted cards	479,070	494,238	494,238
Total Allotted Wheat (Metric Tons)	172,536	88,963	177,930
VGF:			
Total allotted cards	7,208,220	6,273,723	6,261,222
Total Allotted Rice (Metric Tons)	72,172	189,256	123,924

Source: Ministry of Food and Disaster Management (2008).

2.4. *The MoA and MoFL are responsible under their own budgets for providing affected farmers, fishermen, and livestock owners* with postdisaster medium- and long-term financial assistance after major natural cyclone, flood, or drought events, which are declared a disaster. Field extension staff of these ministries are responsible for assessing damage to crops and livestock, and compensation payments are coordinated through the District administration system. Relief assistance may either be in kind in the form of seeds and insecticides, poultry and livestock, or cash payments. Financial details of these ministries' postdisaster financial compensation schemes for affected farmers are not available to report.

2.5. *Some of the larger NGOs/MFIs have also established their own disaster management programs and emergency loan provisioning.* For example, in 2000 PKSF, the apex organization for NGOs and MFIs in Bangladesh, established a Disaster Management Fund (DMF), which aims to help microcredit borrowers through PKSF partner organizations (POs) to access emergency loans following a disaster in order to buy food and medicines, to repair damaged houses, to reestablish drinking water tube wells, and to undertake any other rehabilitation activities. The DMF is part funded by PKSF and a US\$10 million International Development Association credit under the World Bank's Post-Disaster Flood Recovery Assistance Program. The loans are provided by the POs at a reduced (subsidized) interest rate of 4 percent to the beneficiaries and the average size of loan is between Tk 1,000 and Tk 4,000. By April 2007 PKSF had disbursed Tk 358 million in DMF loans to its POs, which, in turn, reported a 98 percent recovery rate on these emergency loans. In addition BRAC is operating a Flood Asset Replacement Loan scheme to enable their microborrowers to access loans in kind (e.g., seeds, poultry, livestock, or tree seedlings) after floods for income-generating activities. These loans are for 1 year and carry a standard (commercial) interest rate of 15 percent.

2.6. *Should market-based agricultural insurance be introduced in Bangladesh, its linkage with existing disaster relief programs should be clarified.* If market-based crop and livestock insurance is introduced into Bangladesh, the roles and linkages between the crop and livestock insurance programs and government and private-sector/NGO disaster relief programs should be

reviewed and clarified in order to avoid overlap between the two programs and to establish a public-private structured catastrophe-risk-financing strategy for Bangladesh. International experience shows that where governments intervene with “free” disaster relief for climatic or natural perils, the effort can act as a major disincentive to farmers to purchase crop or livestock insurance especially where premiums are high (“Samaritan dilemma”). Some countries, such as Spain and France, provide disaster relief only for crops and perils which are not included and insured under the national agricultural insurance program. Other countries, for example, the United States, provide natural disaster relief only if the farmer has first purchased minimum catastrophe crop insurance protection under the Federal Crop Insurance Corporation, FCIC, program, or if crop insurance is not available for the affected crop.

Poultry, Avian Influenza Government Compensation Scheme

2.7. *In Bangladesh Class A epidemic diseases, which are highly contagious in livestock and poultry, are not controlled through compulsory slaughter (culling) either of the affected animals or the unaffected animals in the herd/flock.* Rather, vaccination is used wherever possible to control disease outbreaks. This is in contrast to several European countries where class A epidemic diseases are immediately communicable by law and often carry a compulsory government slaughter order for affected and unaffected animals in the herd/flock and also any animals in the containment area. In these cases the state usually provides financial compensation to the livestock owners for the compulsory slaughter (culling) of their animals.

2.8. *GoB has set up a Compensation Fund for Culled Birds affected by Avian Influenza.* There is one exception in Bangladesh, namely, for highly pathogenic avian influenza, HPAI, which carries a compulsory slaughter order. In 2006 the GOB approved a National Avian Influenza Pandemic Preparedness and Response Plan and project, which has been implemented with World Bank financial assistance since 2007.¹³ There are two main organizations involved in the avian influenza control program, the Department of Livestock Services (DLS) and the Bangladesh Livestock Research Institute, both of which are under the MoFL. A key component is a compensation fund which is designed to indemnify poultry owners for the compulsory destruction of birds, eggs, and poultry feed during avian flu containment and control programs. Compensation for culled birds is recognized as being essential to ensure that farmers immediately report any suspected outbreaks of HPAI and that they then participate fully in the disease control measures recommended by the authorities. Bangladesh has reported outbreaks of HPAI since 2007 both in backyard flocks of poultry and in commercial flocks. It is not possible, however, to report the details of the numbers of HPAI outbreaks and culled birds and the value of compensation paid to poultry owners.

2.9. *There are major issues for both governments and insurance companies to consider in providing compensation protection for epidemic diseases in livestock.* Many insurers and reinsurers are not willing to insure epidemic diseases because of the systemic nature of epidemic diseases in livestock and the potential for losses to accumulate over large regions with very high associated claims costs. Similarly there is a question whether governments and society can afford to bear the potentially huge costs of compensating livestock producers in the event of catastrophic disease losses in their animals. To illustrate the magnitude of the potential costs from a livestock epidemic disease outbreak, the World Bank estimated that under a severe HPAI outbreak in poultry in Bangladesh the economic costs might be in the order of US\$154 million (0.3 percent of

¹³ World Bank June 2007: Report No. T7695-BD. Technical Annex, Avian Influenza Preparedness and Response Project

GDP) rising to US\$1.23 billion (2.2 percent of GDP) under the worst loss scenario.¹⁴ The issue of livestock epidemic disease cover is discussed further in chapters 3 and 4.

Bangladesh Insurance Sector

2.10. *The insurance industry has been in existence for about 190 years in Bangladesh.* Following independence in 1971, the Government nationalized both the banking and insurance sectors and the 49 insurance companies operating in the country were placed under five national insurance corporations. In 1984, insurance legislation was enacted to permit a return to private-sector insurance. In 2009 there were 62 registered insurance companies operating in Bangladesh: 60 are private companies and two are public-sector insurers. This section provides a summary overview of the insurance sector in Bangladesh and further information is contained in annex 2 (Regulated Insurance market) and annex 3 (Microinsurance Sector).

Regulated Insurance Market

2.11. *Insurance Regulator:* The Bangladesh insurance industry is regulated by an independent body, the Insurance Development and Regulatory Authority (IDRA), as stipulated in the IDRA Act 2010. This Authority is constituted with a chairman and four members. The chairman, as the chief executive of the institution, is in charge of running the Authority. Previously, the industry was regulated by the Chief Controller of Insurance, Department of Insurance, Ministry of Commerce. Key functions of the Authority include the licensing of insurers, setting of capital and solvency margins, consumer protection, policy approval, monitoring and supervision of insurance company accounts and balance sheets, and investment funds.

2.12. *Insurance legislation:* In Bangladesh public and private limited insurance companies are regulated by the Insurance Act 2010 and IDRA Act 2010. Previously, insurance legislation was governed by the Insurance Act 1938 and Insurance Rules 1958. Important provisions of the current Acts include the following:

- *The insurance company must be registered with and licensed by the IDRA in order to transact life or general insurance business. Legislation requires separate companies to underwrite life and general insurance as well as traditional and Islamic shariya-based insurance.*
- *The 2010 Act specifies the types of companies which are authorized to conduct insurance business, including (i) public limited companies incorporated under Companies Act, (ii) cooperatives which were previously registered under Insurance Act 1938, and (iii) subsidiaries of foreign incorporated insurance companies. It is a very important feature of Bangladesh that under the 1938 Insurance Act, cooperative insurance societies have been officially recognized and regulated and authorized to transact insurance business, including agricultural insurance. As per the 2010 Act, mutual insurance companies have now been prohibited from conducting non-life-insurance business and this would prevent them from underwriting agricultural insurance. It is understood that cooperative insurers continue to be permitted to underwrite non-life business, including agriculture.*
- *The NGOs/MFIs are regulated separately by the Microcredit Law of July 2006 which allows them to “offer different types of insurance services and other social development-*

¹⁴ Ibid 2007

oriented loan facilities” (Article 24). The NGOs/MFIs are not, however, recognized under the Insurance Act as organizations authorized to issue their own microinsurance policies and to accept risk in exchange for and premium payment and to indemnity claims. Under the new 2010 Act, the role of NGOs and MFIs could be explained as being restricted to acting as a broker or intermediary, distributing authorized life and general insurance policies to their members which issued by and underwritten by registered and approved insurance companies.

- *There are minimum capital and deposit requirements* to operate an insurance company. For general insurance companies previously the minimum paid-up capital requirement was Tk 150 million, but under the new 2010 regulation this requirement has been increased substantially to Tk 400 million (US\$5.9 million). Similarly, the minimum capital requirements for life companies have been increased from Tk 75 million to Tk 300 million (US\$4.4 million). For cooperative insurance societies, the minimum capital requirement is considerably lower but has been raised from Tk 20 million to Tk 25 million (US\$0.37 million) and a similar deposit is required of Tk 25 million. Mutual insurance companies have an even lower minimum paid-up capital requirement of Tk 15 million (US\$0.22 million). (See annex 2 for full details).
- *Part IV of the Insurance Act 2010 deals with intermediaries.* Previously insurance regulations did not permit agents or brokers and payment of commissions to intermediaries. Therefore each insurer has had to establish its own branch offices and direct sales outlets and this has added huge overhead administrative and operating expenses to the insurer’s premiums. Clause 124 of the 2010 Act now permits independent insurance brokers to operate in the market. An insurance broker’s license will be issued by the IDRA. The director or the shareholder of an insurance company is prohibited from working for a broker. ***This new provision will allow an NGO/MFI to register as an insurance intermediary and to act as a potential delivery channel for agricultural insurance products to its members.***

2.13. ***Authorized categories of non-life insurance are extensive.*** The Insurance Companies in Bangladesh can normally cover the risks of fire, lightning, explosion, earthquake, riot and strike damage, hail, flood, cyclone, air/marine/land, transit, accident, employer’s liability, workmen’s compensation, public liability, professional indemnities, burglary, robbery, theft, fidelity, motor vehicle, engineering, third party risks, glass, life, disease, sickness, health, agricultural crop, livestock and poultry risks, and every kind of guarantee and indemnity business and counter guarantee and counter indemnity. Currently, however, Sadharan Bima Corporation (SBC) is the only company to have a registered and approved livestock mortality policy, and none of the private commercial insurance companies have yet to develop their own agricultural insurance products.

2.14. ***The special case of index-based insurance may also have to be considered by the IDRA,*** if crop-weather index insurance or area-yield insurance is developed and sold to farmers in Bangladesh. There may also be a case for specific agricultural insurance legislation to be drawn up for Bangladesh to cover both traditional indemnity based products and new drought, flood, and other index products.

2.15. ***Insurance penetration is very low in Bangladesh in comparison with other South Asian countries.*** From 1999 to 2004, the average gross premium income (total of life and non-life business) as a share of GDP was 2.7 percent in India, 1.27 percent in Sri Lanka, and 0.65 percent

in Pakistan; it was, however, only 0.51 percent of GDP for Bangladesh.¹⁵ In 2007 the total market gross premium volume stood at Tk 42.5 billion (US\$625 million) of which the private-sector company share of premium was Tk 38.6 billion (91 percent of total). In 2007 the insurance premium in Bangladesh was slightly less than US\$3.0 per capita. The market is dominated by life insurance while non-life insurance accounted for only about Tk 10.7 billion (US\$157 million) or 25 percent of total premium in 2006. Non-life business centers on property-fire and marine hull and cargo insurance, accounting for nearly three quarters of non-life premium, followed by motor insurance and miscellaneous classes. (See annex 2 for further details of non-life-insurance market).

2.16. ***Most of the products and services offered by the commercial non-life insurance sector in Bangladesh are not relevant to the needs of two-thirds of the population who are based in rural areas.*** Conversely, the private commercial life insurance sector has offered a range of microinsurance products (life and health insurance covers) for a number of years, which have been widely purchased by urban and rural poor. Delta Life Insurance Company was the first private regulated insurer to offer microinsurance in 1988, titled Grameen Bima or “village insurance,” and on the basis of its success, 13 of the 17 private life companies in Bangladesh currently offer microinsurance products. For nine of these companies the reported coverage in 2005 was about 4.48 million clients with premiums of approximately Tk 5.5 billion, which is equivalent to about 25 percent of the total life insurance market premium in 2005.¹⁶

2.17. ***The cooperative and mutual insurance market is very limited.*** Insurance legislation permits cooperative and mutual insurance. Currently very little insurance is underwritten by these entities.

2.18. ***SBC is the dominant figure in the reinsurance market.*** For general (non-life) insurance business, private companies are required by law to cede 50 percent of their treaty reinsurance business to SBC, the public-sector insurer and reinsurer. The private companies are then free to place the remaining 50 percent of their treaty reinsurance requirements either with SBC or with international reinsurers. In practice, SBC offers very competitive terms and conditions and practically 100 percent of reinsurance business is placed with SBC. Some private insurers also access reinsurance capacity from GIC of India and international reinsurers, mainly in the London and European markets. Traditionally, SBC was major direct insurer both of public-sector utilities and of private business, but today 75 percent of the company’s premium income is derived from reinsurance of the private companies, 20 percent from public-sector business, and only 5 percent from private direct underwriting.

Nonregulated Insurance Market

2.19. ***Microfinance companies are active in the insurance market.*** Bangladesh’s MFIs started to offer a wide range of microinsurance products to their members in the late 1990s, including loan insurance, life insurance, health insurance and property insurance. The major providers of microinsurance today include BRAC, Grameen Kalyan, ASA, Proshika, Gonoshashtho Kendar, Shasthya Kendar, Integrated Development foundation (IDF), and Society for Social services (SSS).¹⁷ The 2007 INAFI market survey revealed that 61 MFIs were offering a total of 81 microinsurance products/schemes, of which loan protection insurance was the most

¹⁵ Annual Report 2006, Eastland Insurance Company Limited

¹⁶ Al Hasan 2007.

¹⁷ Al Hasan 2007, *ibid*

popular product, offered by 57 (93 percent) of the MFIs, followed by life insurance, offered by 13 (21 percent) of MFIs. Four also offered livestock microinsurance (table 2.2.).

Table 2.2. Type of Microinsurance Product Offered by MFIs

Type of Insurance Product	Number of MFIs offering Product/Scheme	Percent of MFIs offering product*
Loan protection Insurance	57	93%
Life Insurance	13	21%
Health Insurance	5	8%
Livestock Insurance	4	7%
Property Insurance	2	3%

Source: Adapted from Al Hasan 2007. * Total Number of MFIs = 61.

2.20. *The loan protection policy is designed to protect the MFI against the death of the borrower, which might lead to nonrepayment of the loan.* It is essentially a supply-driven product which the MFIs link on a compulsory basis to their microfinance and it is a standard product which is adopted by nearly all the MFIs that have entered the market for microinsurance. The average premium rate for this cover is 0.8 percent of the loan amount, with a range from 0.2 percent to 4.0 percent across the surveyed MFIs. The policy term is linked to the duration of the loan period, usually up to a maximum of 12 months. In the event of death of the borrower, the outstanding amount of loan is covered by the policy. The life insurance products being marketed by a smaller number of the MFIs are similar to the loan insurance product, but the policy duration is usually for a longer term of between four to eight years. Microhealth-insurance rates vary between 0.8 percent and 2.5 percent and cover typically includes primary health care services and discounts of 25 percent to 50 percent on hospitalization and essential medicines. The livestock insurance products offered by four MFIs are reviewed below. Premiums are either deducted from the member's account or are contributed by the MFI themselves.

2.21. *The INAFI market survey showed that of the 30 million microfinance clients, 69 percent were covered by the microfinance products listed in table 2.1.* Many of the MFIs target poor females, and this is reflected in the finding that 17.5 million or 85 percent of the microinsured's were female. The distribution of microinsurance policies by MFI was BRAC 5.5 million policies (27 percent of total), ASA 5.7 million policies (28 percent), Grameen Bank 5.58 million (27 percent), Proshika 1.94 million policies (9 percent), and the remaining 1.97 million policies by the remaining 58 small and medium MFIs.

2.22. *There are several drawbacks of the current microinsurance products and schemes offered by the NGOs/MFIs.* Currently these microinsurance programs are not regulated or approved by the IDRA and are therefore not formally recognized as insurance. The loan and life products are supply driven and mainly protect the MFI against loan default in the event of death of the borrower. The cover term is usually very short; the products are often loosely structured and rates are fixed with no reference to actuarial rating principles; the sum insured is usually based on the amount of loan and does not reflect the actual financial needs of the household in the event of the death of the borrower; and premiums are usually added to the MFIs' savings and deposits and then used as revolving funds. There is no form of reinsurance protection for the MFI. This is in contrast to the regulated micro-life insurance programs offered by the private insurance companies where the policies have to be structured and approved by the IDRA; policy

terms and conditions are structured in accordance with the clients requirements, age, and health status; premiums are actuarially determined; and coverage is usually provided for 6 to 15 years or sometimes whole of life and the sums insured are considerably higher. Furthermore, the company microinsurance schemes are much more financially secure, as the premiums can be invested only in approved government bonds and securities, stocks, and deposits and the schemes are protected by reinsurance. Further details of the microinsurance products and programs offered by the nonregulated NGOs/MFIs and the issues surrounding these programs are contained in annex 3.

Supply of Agricultural Insurance in Bangladesh

Private Commercial Sector Involvement in Agricultural Insurance

2.23. *There is no involvement of the private commercial insurance sector in agricultural crop, livestock, forestry, or aquaculture insurance.* The reasons why Bangladeshi private commercial insurers have not been involved in crop or livestock insurance to date, include the following: (i) their general belief that agriculture is too risky to underwrite, particularly in view of the very poor underwriting results of one pilot scheme which operated during the 1970s and 1980s; (ii) the lack of awareness on the part of Insurers of crop and livestock insurance products and operating systems and procedures; (iii) the lack of accurate time-series animal mortality data and crop production loss or damage data on which basis to establish technical premium rates; (iv) the prohibitively high administration costs of dealing with very small individual farmers, in particular the costs associated with preinspections and adjusting crop or livestock losses on an individual farmer basis; and (v) the nonavailability of agricultural reinsurance protection.

Public-sector Agricultural Insurance

2.24. *SBC, the public-sector non-life-insurance company introduced a pilot crop insurance scheme in 1977 and then a pilot livestock (cattle) insurance scheme in 1981.* Features of these programs are summarized in this section and a full review is attached in annex 4. SBC established a crop and livestock insurance department in Dhaka to implement the scheme.

2.25. *SBC adopted a conventional individual-grower multiple-peril crop insurance (MPCI) yielded-shortfall policy* which provided coverage against a wide range of climatic perils, including the potentially catastrophic climatic perils of flood, drought, and wind and biological perils of pests and diseases (box 2.1.). The program started on a pilot voluntary basis for rice (Aman, Boro, and Aus), wheat, sugar cane, and jute. The sum insured was set at 80 percent of the past three-year average yield for each crop on each farm and valued at the government intervention price for the crop, or in other words a revenue-based valuation. Premium rates were calculated on an actuarial basis, but as these were deemed to be unaffordable for poor farmers, actual premium rates were capped at between 3 percent for wheat and jute and a maximum of 5 percent for Aman paddy and sugar cane. Loss adjustment was based primarily on “eye estimation” techniques.

2.26. *The SBC pilot crop insurance program operated for 19 years on a voluntary basis during which time the uptake rates were consistently low and the program incurred major underwriting losses.* Reasons for the low uptake and demand for the SBC voluntary crop insurance pilots include: the insurer did not receive any support from government to implement the pilots; there were no comprehensive farmer awareness and insurance training programs; nor were they actively marketed and promoted through producer organizations and finally they were not implemented as part of a bundled program of improved technology and extension advice etc.

During the period 1977 to 1995, the program was insured exclusively by SBC, which retained 100 percent of the losses, and there was no support from government. The annual average loss ratio was a very high 508 percent (box 2.1.). In view of the unsustainable financial losses, the Committee on Crop Insurance constituted by the Ministry of Commerce suspended the pilot crop program in 1995. In spite of several internal evaluations and proposals for reformulating and strengthening the crop insurance program over the past 15 years, to date no insurer in Bangladesh has relaunched crop insurance.

2.27. *SBC's poor experience with smallholder individual grower MPCl closely mirrors the international experience in many other developing countries* both in South Asia (India, Philippines) and in Latin America (Brazil, Ecuador, Costa Rica, Panama), and which has been extensively documented and researched (e.g., Hazel et al., 1986; Hazel 1992; Skees et al., 1999; Mahul and Stutley, (2010). In Bangladesh, the key issues which led to the failure of the SBC MPCl program center on (i) low demand for the voluntary program and problems of adverse selection and moral hazard, (ii) technical drawbacks of the policy design including the setting of insured yield coverage levels too high and the capping of premium rates at well below the actuarially required levels, (iii) operational issues including poor control over loss assessment and loss assessment procedures and high administrative costs, and finally (iv) lack of financial and other support to the program from the Government. (See annex 4 for full discussion of each of these issues).

Box 2.1 SBC Multiple-Peril Crop Insurance Program: 1977 to 1995

Summary Details of SBC Crop Insurance Policy		
Features	Details	
Type of Policy	Individual Grower Multiple-Peril Crop Insurance (MPCI) Loss of Yield Policy	
Insured perils	Multiperil: flood, drought, cyclone, hail, pest, disease, insect	
Insured Crops	Aman paddy, Boro paddy, Aus Paddy, Wheat, Jute, Sugar Cane	
Policy Holder	The scheme was offered to two groups of farmers: (i) members of the agricultural cooperatives under BRDB and (ii) individual farmers taking loans from commercial banks and BKB.	
Voluntary or Compulsory	Voluntary, but some linkage to credit institutions was intended.	
Sum Insured	The sum insured was set at 80% of the preceding three-year average yield of the particular farm in question, and valued at the government-declared procurement price of the crop. The sum insured was therefore determined on an individual farm basis	
Deductible	20% (80% yield guarantee). A 10% excess also applied. For total losses, the claims were limited to a scale according to the stage in the growth cycle when the loss occurred.	
Premium Rates	Rates applied to 80% yield guarantee. Uniform premium rates in all areas. Typical premium rates were: Aman 5%, Aus 4%, Boro 3%, Jute 3%, Wheat 3%, Sugar Cane 5%.	
Exclusions	Qualitative loss and damage, price fluctuations, fire, theft, animal damage, nuclear risks, war, civil war, riots.	
Loss Assessment Procedure	Eye estimation and crop cutting according to needs to establish actual yield and amount of yield loss or damage to the crop. Loss assessment team comprising SBC official, TEO, and credit agency official.	
Government subsidy	None	
Reinsurance	None	
Summary of Crop Insurance Results 1977 to 1995		
Item	Total (1977 to 1995)	Annual Average

No. of Farmers Insured	18,782	989
Crop Area Insured (Ac)	23,794	1,252
Sum Insured (Tk)	110,529,276	5,817,330
Premium (Tk)	3,962,337	208,544
Claims Paid (Tk)	19,766,803	1,062,647
Average Premium Rate %	3.6%	3.7%
Loss Cost %	17.9%	17.9%
Loss ratio %	499%	508%

Source: SBC 2009

2.28. ***SBC launched in 1981 a pilot cattle mortality cover policy covering accidental death and diseases.*** The program was offered only to livestock projects financed by BKB and other nationalized banks. Salient features of the SBC livestock policy and the coverage achieved between 1981 and 2008 are summarized in box 2.2 and the policy wording and full results are detailed in annex 4.

2.29. ***The SBC livestock insurance pilot project has operated since 1981 with a long-term loss ratio of 56 percent, but it has never achieved a high degree of smallholder market penetration.*** Over the 24 years of operation the program has insured a total of 7,591 head of cattle, or an average of only 330 cattle per year, and generated an average annual premium of slightly below Tk 240,000 (about UDS\$3,500). Reasons for the low level of demand for voluntary livestock insurance again centre on SBC's lack of a concerted marketing and sales strategy and specific producer awareness and education training programs. The mortality rate experienced under this insurance scheme has been only 1.2 percent of the insured animals, which is very much lower than the national mortality rates, which are reported at 3 percent to 5 percent in cattle. The average premium rate charged over all years is 3.5 percent, but since 1998 a flat rate of 5 percent has been levied by SBC. The long-term loss ratio for the livestock insurance program is only 56 percent, but due to the very small scale of the program, once administrative and operational costs are included it is unlikely it has operated profitably.

2.30. The key issues for SBC appear to center on the following:

- ***The technical soundness of insurance cover against diseases and “vaccination failure”*** for the wide range of class A epidemic diseases in cattle, as listed in box 2.2: In Bangladesh the livestock veterinary services are underresourced; only a very small proportion of the national cattle herd is vaccinated, and under these circumstances it is considered unsound to offer a livestock insurance policy which insures against vaccination failure in livestock epidemic diseases leading to death of the animal
- ***The catastrophe exposure:*** The livestock mortality program has not been reinsured over its 24 years of operations and it is potentially very exposed to catastrophe losses due to accidental death (flood, cyclone) and or epidemic disease. As the program has remained very small over this period and the maximum total sum insured has not exceeded Tk 50 million in any year, SBC would probably be able to retain its catastrophe exposure, but if livestock insurance is to be scaled up in Bangladesh, reinsurance will be essential.
- ***The low demand for livestock insurance:*** Over the past 24 years the maximum number of insured cattle in any one year occurred in 1991 with 1,931 insured head and total sum insured (TSI) of Tk 47.3 million and premium income of Tk 1.7 million. This compares with the average of 330 insured animals per year. It is apparent that the program has not

been successful in achieving acceptance by livestock owners in Bangladesh and in part this may be due to the fact that SBC marketed the program only to the national banks providing livestock credit to farmers.

- **Lack of scale and high administration expenses:** Livestock insurance is very expensive to administer where individual animal cover is provided and where veterinary preinspections are required to confirm the animal is in sound health and fully vaccinated prior to inception of cover. The SBC program is likely to have incurred very high administrative overheads.

Box 2.2 SBC Livestock Mortality Insurance Program: 1981 to 2008

Summary Details of SBC Livestock Insurance Policy	
Features	Details
Type of Policy	Individual animal insurance for cattle
Insured Perils	Animal mortality due to (i) accident and (ii) diseases
Exclusions	<ul style="list-style-type: none"> • Surgical operations other than that required due to accident or disease during the period of the cover, and castration • Malicious or willful injury or neglect, overloading, unskillful treatment, or use of the animal other than stated in the policy without the consent of SBC • Disease contracted prior to commencement of cover or within 15 days from the commencement of cover. Intentional slaughter of the animal except in cases where destruction is necessary to terminate incurable suffering on humane consideration on the basis of certificate issued by a qualified veterinarian or in cases where destruction is resorted to by order of lawfully constituted authority • Poisoning • Famine of fodder due to natural calamities such as flood and drought • Transport by air, sea, rail, truck, and inland carriers • Class A epidemic diseases (rinderpest, blackquarter, haemorrhagic septicaemia, anthrax, FMD, Filaris and Pleuropneumonia), save where a veterinary certificate proves that these diseases are successfully inoculated on the animal • Theft or clandestine sale of the insured animal • Permanent or total disability • Nuclear risks • War, civil war, riots
Policy Holder	Individual animals belonging to individual farmers
Voluntary or Compulsory	Voluntary, but some linkage to credit institutions was intended
Sum Insured	Based on the market value of the animal or the amount of loan (credit)
Deductible	20% of the value of the claim borne as a co-insurance by the Insured
Premium Rates	Rates have changed over time. Between 1998 and 2003 a flat rate of 5% was charged.
Government Subsidy	None
Reinsurance	None

Summary of Livestock Insurance Results: 1981 to 2008		
Year	Total (1981 to 2008)	Annual Average
No. of Policies Issued	1,026	45
No. of Insured Cattle	7,591	330
Sum Insured (Tk)	162,107,382	6,754,474
Premium (Tk)	5,734,364	238,932
No. of Claims Settled	92	4
Paid Claims (Tk)	3,220,500	134,188
Mortality Rate %	1.2%	

Average Premium Rate %	3.5%	
Loss Cost %	2.0%	
Loss Ratio %	56%	

Source: SBC 2009.

2.31. *Shrimp production is Bangladesh’s second largest export earner, and in the past SBC has underwritten a named-peril aquaculture insurance policy for shrimp farms.* Shrimp production in Bangladesh is concentrated in the southern coastal region and is highly exposed to flood, tropical cyclone and tidal surge, and diseases of shrimp. The SBC shrimp policy was introduced in the 1990s as a named-peril cover restricted to flood, cyclone and tidal surge, and diseases were specifically excluded. The policy covered both loss of fish stock (shrimp and prawns) and loss or damage to the shrimp farm installations, buildings, ponds, and feedstock on site. The policy was marketed on a voluntary basis with a fixed premium rate of 0.99 percent of the sum insured, which was based on the input costs (stock, feed, etc) for each 120-day shrimp production cycle. The program never achieved the required sales levels, the fixed premium rate was far below the correct technical rate(s), and in the absence of a conventional deductible the product was exposed to first loss. On account of the very poor underwriting results, SBC withdrew this cover by 2004. (Further details of the SBC shrimp insurance scheme are presented in annex 10).

Nonregulated Livestock Insurance

2.32. *Several MFIs have provided their own informal livestock mortality microinsurance products.* The MFIs providing livestock mortality loan protection cover include Proshika (since 1990), Grameen Fisheries and Livestock Foundation (since 2001), and Palli Bikash Kendra (PBK), Dustho Shasthya Kendra (DSK) and Gana Unnayan Kendra (GUK). Key features of these livestock microinsurance products and schemes are reviewed below and further details are provided in annex 4.

Proshika Participatory Livestock Compensation Fund (PLFC)

2.33. Since its formation in 1976, the Livestock Development Program (LDP) has been a core component of PROSHIKA’s development activities for resource-poor farmers and rural landless HHs, especially women. The LDP has three main components: (i) livestock production (cattle, sheep, and goats); (ii) poultry production; and (iii) livestock support services. LDP provides a range of financial and technical support services to its group members, including livestock investment credit; training and skill development in animal husbandry practices; and training for para-veterinarians, vaccinators, and artificial insemination technicians.

2.34. *Proshika was the first MFI to introduce a livestock mortality loan protection scheme in 1990 under its Participatory Livestock Compensation Fund, PLCF.*¹⁸ The PLCF is linked on a compulsory basis to PROSHIKA’s revolving credit fund for cattle, sheep/goats, and poultry-rearing projects. The PLCF compensates against the “sudden death” of insured livestock and poultry during the loan repayment period (usually 12 to 24 months), and it is in effect an all-risk accident and disease policy. It does not, however, compensate poor management practices or negligence on the part of the Insured. The rates charged by the PLCF are between 3 percent and 5 percent of the purchase price (or loan amount) for cattle and sheep/goats and 10 percent for

¹⁸ PROSHIKA 2008, Activity Report July 2006 to June 2007.

poultry.¹⁹ Over the 19 years that the PLCF has operated, a total of 11,739 livestock producers' groups have been insured under this program and a total of 140,439 head of livestock have been insured, of which 87 percent have been cattle and smaller numbers of sheep and goats and 13 percent poultry. Claims have been paid out on the death of 4,855 head of animals/poultry with an implied average mortality rate of 3.5 percent with claims valued at Tk 21.3 million against premium receipts of Tk 31.4 million equivalent to an average loss ratio of 68 percent (box 2.3.).

2.35. It is noted that under the PROSHIKA Savings Scheme (PSS), the MFI also provides its members compensation for loss of life and property (i.e., micro-life insurance and property insurance).

Box 2.3. Proshika Participatory Livestock Compensation Fund

<p>Scope</p> <ul style="list-style-type: none"> • The Participatory Livestock Compensation Fund (PLCF) pays for the loss caused by the sudden death of cattle, goats, and poultry under their livestock development program. • The PLFC mortality cover is compulsory for PROSHIKA members taking out microcredit livestock investment loans from the MFI. <p>Features</p> <ul style="list-style-type: none"> • Coverage: animal mortality due to sudden death (includes accident and disease) • Insured classes of livestock: cattle, sheep/goats and poultry • Livestock mortality coverage is bundled as part of a package which includes credit and technical assistance. • Cover Period: duration of the livestock loan, which is usually 12 months to 24 months • Guarantee amount (sum insured): loan amount/purchase value/investment scale • Subscription (Premium) rates: originally 5 percent (cattle and goats) and 10 percent (poultry). Currently in 2009 the rates applied are lower at 3 percent (cattle) and 6 percent (poultry). • Premium contribution is paid before the loan is disbursed. • Deductible: 5 percent of the TSI applies for poultry insurance • Loss adjustment: conducted by MFI members under the supervision of PROSHIKA <p>Results (1990 to 21/03/2009)</p> <ul style="list-style-type: none"> • 11,739 livestock producer groups have participated in PLCF since inception. • 140,439 head of animals have been insured under PLCF since inception, of which cattle (and goats) account for 122,678 animals (87 percent) and poultry accounts for 17,761 birds (13 percent of total) • Total value of livestock loans protected under PLCF = Tk 598 million (TSI), with average sum insured per animal of Tk 4,256. • Total borrower's contributions (premium): Tk. 31.4 million, with an average premium rate of 5.25 percent • Total claims paid (number of animals): 4,855 animals giving an average mortality rate of 3.5 percent • Value of total claims paid: Tk 21.3 million, giving a long-term average loss cost of 3.6 percent • Loss ratio: 67.9 percent (average since inception in 1990 up to 21/03/2009) <p>Key Challenges</p> <ul style="list-style-type: none"> • The PLCF mortality product is not recognized under the Insurance Act 1938/2010 • Proshika PLCF is NOT REINSURED and is exposed to catastrophe claims (flood, cyclone, epidemic disease). <p>Sources: PROSHIKA 2008, PROSHIKA Field visits 2009.</p>

¹⁹ Rates reported by PROSHIKA 2008, page 13. It is understood rates in 2009 are lower at 3 percent for cattle and 6 percent for poultry.

Grameen CLDDP Livestock Insurance Fund

2.36. The Grameen Fisheries and Livestock Foundation (Grameen Moshto Pashusampad Foundation, GMPF) is a sister organization of the Grameen Bank (GB). In 1999, GMPF added livestock and dairy activities to its fisheries program for small rural HHs under the United Nations Development Program–funded Community Livestock and Dairy Development Project (CLDDP). The CLDDP dairy producers were provided livestock loans which were protected under a livestock mortality compensation scheme provided by the Livestock Insurance Fund (LIF).²⁰ (See box 2.4 for details)

2.37. *The LIF program insures against death of the dairy cow where this is “outside the control of the owner”, and in effect it is an all-risks livestock mortality policy.* Insurance is provided as part of an integrated package under which CLDDP veterinary and extension staff assist in the preinspection of the dairy cow or heifer and certify its health status. The animal is then routinely inspected and vaccinated by CLDDP-trained veterinary staff and in the event of death the cause of loss is verified by the veterinary staff. These measures lead to greatly reduced livestock mortality rates and the ability to levy very low premium rates for individual animal mortality cover. The sum insured is equivalent to the amount of loan taken out to purchase the cow and premium is currently charged at a rate of 3 percent of the value of the loan. Coverage terminates once the loan has been repaid (usually over a maximum of two years). In addition, a fee of 2.5 percent of the value of the loan is levied to cover the cost of veterinary services, vaccinations, and technical assistance. The program has now operated for eight complete years during which a total of slightly over 7,000 dairy cows have been insured with an average mortality rate of 2.8 percent. The LIF liability is totally retained within GMPF, and the program does not carry any form of catastrophe reinsurance protection.

Box 2.4. GMPF CLLDP Livestock Insurance Fund: 2001 to date

Scope			
<ul style="list-style-type: none"> • The Livestock Insurance Fund is a component of CLDDP Livestock Development Program (1999) and compensates dairy cattle owners against mortality of their cows. • Livestock mortality insurance is compulsory for dairy farmers who purchase cows/heifers on credit using CLDDP microloans. • Insured animals: heifers, dairy cows, beef cattle (> 70 percent dairy cows) • Territorial scope: mainly northwestern Bangladesh 			
Features			
<ul style="list-style-type: none"> • Community-based program • Coverage: animal mortality due to disease, accident, and any cause outside the control of the owner • Insurance is provided as part of an integrated package which includes, credit, technical assistance, vaccines and veterinary services, concentrate feeds and fodder, and milk marketing services. • Guarantee amount (sum insured): loan amount /replacement cost • Premium rate: 3 percent (previously 2.5 percent) of the loan money deducted at source • Service fee of 2.5 percent of value of loan is charged to Livestock Development Fund (LDF) in order to contribute toward veterinary inputs (animal inspections, vaccinations etc) and to cover salaries of veterinary staff. 			
Results			
A. CLDDP Project 2001 to 2005:			
Year	No. of insured dairy cows	No. of insured cows died	Mortality rate (%)

²⁰ See <http://www.grameen-info.org/grameen/GrameenMotsho/index.html>

2001	1,337	25	1.9%
2002	586	33	5.6%
2003	707	47	6.6%
2004	798	29	3.6%
2005	822	29	3.5%
Total	4,250	163	3.8%
Livestock insurance premiums (Tk)		1,975,000	
Livestock indemnities paid (Tk)		1,485,000	
Loss ratio%		75%	
B. CLDDP Sustainable Project from 2006 to 2008:			
Year	No. of insured cows	No. of insured cows died	Mortality rate (%)
2006	1,195	14	1.2%
2007	875	16	1.8%
2008	695	1	0.1%
Total	2,765	31	1.1%
All Years	7,015	194	2.8%
<ul style="list-style-type: none"> • Overall loss ratio at end 2008 is about 45%. 			
Key Challenges			
<ul style="list-style-type: none"> • The Grameen livestock mortality product is not recognized under the Insurance Act 1938 /2010. • The Grameen livestock mortality product is NOT REINSURED and is exposed to catastrophe claims (flood, cyclone, epidemic disease). 			
Source: Authors, based on information provided by Grameen Bank March 2009.			

2.38. Several other NGOs/MFIs including Palli Bikash Kendra (PBK), Dustho Shasthya Kendra (DSK), and Gana Unnayan Kendra (GUK) underwrite their own livestock mortality loan protection schemes. (See annex 4 for further details).

Key Issues for MFI Livestock Loan Protection Schemes

2.39. The key issues for the MFIs providing livestock mortality-loan protection microinsurance schemes appear to center on the following:

- ***The technical soundness of providing all-risk mortality cover in livestock:*** in the absence of any formal risk sharing or reinsurance protection, this leaves the MFIs very exposed to potential catastrophe losses due to flood, cyclone, and especially epidemic diseases. It is noted that internationally very few livestock insurance programs offer all-risks mortality cover in livestock. Under individual animal insurance programs, cover is normally restricted to simple accident and mortality and diseases are usually excluded: class A highly contagious epidemic diseases are nearly always excluded.²¹ A few specialist livestock insurers (e.g., in Germany) offer epidemic disease cover, but this is always on a group animal or herd basis and the policies carry high first loss deductibles.
- ***The need for catastrophe livestock reinsurance protection:*** Although PROSHIKA and GMPF have experienced reasonable underwriting results over time and premiums have been adequate to cover actual claims, the fact remains that in the absence of any form of catastrophe excess-of-loss protection the individual cooperatives would be very

²¹ Class A diseases as defined by the OIE, International Organisation of Epizooties.

financially exposed in the event of major losses which exceed the premium collected from their livestock members. If the MFIs continue to provide sudden death/all-risks cover including epidemic diseases, it is highly unlikely that they will be able to contract reinsurance protection from either the local public or private insurance companies in Bangladesh, or from international reinsurers.

- ***The need to resolve the legal status of the MFIs' livestock mortality compensation schemes will probably if they are to be scaled up and attract reinsurance protection.*** Currently the MFIs' microinsurance products for life, health, property, and livestock mortality are not approved or regulated by the Department of Insurance, and this means that they cannot qualify for reinsurance by the local market and/or international reinsurers. It is not known whether insurance regulations would permit an MFI to use a local insurance company under a purely fronting exercise (i.e., where the company does not retain any risk) and to access international reinsurance on an excess-of-loss basis.
- ***Ways of scaling-up livestock insurance through the MFIs:*** Currently only a very small number or less than half a dozen MFIs provide livestock compensation schemes. Bangladesh has over 25 million head of cattle and with current insured levels of a few thousand head of cattle per year, the penetration of livestock insurance is very low. It is unlikely, however, that many MFIs will be willing to risk their members' savings and revolving credit funds by providing livestock mortality insurance unless some form of risk transfer and reinsurance program is in place and this in turn is likely to require changes to insurance legislation as noted above.
- ***Supply-led as opposed to demand-led products:*** The current range of livestock insurance products provided by the MFIs are supply led as opposed to demand led and do not necessarily provide farmers with the cover they are seeking. The livestock insurance schemes reviewed above are all compulsory programs linked to the MFIs' credit programs. Although some classes of regulated insurance are compulsory (for example, third party liability cover for motor vehicles), most crop and livestock insurance is provided on a voluntary basis. The sum insured is usually restricted to the amount of the lien as opposed to the market replacement value of the animal, and once the loan has been repaid cover ceases leaving the owner very exposed to the death of the animal.

Nonregulated Crop Insurance

2.40. Currently none of the MFIs are offering crop insurance products and services to their grower members.

2.41. ***INAFI 2009 proposes to form a Mutual Crop Insurance Company.*** Since 2007, INAFI (International Network of Alternative Financial Institutions) Bangladesh has been working with various aid donors, international NGOs, and banks to develop mutual insurance for the NGOs/MFIs in Bangladesh. This concept of mutual or cooperative microinsurance is being developed under its MIME program. In 2009, INAFI had ambitious proposals to develop, in conjunction with the North-South University and PREM (Netherlands), a new mutual microinsurance company which would pool the agricultural crop and livestock insurance risks of 12 of the largest NGOs/MFIs in Bangladesh. This mutual insurance company would operate under INAFI's auspices and would be completely separate from the MFIs' credit operations and would open the possibility of purchasing pooled catastrophe crop reinsurance protection for all 12 participating MFIs. It is understood that if mutual insurance becomes a legally recognized and regulated class of insurance in Bangladesh, the mutual model might provide an important option

for developing crop and livestock insurance in Bangladesh. It appears, however, that under the new 2008 amendments to the Insurance Act that mutual insurers will no longer be authorized to operate as general insurers, although they may continue to act as life insurance companies. It is also understood that cooperative insurers can continue to underwrite general insurance business in agricultural insurance.

Demand for Agricultural Insurance in Bangladesh

2.42. *The most comprehensive work to date on farmers' demand for agricultural insurance in Bangladesh has been conducted by PREM²² in conjunction with INAFI²³ Bangladesh.* In 2006 these counterpart organizations conducted a large-scale survey into the demand for crop insurance against the single peril of flood with 3,600 rural HHs located in riverine and coastal areas in seven Districts of Bangladesh which were selected to represent four different types of flood exposure: (i) river flood with no embankment protection, (ii) river flood with embankment protection, (iii) flash flood (HHs located in the hoar basin), and (iv) coastal cyclone-induced excess rain/flood/tidal surge. Using a contingent valuation method, each HH was asked if it would be willing to participate in a hypothetical insurance scheme which would compensate flood losses in return for a formal premium payment, the level of which was determined according to the HHs "willingness to pay" for such a cover. The key findings of this survey included the following:²⁴

- Two-thirds of the sampled HHs owned agricultural land with an average of 1 hectare per HH. Ninety-eight percent of all respondents experienced flood-related losses, with an adjusted value for average crop damage of US\$388/HH (median cost of damage US\$261). The cost of flood damage varied widely by type of flood, with flash flood resulting in average losses in excess of \$1,000 compared to less than \$400 for all other types of flood.
- The frequency of flood damage was very high, ranging from at least once every year in the coastal region to a minimum return period of one in every six years for HHs living in riverine areas with flood protection embankments. HHs living in the hoar basin suffered from flash floods one in every three years, while those in riverine areas without any form of flood protection embankment incurred losses one in every five years.
- Faced with these extremely high exposures to flood losses, it is not surprising in the World Bank's view that 56 percent of HHs replied that they would be willing to purchase crop flood insurance. For the remaining 44 percent of respondents indicating they would not buy flood insurance, the main reasons included limited financial income (42 percent of nonbuyers) and dislike of the terms and conditions of the proposed flood insurance cover (33 percent).

²² Poverty Reduction and Environmental Management (PREM) program in Bangladesh funded by the Dutch Ministry of Foreign Affairs and which is being implemented by the Institute for Environmental Studies, Vrije University Netherlands in conjunction with INAFI/

²³ International Network of Alternative Financial Institutions (INAFI) is an international network of specialists providing technical assistance and training and institution building in the field of alternative financial institutions including microfinance and microinsurance. INAFI's Headquarter is in Senegal and it has regional offices in Costa has regional offices in Bangladesh, Kenya and Costa Rica.

²⁴ For key survey results see (a) Akter, S. & Roy Brauwer, 2007, Demand assessment and test of commercial viability of crop insurance in Bangladesh, PREM Wording paper, June 2007, (b) PREM 2007, Crop Insurance in Bangladesh: protecting poor farmers against natural disasters. PREM policy Brief No. 18 June 2007.

- For the sample expressing a willingness to purchase flood insurance, 78 percent depended on agriculture for their primary source of income and on average they were considerably larger landowners (average 1.5 ha of land) than those who were unwilling to purchase flood insurance.
- The study found that the willingness to pay crop flood insurance premium varied between Tk 26 (US\$0.41) and Tk 45 (US\$0.71) per week for flood insurance, and that farmers facing the lowest average return period in riverine flood areas with embankment protection were willing to pay the highest rates while the farmers in the flash-flood prone areas who suffer the highest losses were the least willing to pay for these losses. The explanation for this dichotomy was that the farmers in the flash-flood prone areas were least able to afford crop insurance premiums.
- The study also calculated the commercial viability of crop-flood insurance according to the premium rates farmers were willing to pay and concluded that flood insurance was only marginally viable in the riverine areas assuming median damage levels and was highly unprofitable in coastal regions and regions susceptible to flash flooding.
- The study concluded that in the design of any crop-flood insurance scheme, policy makers must take into account two key factors: (i) the very different nature of flood damage in different regions of Bangladesh and (ii) the different socioeconomic conditions of farmers and their ability to pay for crop insurance.

2.43. ***The PREM-INAFI study provides useful insights into the potential demand for flood insurance by Bangladeshi farmers.*** Given the restricted nature of the hypothetical cover offered under this study, the fact that more than 50 percent of respondents indicated their willingness to purchase crop insurance indicates the very high potential demand by Bangladeshi small farmers for suitable crop risk-transfer mechanisms. The survey results regarding the return periods for different types of flood, as reported by the farmers, represent a very important finding which has major implications for the potential insurability of flood. In this context the World Bank notes that a conventional commercial insurance product cannot insure farmers in areas with a known and predictable flood exposure every year; rather the minimum acceptable flood return period for insurance purposes is in the order of five to seven years. For those areas which have a regular and predictable flood exposure, individual farmer voluntary crop insurance is not a commercially viable solution and other solutions need to be developed.

2.44. ***Another recent study conducted by the Government of Bangladesh²⁵ also reinforces the PREM-INAFI research findings.*** A demand survey was conducted as part of the study on a sample of 450 heterogeneous farmers selected from three sample Districts: Sunamganj, Rajshahi, and Satkhira, given their being prone to flood, drought and cyclone, or salinity, respectively. Almost all of them expressed an interest in being part of crop insurance program and a “willingness to pay” for this coverage depending on their economic status, numbers of crops produced in a year, and degree of vulnerability to natural disaster. On an average, the willingness to premium payment rate has been found at about 3-6 percent of yield value of crops per season.

2.45. ***While a formal demand assessment was outside the scope of the current World Bank Study, panel discussions were held with crop and livestock producers in the 3 study districts to elicit information on their constraints to production, current risk management strategies and views on agricultural insurance.*** These discussions highlighted the fact that in addition to natural and climatic peril exposures, Bangladeshi farmers face a wide range of production

²⁵ Climate Change Cell, Department of Environment, Ministry of Environment and Forests, June 2009: “Crop Insurance as a Risk Management Strategy in Bangladesh”

constraints including limited access to working capital, lack of timely supply to/and quality of inputs, increasing input costs and uncertain output prices, lack of on-farm storage facilities and exposure to post-harvest losses, lack of access to vaccines for their livestock etc. These constraints must be taken into consideration in the development of any agricultural insurance solutions. In the study districts farmers' exposure to flood varies from village to village and proximity to major rivers: flood is a catastrophe exposure which individual farmers have no control over. Irrigation water supply is either by public sector canal, or by large tubewells. Farmers' main response to lack of irrigation water supply (drought) is to invest in their own shallow-tube wells as observed in several of the villages. An appreciable hail exposure was identified by farmers across all 3 districts: farmers do not, however, practice any risk management practices against hail²⁶. Livestock owners and aquaculture producers often identified diseases as a major concern as well as limited access to vaccines and medicines.

2.46. *The needs and benefits of agricultural insurance were discussed with the farmer panel groups and almost all farmers agreed that agricultural insurance could be a useful tool as part of their agricultural risk management strategy.* However, given their lack of knowledge and awareness of specific crop and livestock insurance products and lack of experience of the benefits and constraints of such products, it was not possible to quantify objectively their potential levels of demand for these, at present, hypothetical products. It should be recognised that only real transactions (for example through an insurance pilot project) will reveal the true demand for insurance.

2.47. *In any future pilot project design stage a detailed demand and needs assessment study should be conducted. This study should also carefully address the crop insurance needs of different types of Bangladeshi farmer and agricultural insurance solutions designed to meet their needs.* Any future pilot crop and livestock insurance schemes will need to identify carefully their intended target audience. Purely subsistence farmers are unlikely to benefit from crop or livestock insurance and these products are more suitable for semi-commercial small and marginal farmers who are members of the MFIs and or local cooperatives. The larger commercial farmers may in due course be targeted by the private insurance companies. Under traditional indemnity-based crop insurance programs, share-croppers often do not benefit from crop insurance as the policy tends to be issued in the name of the land-owner and in the event of a loss the indemnity is paid directly to the landlord. However, area-yield index insurance and weather index insurance is well suited to the needs of sharecroppers because they can take out their own policy in their own name as the sole beneficiary (See Chapter 4 for further details).

²⁶ Large-scale commercial farmers in hail prone countries such as Israel, USA, Argentina, may invest in hail netting, or in active anti-hail technology (ant-hail cannons, hand-held rockets).

Chapter 3: Agricultural Risk Assessment in Bangladesh

Objectives and Scope of Agricultural Crop, Livestock, and Weather Risk Assessment

3.1. To date, in Bangladesh there has been little formal risk assessment for crop insurance purposes of the key climatic, biological, and natural perils and their impact on crop production and yields and farm incomes. Similarly, there has been no assessment of normal and catastrophe livestock mortality rates and the implications for the design of livestock insurance programs. The risk assessment presented in this chapter aims (i) to aid policy makers and planners in Bangladesh in understanding the major climatic and natural-peril risk exposures in the main crops of paddy rice and wheat grown in Bangladesh, (ii) to quantify wherever possible the value of expected crop losses in normal and catastrophe loss years, and (iii) to discuss the implications for any future pilot crop insurance programs. The specific objectives of the agricultural crop, livestock, and weather risk assessment are (a) to identify and quantify the key natural, climatic, and biological perils affecting crop and livestock production in Bangladesh and to classify these perils according to their frequency and severity; (b) to perform a preliminary risk analysis in order to quantify the catastrophe exposure to selected target crops both at national level and for three selected Districts; and (c) to define homogeneous crop risk zones and to map the risks for each crop.

Data Availability for Crop, Livestock, and Weather Risk Assessment

3.2. The data sources which have been used in this crop and livestock risk assessment exercise are summarized below and further details on data collection and reporting and issues relating to the accuracy of data are addressed in annex 5.

3.3. **Data for crop risk assessment:** Two types of data are commonly used in the assessment of risk in crop production:

- **Crop damage or production loss data by cause of loss:** In Bangladesh, crop losses are recorded by the Bangladesh Bureau of Statistics (BBS) for major natural disasters in terms of damaged area (totally damaged area and partially damaged area). Damage data is especially useful for the design and rating of named-peril damage-based policies. This study looked at 16 years of crop damage statistics for key perils from 1990 to 2005. The BBS's crop damage statistics have been complemented with crop damage statistics from the Disaster Management Bureau (DMB) and with the loss appraisal for Cyclone Sidhr performed by the Government of Bangladesh (GoB, 2008).
- **Crop production and yield data:** The analysis of variance in time-series production and yield data forms the basis of any "loss of crop yield-based insurance and indemnity" program. Bangladesh has established system of recording crop production and yields and a minimum of 39 years published regional-level crop production and yield data are available for major crops and minor crops in the

country.²⁷ Although, sub-District or Upazila crop-yield data are not published, under this study it has been possible to collect annual average yields over the past 16 years, from 1992–93 up to and including 2007–08, for Aman HYV paddy and Boro HYV paddy in Bogra, Dinajpur, and Pabna Districts. These series have been used to develop the risk assessment models at (i) the regional level to assess the risk exposure at a national level for Bangladesh and (ii) the Upazila level in order to establish expected yields and illustrative premium rates for an area-yield index insurance program.

3.4. **Data for weather risk assessment:** Crop risk assessment aims to combine an analysis of crop damage or production and yield variation with time-series climatic data. The concept here is to correlate weather variables with crop production and yields for causal relationships and where the time-series climatic data can be used to establish the frequency of occurrence and severity of loss events for rating purposes. Bangladesh has a lengthy history of weather-data recording through the Bangladesh Meteorological Department (BMD). BMD records weather data measured at its 35 manual weather stations network spread throughout Bangladesh's 64 Districts, and these data include weather parameters such as rainfall, temperature, and radiation. A preliminary weather risk assessment is presented in this chapter based on weather data collected for sample meteorological stations.

3.5. **Data for livestock risk assessment:** The Department of Livestock Services (DLS) of the Ministry of Fisheries and Livestock (MoFL) is the main organization in Bangladesh responsible for monitoring and recording animal disease and mortality levels, but on account of severe staffing and financial resource constraints the DLS had not been able to establish a regional or national livestock mortality database. Some limited livestock disease data for Bangladesh is available through the World Animal Health Organization (OIE), and mortality data are also available from the SBC and NGO/MFI livestock compensation schemes. This partial data is reviewed toward the end of this chapter.

Agricultural Crop Production in Bangladesh

3.6. Bangladesh lies between 20°30' and 26°40' north latitude and 88°03' and 92°40' east longitude. The country is situated on one of the biggest river deltas in the world and has an area of about 147,570 km². It enjoys a subtropical monsoon climate with a hot and rainy summer season from July to September and a dry winter from December to March. The country experiences annual average precipitation of 2,300 mm, varying from as little as 1,200 mm in the west to over 5,000 mm in the east. The rivers Ganges-Padma, the Brahmaputra-Jamuna, and the Surma-Meghna and their numerous tributaries form the main arteries of the drainage system of Bangladesh. The territory consists mainly of the flood plains of these three rivers.

3.7. Bangladesh is divided into six administrative divisions. The administrative divisions are, in turn, subdivided into 64 administrative Districts,²⁸ and each District, in turn, is divided into a total of 478 sub-Districts (Upazilas). Finally, each Upazila is divided into unions, each Union consisting of a number of neighboring villages. The union is the lowest administrative level in Bangladesh, and there are approximately, 4,500 Unions in the country.

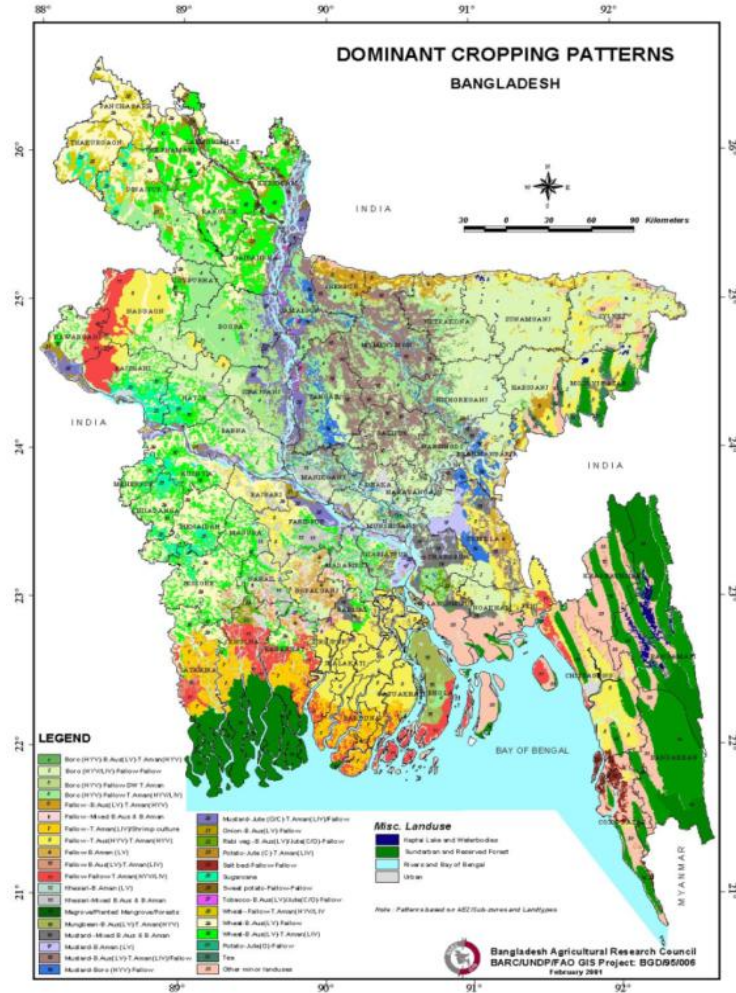
²⁷ In Bangladesh two organizations are involved in the recording of crop production and yields, (1) the Bangladesh Bureau of Statistics and (2) The Department of Agriculture Extension.

²⁸ There is also one further administrative classification the "Greater District" or Region. There are 23 Greater Districts or Regions in Bangladesh which comprise between 2 and 3 neighbouring Districts.

Climate and Cropping Systems

3.8. **Bangladesh has more than 30 different cropping patterns.** The cropping patterns are defined mainly by climatic and topographical factors, but also by the land inundation type and the availability of irrigation water and type of seeds grown (local versus hybrid varieties). Most areas can sustain three crops a year. Paddy crops, which account for approximately 80 percent of the area under cultivation, are grown throughout the country. Wheat, occupying 4 percent of the area under cultivation, is predominantly grown in the northwest of Bangladesh and in Districts along the Padma River. The dominant cropping patterns of Bangladesh are shown in map 3.1.

Map 3.1. Dominant Cropping Patterns in Bangladesh

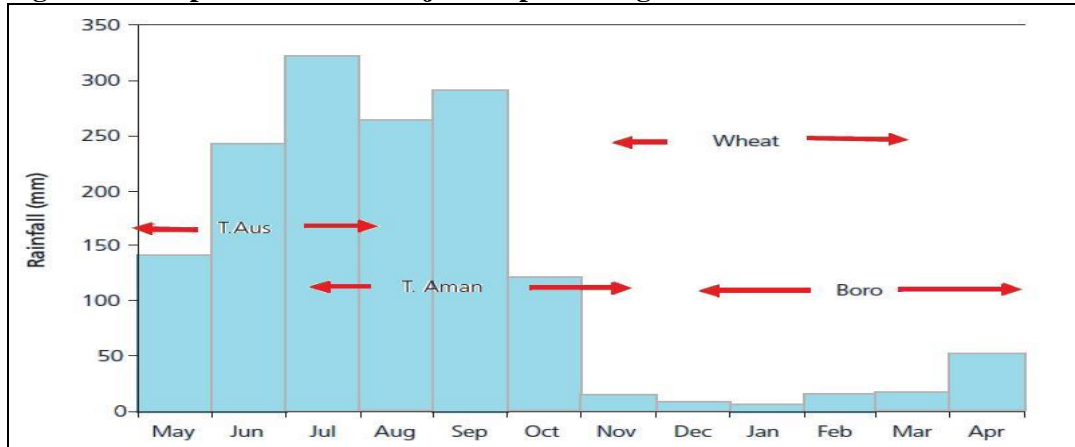


Source: (BARC, 1995).

3.9. **Crop selection and cropping calendars in Bangladesh are adjusted to the monsoon rains.** Two main crop seasons can be distinguished in Bangladesh: the Kharif summer monsoon season and the Rabi winter dry season. The Kharif season starts in July and extends up to November, when crop cultivation is mainly rain fed and reliant on the monsoon rains; this crop season is characterized by high temperatures, rainfall, and humidity. The Rabi crop season begins at the end of the monsoon period in late November and extends up to the end of March; this

season is characterized by dry sunny hot weather but with a cool period in January and February. Aus paddy crops are grown in the pre-Kharif season from May to July. Aman paddy crops are grown in the Kharif season from July to November. Boro paddy crops are grown in the Rabi season from December to April. Wheat is a winter grown from November to March. Figure 3.1 shows the crop calendar for major crops and the adjustment of crop calendar to the monsoon rainfall.

Figure 3.1 Crop Calendar for Major Crops in Bangladesh



Source: (FAO, 2007)

3.10. *The cropping patterns in Bangladesh are highly influenced by topography and susceptibility to different types of flooding.* The flood “inundation” land types in Bangladesh can be divided into five main categories (Bangladesh Bureau of Statistics, 2007): highland, medium land, low land, very low land, and hilly land. The main features of each of these land inundation types are summarized in box 3.1

Box 3.1 Bangladesh: Features of the different land inundations types

Highland: – The area is relatively high and cannot hold waters during monsoon. Some waters are retained by raising *bandhs* around fields. Highland may be suitable for Kharif or perennial dry-land crops if the soils are permeable. Impermeable soils may be suitable for transplanted Aus and/or Aman paddy if *bandhs* are made to retain rainwater on fields. The tract and area spreads over Modhupur Garh in Mymensingh, Bhaol’s Garh in Dhaka, Barind tract in Rajshahi Division, Lalmai area in Comilla, and ‘Tilla’ areas in Sylhet region.

Medium land – This land is normally flooded to a depth between 90 centimeters and 180 centimeters during the flood season. Water movements can be controlled with help of *bandhs*. Medium Highland is suitable for crops which can tolerate shallow flooding, such as broadcast or transplanted Aus paddy, jute, and transplanted Aman paddy. Early Kharif dry-land crops which mature before flooding starts can be grown on permeable soils, and late Kharif and early Rabi dry-land crops on soils which drain in September-October. Medium lowland is flooded too deeply for transplanted Aus or transplanted Aman paddy to be grown safely. Mixed broadcast Aus and deepwater Aman is a common practice; or long Aman seedlings may be transplanted if floodwater recedes early enough. Dry-land Rabi crops are widely grown on soils which drain in October or November. The area includes northern parts of Dhaka and Barisal, part of Mymensingh, eastern of Chittagong, Noakhali and Comilla, parts of Sylhet, Rajshahi, Dinajpur, Rangpur, Bogra, Pabna, Khulna, Jessore, and Kushtia.

Low land – Monsoon waters stand in the land more than 1 m depth and may reach 3.5 m, and the water movements cannot be controlled. Low land is flooded too deeply for broadcast Aus or transplanted Aman

to be grown. Deepwater Aman is typically grown on such land, although the cultivation of irrigated Boro paddy on such land in the dry season now precludes the cultivation of deepwater Aman over considerable areas of low land. Dry land Rabi crops can be grown only if floodwater recedes before December. The area includes parts of Pabna and Faridpur, southern part of Dhaka, part of Mymensingh, western parts of Comilla and Noakhali, and parts of Sylhet, Bogra, and Khulna.

Very low land – The land consists of haors, beels, canals, and other low-lying areas and during the rainy season looks like large lakes. Water depth may be as much as 9 meters. In winter, waters dry up except in the center. Very Low land generally is too deeply flooded for even deepwater Aman paddy to be grown (this is not necessarily because of the depth of flooding but because of such associated characteristics as early flooding, rapid flooding, or wave action on large open bodies of water, as in the Sylhet Basin). Where cultivated, very low land is generally used for irrigated Boro paddy, either HYV or local varieties. Bottomland stays too wet for paddy to be broadcast sown. The traditional crop on such land is local transplanted Boro paddy, either unirrigated or irrigated by traditional low-lift irrigation devices. In a few other areas where flooding normally does not exceed about 1.5 m, very long Aman paddy seedlings are transplanted early in the monsoon season. Most of the haors and beels lie in Sylhet region and in Kishoreganj and Netrokona Districts of Mymensingh region.

Hilly land – The land spreads over Chittagong Hill Tracts in a forested area that is distinct from the rest of the country. It includes part of Chittagong, northern part of Mymensingh, north and southern parts of Sylhet, eastern border of Comilla, and northeastern strip of Noakhali region.

Source: Bangladesh Bureau of Statistics, 2007.

3.11. ***The development of public-sector irrigation and especially private shallow tube-well irrigation facilities in Bangladesh has led to a major expansion in the cultivation of Rabi (dry season) crops in the past decade.*** Bangladesh has increased considerably the irrigated area in the past 10 years. In 1996–97 there were only around 9,000,000 acres under irrigation. In 2009, 14,560,000 acres, or 43 percent of the cultivated area was under irrigation. As a result of the improvement in irrigation coverage, the cultivated area of Rabi crops has notably increased from 20 percent of the total cultivated area in the seventies to 36 percent of the total cultivated area in 2007–08.

3.12. ***Bangladesh faces a complex environment for crop production; thus the cropping systems in the country are also complex.*** In order to cope with the risks associated with cropping activities, the farmers have devised a complex but sustainable, low-input, risk-aversion type of mixed farming to attain a minimum food security in the face of natural hazards. As part of their risk-management strategy, the farmers employ different technology packages on their crops, which include the selection of the varieties, the selection of the planting dates, the crop planting modalities, the crop husbandry practices, and so forth.

3.13. ***Bangladesh may be significantly affected by climate change.*** The General Circulation Model (GCM) used by the US Climate Change Study team for Bangladesh predicted that the average increase in temperature would be 1.3°C and 2.6°C for the years 2030 and 2070, respectively. It was found that there would be a seasonal variation in changed temperature: 1.4°C change in the winter and 0.7°C in the monsoon months in 2030. For 2070 the variation would be 2.1°C and 1.7°C for winter and monsoon seasons, respectively. Winter precipitation was predicted to decrease to a negligible rate in 2030, while in 2075 there would not be any appreciable rainfall in winter at all. On the other hand, monsoon precipitation would increase at a rate of 12 percent and 27 percent for the two projection years, respectively (Ahmed, 1999).

3.14. ***Climate factors strongly interact to affect crop yields; therefore, it is likely that climate change will affect crop production.*** Over 30 percent of the net available cultivable land of

Bangladesh is located in the coastal areas which will be affected by the combination of sea level rise and an increase in salinity in the already affected soils of the coastal regions. Less rainfall during winter due to climate change would lead to a decrease in moisture content of the topsoil, as well as less recharging of the groundwater table. Higher evaporation would cause worse drought-like conditions. In summer, increased precipitation would worsen the flood situation, which will have a negative effect on agricultural production.

Regional Distribution of Crop Production

3.15. *In the crop calendar year 2006-07, the gross cultivated area in Bangladesh was nearly 34,000,000 acres, of which 14,559,000 acres (43 percent of total) were irrigated.* In 2006-07, cereals accounted for 82 percent of total cultivated area, with paddy rice being the most important cereal crop, accounting for 78 percent of total cultivated area, followed by cash crops at 9.4 percent of cultivated area and other crops (including vegetables and pulses) at 8.8 percent of cultivated area (table 3.1.). The total cultivated area for summer season and winter season crops and permanent crops was 33,679,000 acres, implying a cropping intensity of 170 percent. Further information about harvested area and crop production is presented in annex 6.

Table 3.1. Bangladesh Crop Production in 2006-07

Crop	Harvested Area (acres)	% of Area	Production (Metric Tons)	Average Yield (kg/ha)
Paddy Crops	26,141,643	77.6%	27,318,000	1,045
Wheat	985,964	2.9%	737,000	747
Minor Cereals	425,495	1.3%	916,965	2,155
Total Cereals	27,553,102	81.8%	28,971,965	1,051
Cash Crop	3,167,635	9.4%	12,731,802	4,019
Total Other Crops	2,958,907	8.8%	5,555,783	1,878
Total Crops	33,679,644	100%	47,259,550	1,403

Source: BBS, 2009

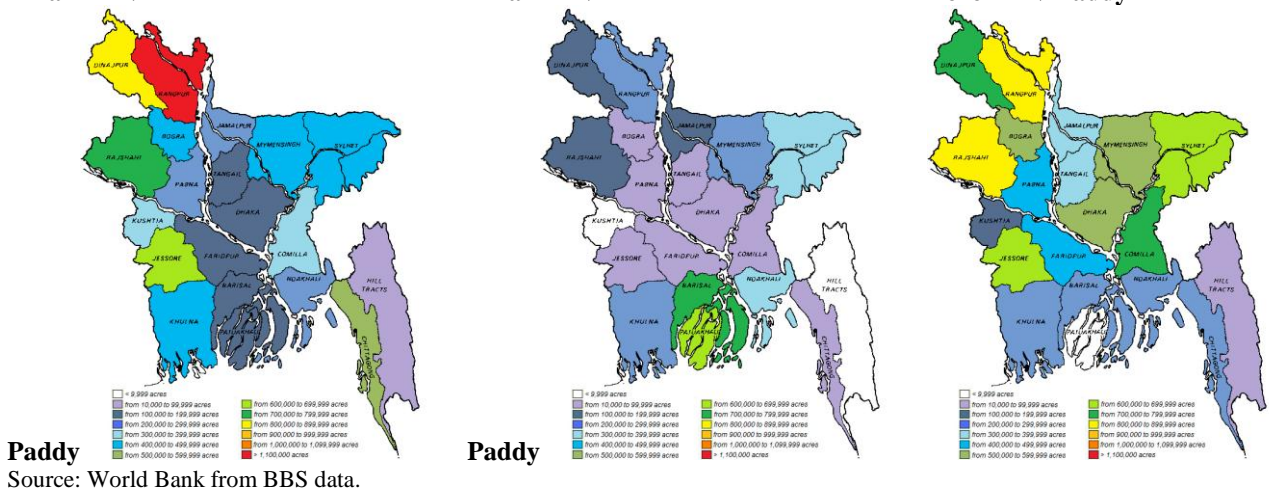
3.16. *In Bangladesh the spatial distribution of crop production depends on the farmers' risk coping strategies.* Paddy farmers' crop cultivation strategies and decisions include (i) which paddy varieties to select for each of the three cropping seasons (local versus high-yielding varieties, short versus long duration, resistance to flooding and/or drought and pests and diseases, etc.); (ii) which type of cultivation system to adopt (broadcast sowing of seeds versus transplanting of paddy seedlings); and (iii) depending on the expected yield and riskiness of their growing locations, how much purchased inputs (fertilizers, plant protection chemicals, Etc.) to apply to the paddy. The combination of these different decision variables means that in Bangladesh it is possible to identify seven different types of paddy crops: (a) Aman high-yield varieties (Aman HYV), (b) Aman local-transplanted varieties (Aman LTV), (c) Aman local-broadcast varieties (Aman LBV), (d) Boro high-yield varieties (Boro HYV), (e) Boro local varieties (Boro LV), (f) Aus high-yield varieties (Aus HYV), and (g) Aus local varieties (Aus LV). High-yielding varieties are typically more input and labor intensive than local varieties, and local transplanted varieties are more labor and input intensive than local broadcasted varieties.

3.17. *The crops requiring higher investments tend to be cultivated in relatively lower risk areas, while the crops requiring lower investments tend to be cultivated in higher risk areas.* Boro HYV, which is a high-input, demanding crop, is cultivated in winter mainly in the central and northern Districts. Conversely, Boro LV paddy, which requires fewer investments than Boro HYV paddy, is grown mainly in the very low lands in the northeast. Aman HYV, which like Boro HYV paddy is an input demanding crop, is grown mainly in the medium lands situated on the western Districts of Bangladesh. Aman LTV paddy, which is a relatively low input crop, is

grown throughout the country but mainly in the southern part of the country. Aman LBV paddy, which requires very low investments, is cultivated mainly in the central parts of the country that are prone to floods due to drainage congestion. Aus HYV paddy and Aus LV paddy are grown on a scattered basis throughout the country but mainly in those regions facing tropical cyclone risk, including Noakhali, Khulna, Barisal, and Patuakhali regions. Wheat is cultivated in the areas along the Padma River and northwest Bangladesh regions. The spatial distribution of the cultivated area for the major paddy crops by season and variety is presented in map 3.2. and further details for all main cereal crops are shown in annex 6.

3.18. *The design of any crop insurance program for Bangladesh should take into consideration the crop management strategies implemented by the farmers in each region.* The different strategies have different expected outputs in terms of yields and in terms of yield variability. For instance, Aman LBV, Aus LV, or Boro LV can be considered as relatively speculative crops; farmers, instead of leaving their land fallow, prefer to take the risk and cultivate these opportunistic crops which require very low investment but which have a very uncertain result due to a combination of high climatic risk exposures and low management and technology levels. These 3 speculative and high risk paddy crops are not considered as being suited to crop insurance, at least in the start-up phase. Attention should therefore focus on the HYV transplanted varieties of paddy in the Aman and Boro seasons and also wheat.

Map 3.2. Bangladesh: Spatial Distribution of Cultivated Area of Paddy and Wheat
Aman HYV Aman LTV Boro HYV Paddy



Crop Production and Yields

3.19. *Crop production and yields are collected on a routine basis* by the BBS and the Department of Agricultural Extension (DAE) using sample surveys and area estimation, crop-yield cutting, and visual estimation techniques. The lowest level of reporting of annual cultivated area, production, and yield data is the region (“Great district”) and then aggregation at a National crop level. However, upon request and on a fee basis, BBS can provide crop production and yield statistics for lower levels of aggregation such as the District (Zila) level or even the sub-District (Upazila) level. Crop-cutting methods are discussed further in chapter 4 and annex 5.

National Crop Yields

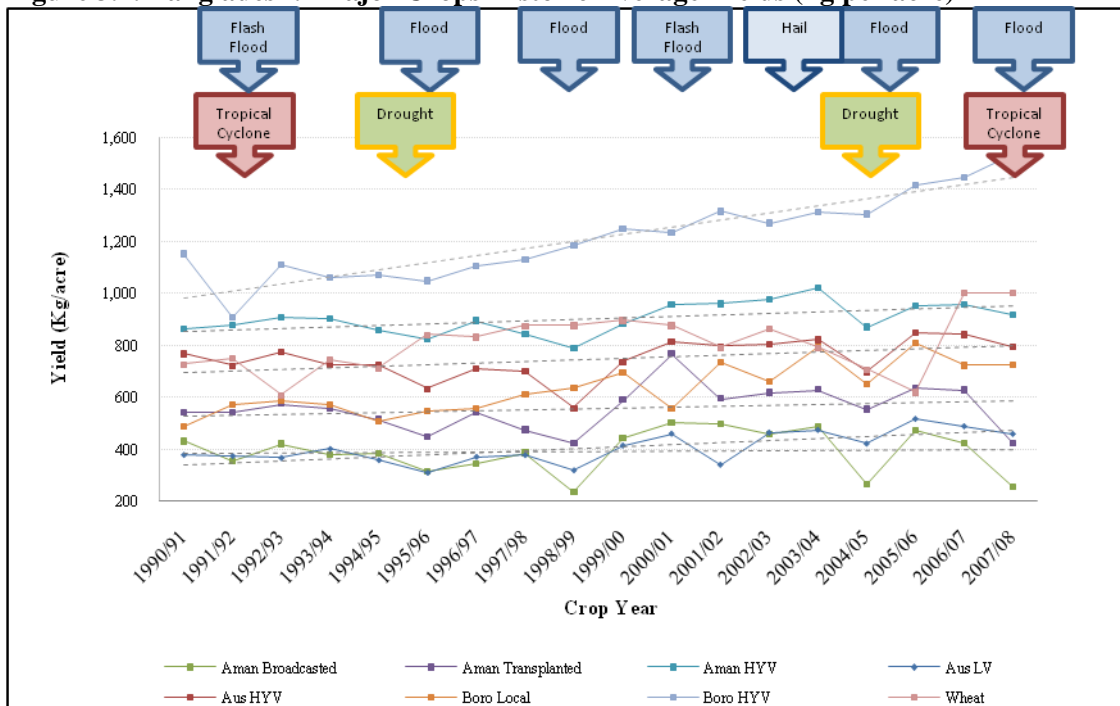
3.20. A set of seven major crops—Aman HYV, Aman LTV, Aman LBV, Aus HYV, Aus LV, Boro HYV, Boro LV, and Wheat—have been selected for an analysis to determine their historic tendency in yields and yield variability due to natural calamities. The selected sets of crops are considered to be a representative sample of crop production in Bangladesh, as they represent 81.8 percent of the countrywide cultivated area.

3.21. ***High-yield varieties (HYV) of paddy have typically different yield performance than the local broadcast and local-transplanted varieties.*** The yields in HYV paddy crops are, on average, up to twice the yield of the local varieties. At the same time, the yield variability of HYV paddy crops is lower than that observed for the local varieties of paddy. Apart from the genetic yield potential of the seed, another reason that might be contributing to this is the fact that local varieties of paddy crops tend to be cultivated in marginal lands and are therefore prone to yield losses.

3.22. ***Most of the crops analyzed under this study exhibit technology-yield trend increases over the past 18 years, 1990–91 to 2007–08.*** The yield increases are due to the introduction of improved technology including genetically improved HYV seeds, higher and balanced use of fertilizers and agrochemicals, and the improvement in irrigation facilities. Rabi crops show a higher yield improvement trend than Kharif and pre-Kharif crops. Among the Rabi crops, boro HYV paddy is the crop that shows the major increase in yields over the past 18 years; average yields have increased by 38 percent from 1,057 kg/acre in 1990–91 to 1992–93 to an average of 1,450 kg/acre during the period 2005–06 to 2007–08. Boro LV paddy follows boro HYV, with an increase in yields of 37 percent over the past 18 years. Wheat exhibits a yield growth rate of 21 percent over this period. Much smaller yield improvements apply to pre-Kharif (Aus) paddy and Kharif (aman) paddy. (See figure 3.2).

3.23. ***Natural calamities such as flood, drought, and cyclone cause high crop-yield losses*** as shown by the annual variation in national average crop yields in figure 3.2 for the 18 year period 1990–91 to 2007–08. For example, the floods of 1998–99 caused national yield reductions of 35 percent in aman LBV paddy, 17 percent in aman LTV paddy, and 9 percent for aman HYV paddy compared to the previous five year average. In 2004–05 floods and droughts caused major reductions in national average yields for all major crops of paddy and wheat, and in 2007–08 Aus and Aman paddy crop yields were severely reduced by floods followed by Cyclone Sidr.

Figure 3.2. Bangladesh: Major Crops Historic Average Yields (kg per acre)



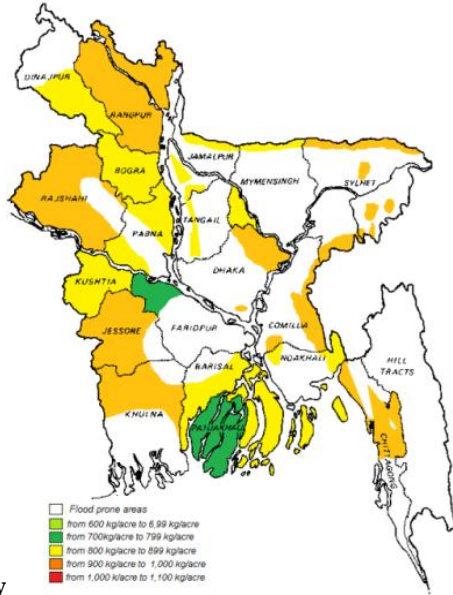
Source: World Bank based on BBS statistics.

Regional Crop Yields

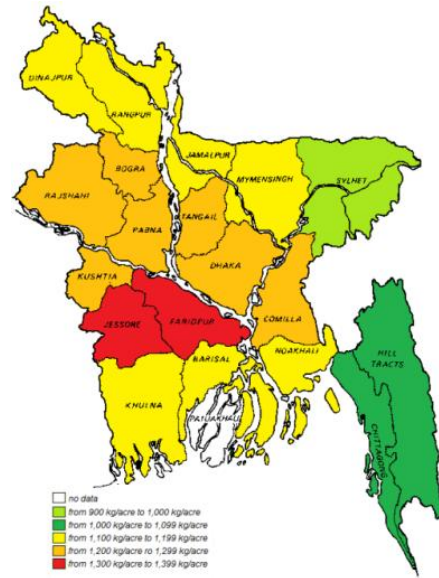
3.24. *The spatial distribution of annual average yields at the regional level is influenced by the predominant inundation land type in the case of Kharif crops and the availability of irrigation infrastructure in the case of Rabi crops.* Aman HYV's yields tend to be higher in western regions and extreme eastern strips of the eastern region of the country where the predominant land inundation type is highland or medium highland. In these regions, aman HYV average yields for the 18 year period are in the range from 900 kg/acre to 1,000 kg/acre. The lowest average yield is observed in Faridpur and Patuakhali regions, both facing flood risks with values in the range from 600 kg/acre to 700 kg/acre. The spatial distribution of boro HYV yields depends on the availability of irrigation facilities. Boro HYV annual average yields for the analyzed 18 year period (1990–91 to 2007–08) range from 1,300 kg/acre to 1,400 kg/acre in Jessore and Faridpur regions, respectively. In the central and western regions of Bangladesh—Rajshashi, Pabna, Bogra, Tangail, Dhaka, and Comilla regions—the 18-year average yields vary from 1,200 kg/acre to 1,300 kg/acre. The lowest average yield for the period 1990–91 to 2007–08, between 900 kg/acre and 1,000 kg/acre is observed in Sylhet. The annual average yield spatial distribution based on 18-year actual average yields for aman HYV and boro HYV is shown in map 3.3. The annual average yield spatial distribution for aman LTV, aman LBV, Aus HYV, Aus LV, Boro LV, and wheat are discussed further in annex 6.

Map 3.3. Bangladesh Spatial Distribution of Paddy Average Yields: 1990–91 to 2007–08

Aman HYV



Boro HYV Paddy



Paddy

Source: World Bank based on BBS data.

Key Climatic Perils and Crop-Area Damage Assessment

3.25. This section presents an analysis of BBS great district or regional level crop-damage statistics by cause of loss (including flood, flash flood, cyclone, hailstorm, and tornado) for paddy crops cultivated in Bangladesh for the 16-year period 1990–91 to 2005–06. This analysis is useful to provide a macrolevel assessment of the relative exposure to and damage levels associated with each type of climatic or natural peril.

Key Climatic Perils

3.26. *The geographical setting of Bangladesh makes the country very vulnerable to natural disasters.* The country is ranked fifth out of 204 countries on the Natural Disaster Index. The major disasters affecting the agricultural sector in Bangladesh are the occurrences of river floods, flash floods, droughts, cyclones and storm surges, and tornadoes, and hailstorm. Map 3.4. shows the geographical distribution of the vulnerability to different natural hazards in Bangladesh.

3.27. *River floods are a recurrent phenomenon in Bangladesh.* The central and northeastern areas of the country are particularly prone to flood due to drainage congestion. Approximately 20 percent of the territory is normally flooded every year. However, abnormal floods affecting 37, 43, 52, and 60 percent of the territory are expected to occur with return periods of 10, 20, and 50 and 100 years, respectively (MFDM, 2006). The floods of 1988 and 1998 were particularly catastrophic for the country and for the agricultural sector. The normal flood period occurs between April to October, with the most severe events during the months of July to August.

3.28. *Flash floods are a recurrent feature in the mountainous areas of the northeast and eastern Bangladesh.* Flash floods can be defined as the sudden-onset floods caused by heavy and

sustained rainfall. This type of flood normally takes place during the premonsoon season, from April to May. The occurrence of early flash floods can be extremely prejudicial to boro paddy as they coincides with the time of harvest. The most vulnerable regions are located in the northern and eastern part of the country.

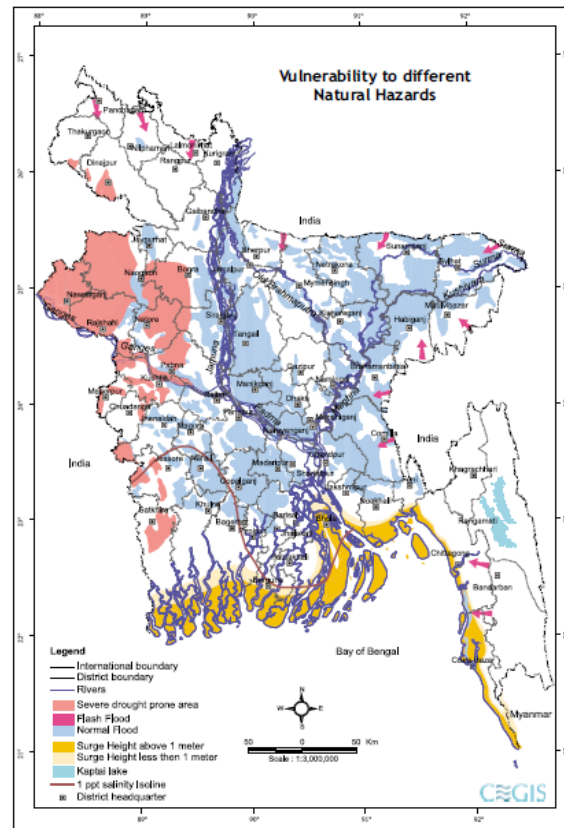
3.29. ***Drought conditions due to rainfall deficit affect different parts of Bangladesh mostly during the premonsoon and postmonsoon periods.*** Out of the 55-year period from 1949 to 2007, 11 drought events occurred in Bangladesh. The worst drought in recent history occurred in 1979 affecting 42 percent of the territory. Dry spells or crop droughts, in particular between April to July, are common and can result in enormous suffering for the poor, especially for those depending on rainfed, subsistence farming. Drought in Bangladesh mainly affects the western part of the country, in particular the Barind Tract region.

3.30. ***Cyclones affect the coastal Districts of Bangladesh, causing immense damage to the agriculture sector.*** Cyclones usually take place during premonsoon (April to May) and postmonsoon (September to November.) periods. The cyclone tracks, once they make landfall in Bangladesh, move northeastwards. The heavy rains accompanying cyclones and the wind-effect rise in tides, called storm surges, cause most of the damages in the agricultural sector. An average of one to three severe to moderate cyclonic storms hit Bangladesh each year, with associated storm surges as much as 13 meters higher than normal that in extreme cases can reach as far as 200 kilometers inland (Milliman et al. 1989). Storm surges of 4, 4.7, 5.4, and 6.4 meters above the normal sea level are expected to occur in Bangladesh with return periods of 5, 10, 20, and 50 years, respectively (Khan, 1993).

3.31. ***Hail and tornadoes affect all the areas throughout the country every year during the months of March, April, and May, being more severe in April.*** The occurrence of hail and tornadoes in Bangladesh is associated with the occurrence of locally severe seasonal storms, popularly known as norwesters. The tornado and hailstorms form within the norwesters and move eastward along the direction of the squall of the mother storm. These storms and tornadoes are more frequent in the afternoon. During this study, farmers in Dinajpur, Pabna, and Bogra mentioned that the occurrence of hail storms is one of the main causes of crop losses in northwestern Bangladesh.

3.32. ***Earthquakes and tsunamis are also significant natural hazards in Bangladesh.*** Although the direct impact of an earthquake on agricultural production is relative, it may affect it indirectly by affecting the irrigation and flood risk-mitigation infrastructure. The country is divided into three earthquake seismic zones, with the highest seismic activity in Zone I, covering the northern Districts from Kurigram to Moulvibazar. Experts have been forewarning a 6 to 7 magnitude earthquake to occur at any time, which would cause unimaginable destruction to infrastructure and loss of life, as well as damage to agriculture.

Map 3.4. Bangladesh: Vulnerability to Different Natural Hazards



Source: CEGIS, Dhaka.

Crop Damage Statistics by Cause of Loss

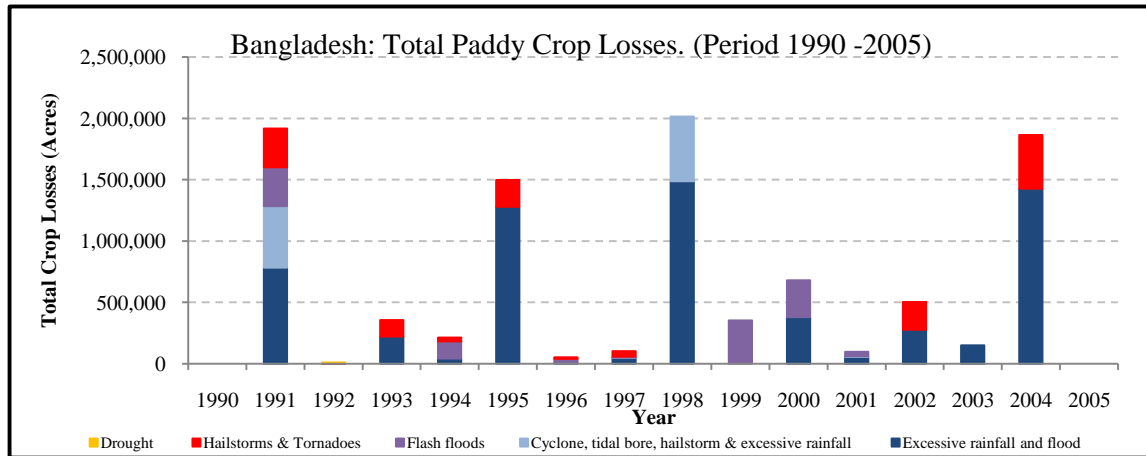
3.33. **An average of at least 2.4 percent of the cultivated paddy area is lost every year due to natural disasters.** The analysis of BBS's regional-level crop-cultivated area damage statistics for the period 1990–01 to 2005–06 shows that, in an average year, 2.4 percent (613,000 acres) of the total cultivated area of paddy crops is lost due to a combination of all the listed natural perils. However, in the worst loss year in this series, 1998–99, 2.0 million acres of paddy were totally destroyed, equivalent to 8.2 percent of the total cultivated (harvested) paddy area. In 1991, 1.9 million acres (7.4 percent of total area) were destroyed, and in 2004 a further 1.9 million acres (6.9 percent of total paddy area) were also 100 percent destroyed by natural perils (figure 3.3.). Nevertheless, it is important to stress that this analysis underestimates true crop-area losses as BBS reports only the crop areas 100 percent damaged, and their statistics do not include partial crop-damaged areas or yield loss caused by these natural perils. Furthermore, drought area losses are not available from the BBS records.

3.34. **Excess rainfall and flood is the main cause of loss**, accounting for 63 percent of the total area losses during the 16 year period (figure 3.4), and the most severely affected Districts include Dhaka, Tangail, Jessore, Rajshashi, and Pabna. Hailstorm and tornado²⁹ is the second most important cause of loss, representing 15 percent of the total paddy area losses; the most affected

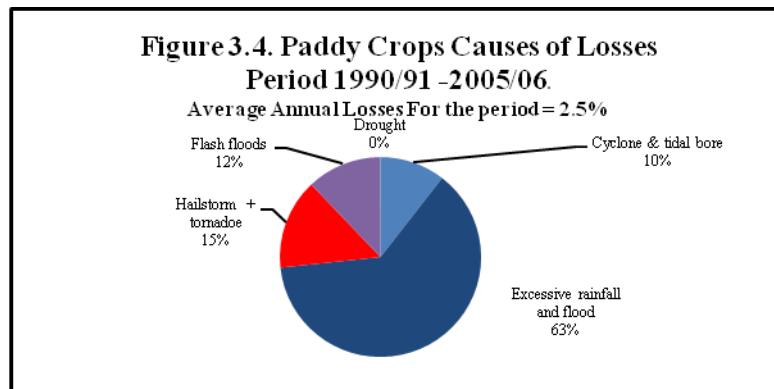
²⁹ BBS does not separate out hail and tornado losses in paddy in their damage reports. Hail storm is often accompanied by strong localised winds and it is often impossible to distinguish between hail damage and wind damage in mature cereal crops. For this reason many hail policies offer cover against hail, plus hail accompanied by wind.

Great Districts by hail and tornado were Sylhet, Chittagong, and Bogra. Flash floods accounted for 12 percent of total paddy losses on average during the reference period and cyclone and tidal bore for 10 percent of total area losses in paddy.³⁰

Figure 3.3 Bangladesh: Total Crop Losses in Acres by Cause of Loss (1990–91 to 2005–06)



Source: Bangladesh Bureau of Statistics.



Source: Bangladesh Bureau of Statistics.

Regional-Level Risk Assessment of Crop Production and Yields

3.35. This section describes the crop-yield risk assessment at the great-district or regional level in Bangladesh. The principle objectives of the regional 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 major crops in each of the 34 great-districts/regions which the country can be divided into. A separate and detailed crop-risk assessment for area-yield crop insurance rating purposes has also been conducted for boro HYV and aman HYV crops grown in three selected Districts, Bogra, Dinajpur, and Pabna, and this District-level analysis is presented in chapter 4 and in annex 7.

Regional Crop Risk Assessment Model

³⁰ It should be noted that according to BBS statistics, this category of crop damage includes: “Cyclone, tidal bore, hailstorms and excess rain”, but the World Bank interpret this to mean losses which are due mainly to cyclone and tidal bore.

3.36. ***The Crop Risk Assessment Model at Regional level (CRAMR)*** described in this section is based on an analysis of variation in regional time-series annual average crop yields for the 7 varieties of aus, aman, and boro paddy rice and the single boro HYV wheat crop grown in Bangladesh. The reason that this model is performed at the regional or great-district level and not at a lower level of disaggregation is because the BBS publishes official crop production, area, and yield data only at the regional level.

3.37. The key underlying crop production, yield, and valuation data and assumptions which the CRAMR model for Bangladesh is built on include the following:

- *Selected crops:* the seven major paddy crops, aman HYV, aman LTV, aman LBV, boro HYV, boro LV, aus HYV, and aus LB, as well as boro wheat, for which regional-level³¹ crop area, production and yield data are available for the past 39 years, 1969–70 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 harvested area for each crop 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 one great-district or region is set at 10,000 acres for all eight crops.
- *Crop yields:* the crop yields are based on the BBS’s reported regional average yields (total production, in metric tons, divided by harvested area (acres)). These yields have then been adjusted to represent average yields on a sown area basis by adding back in the 100 percent total area losses declared by BBS for the period 1990 to 2005. 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 39-year historical yields have been de-trended and readjusted to an expected yield based on the most recent five-year average.
- *Crop output prices:* the eight crops are valued at the published 2007–08 average farm-gate gross margin sales prices for Bangladesh, which are detailed in annex 6.

3.38. ***Assessing yield Losses and value of losses for CRAMR:*** The risk assessment model assumes that the losses occur when the actual average Great District yield for a specified crop falls short of the regional expected yield, defined as the average yield for the most recent five crop years. In any year where the actual yield is below the regional average expected yield for each crop, 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 percent). The average pure loss cost for each crop is then calculated as a simple average over the 39 years of yield data.

3.39. In summary, the CRAMR uses a historical database of 39 years of harvested yield data, adjusted by (i) the 100 percent area losses to represent more accurately the average yields sown area-basis and (ii) technological improvements in crop yields for all major crops grown in all 23 great districts of Bangladesh 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 CRAMR are contained in annex 6.

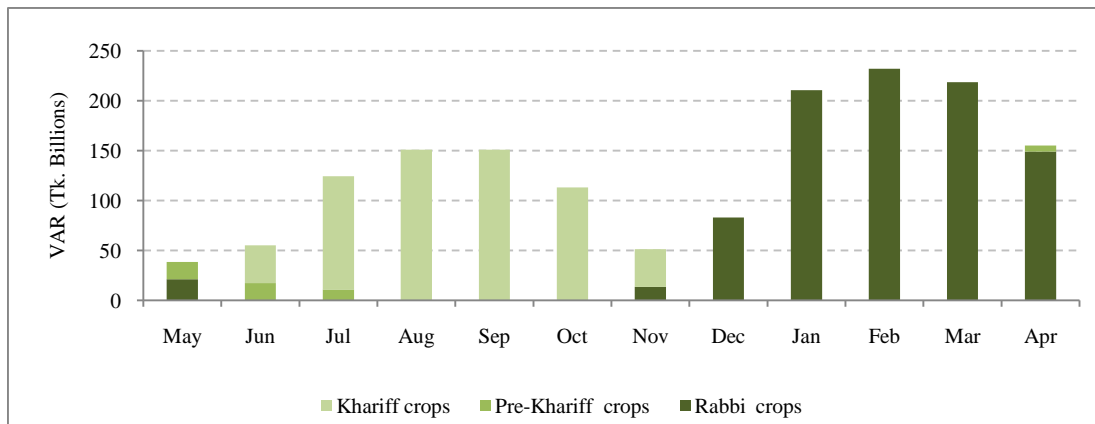
National Aggregate Crop Values

3.40. *The total values at risk (VAR) for the analyzed eight-crop cereal portfolio, assuming 100 percent normal average yields, amounts to Tk 400.3 Billion (US\$5.9 Billion).* The highest values at risk are for the Rabi crops (boro HYV paddy, boro LV paddy, and wheat) accounting for 58 percent of the portfolio’s VAR or Tk 232 billion. In second place are the Kharif paddy crops (including aman HYV, aman LBV, and aman LTV) accounting for 38 percent of VAR or Tk 151 billion. Finally the pre-Kharif crops—aus HYV and aus LV paddy—account for only 4 percent of the total portfolio VAR or Tk 17.3 billion. (See annex 6 for details).

3.41. *A proper portfolio peak risk analysis should be conducted in the planning of any public-private crop insurance program for Bangladesh.* 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. In Bangladesh; the temporal distribution of VAR for major crops presents two main peaks. The major peak in exposed crop values of Tk 232 billion is reached during the Rabi season in the month of February when boro paddy and wheat crops are maturing in-field prior to commencement of harvest. (See figure 3.5. for monthly distribution of crop VARs). Major cyclone or hail events in this period will cause major crop losses. The second peak in VAR of Tk 151 billion applies to aman paddy grown in the Kharif season in the months of August and September prior to the commencement of harvest. The VAR for these major cereal crops is at its lowest in November following the harvest of the Kharif aman paddy crop and again in May following the harvest of Rabi season boro paddy and wheat.

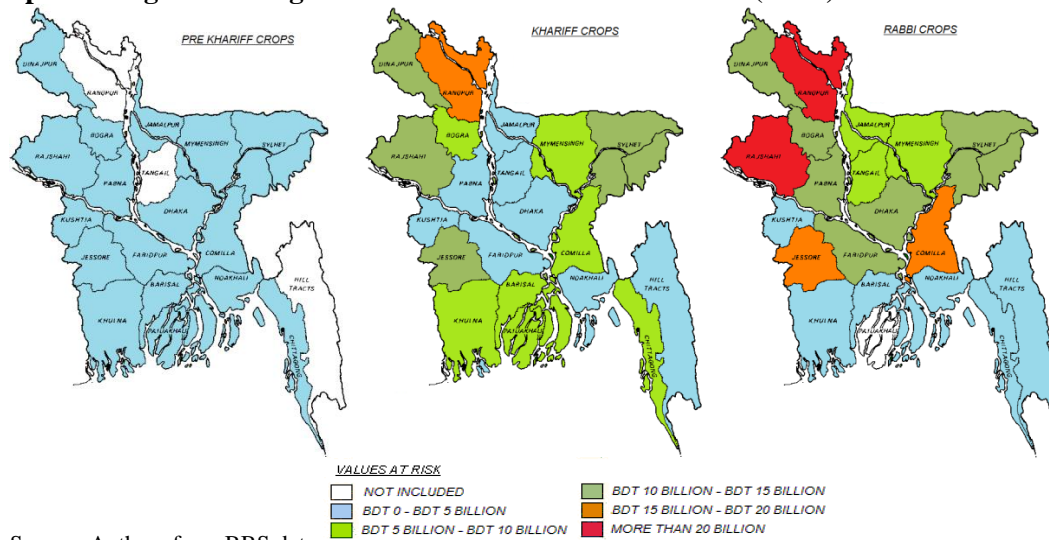
3.42. *The spatial distribution of Kharif paddy crop VARs is directly related to the flood exposure and land-use type, and for Rabi crops on the availability of irrigation facilities.* Pre-Kharif crops regional VARs are low and homogeneously distributed throughout Bangladesh. For Kharif monsoon paddy crops, VARs tend to be more concentrated in the western part of the country, and Rangpur Great District has the largest concentration of crop values at risk in the Kharif season. For Rabi paddy and wheat crops, VARs are concentrated in the central and northern regions of Bangladesh, including Rangpur, Jessore, Comilla, and Rajshashi Great Districts. The spatial or geographical distribution of paddy and wheat VARs is shown in map 3.5. for pre-Kharif or Aus paddy, Kharif or Aman paddy, and finally Rabi crops of Boro paddy and wheat.

Figure 3.5. Bangladesh: Major Crops Monthly Distribution of Values at Risk (VAR)



Source: Authors

Map 3.5 Bangladesh: Regional Distribution of Values at Risk (VAR)



Expected Value of Losses (Claims Costs) for National Crop Portfolio

3.43. *The CRAMR is programmed to calculate the expected value of losses or claims costs and the associated pure loss costs for insured yield coverage levels of 100 percent of the five-year average yield for each for the eight crops.*

3.44. *The average value of lost production is estimated at Tk 25.5 billion per year (US\$375 million) under the assumption of a 100 percent insured yield coverage level, over the period 1969–70 to 2007–08, representing 6.4 percent of the total VAR in the country for the eight assessed crops. Boro HYV paddy, the largest crop accounting for 53 percent of VAR, exhibits the lowest lost cost of 5.7 percent, or in other words it is the least risky of the eight crops which have been analyzed. This is due to the fact that Boro HYV paddy is irrigated and is grown in the Rabi dry season, when the risk of flood is at its lowest. However, Rabi irrigated HYV wheat shows the second highest yield variability of any crop, with an average annual expected value of losses of nearly 9 percent, and it is probable that more wheat is grown in areas which do not have assured irrigation supply. Aman HYV paddy, which is the second largest crop by value or 28 percent of VAR, exhibits a relatively low loss cost of 6.4 percent. Aman LBV paddy exhibits the highest loss costs with average annual losses of 12.4 percent of VAR. Table 3.2 shows the average annual expected losses for each of the 8 crops analyzed in the CRAMR.*

Table 3.2. Bangladesh: Major Crops. Annual Average Value of Crop Losses for 100 percent Insured Yield Coverage Level (Tk)

Crop	3-Year Average Planted Area (Ha)	Total Values at Risk (Tk)	% of Total Values	Average Losses (Tk)	Average Losses as % of Total Values at Risk
Aman HYV	8,180,379	113,134,000,000	28%	7,251,750,030	6.41%
Aman LBV	1,057,897	6,449,000,000	2%	797,748,666	12.37%
Aman LTV	3,834,875	31,458,000,000	8%	2,230,464,536	7.09%
Aus HYV	1,258,680	11,005,000,000	3%	841,372,706	7.65%
Aus LV	1,051,246	6,256,000,000	2%	443,485,172	7.09%
Boro HYV	9,625,982	212,841,000,000	53%	12,201,021,390	5.73%
Boro LV	325,397	3,733,000,000	1%	334,834,481	8.97%
Wheat	1,026,788	15,428,000,000	4%	1,381,754,531	8.96%
TOTAL	26,361,244	400,304,000,000	100%	25,482,431,512	6.37%

Source: Authors from BBS yield data.

Geographical Distribution of Crop Losses

3.45. *The regions with larger cultivated areas of paddy and wheat tend to have lower expected losses.* For example, Rajshahi Great District, which is the most important crop-producing region in Bangladesh, accounting for Tk 37.0 billion of crop values or 9.1 percent of the total national crop VAR, is ranked 18th out of the 23 regions in terms of the expected value of losses. Conversely, Patuakhali, which is located in 20th position in terms of crop production and VAR, is ranked 4th in terms of the expected value of losses (annual average loss cost). The exception to this relation is Sylhet, which is ranked in 4th position in terms of crop VAR and ranked in 2nd place in terms of annual average loss cost. Table 3.3, presents the average annual expected value of crop losses for each of the eight crops analyzed in the CRAMR, with a breakdown per region.

Table 3.3. Bangladesh: Average Expected losses by Crop and Great District (Tk millions)

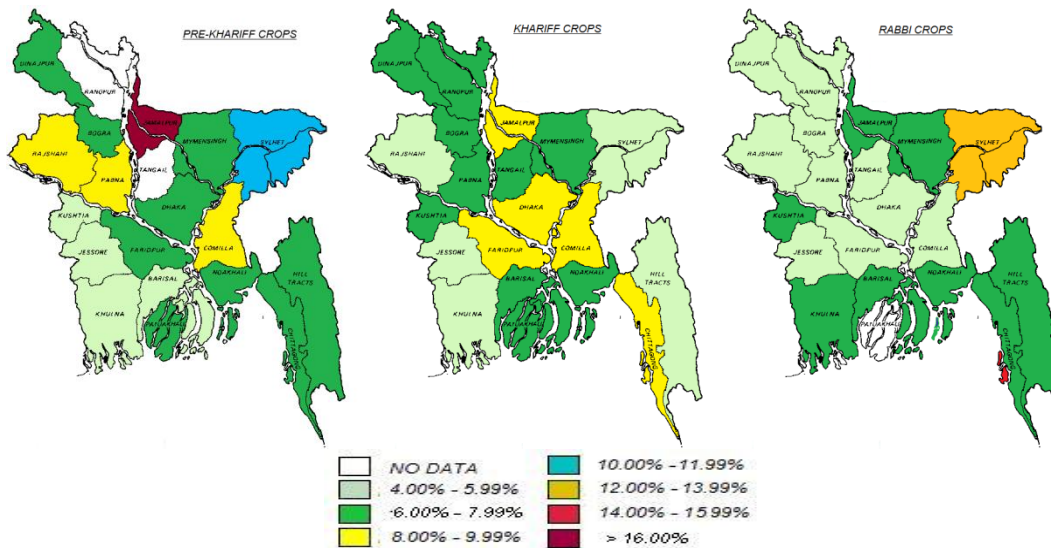
Region	Crop									Total per Region	Loss Cost	Rank	VAR	Rank
	Aman HYV	Aman LBV	Aman LTV	Aus HYV	Aus LV	Boro HYV	Boro LV	Wheat						
Chittagong	809	0	23	89	6	779				1,706	10.70%	1	15,938	13
Chittagong HT	63	0	0	0	13	44	0	0		120	5.17%	19	2,325	21
Comilla	342	139	32	95	26	622		60		1,315	5.35%	16	24,574	6
Noakhali	201	0	219	33	54	325				832	6.86%	7	12,140	18
Sylhet	336	90	128	142	68	1,688	283			2,736	10.09%	2	27,125	4
Dhaka	204	145	23	5	8	604	9	29		1,027	5.45%	15	18,862	10
Faridpur	98	142	47	0	44	488	10	189		1,019	6.04%	12	16,859	11
Jamalpur	357	0	78	23		512		38		1,008	7.22%	5	13,951	16
Kishoreganj	163	0	71	17	14	1,220	18	16		1,519	7.13%	6	21,301	7
Mymensingh	373	0	109	64	4	657		15		1,222	6.42%	8	19,043	9
Tangail	102	39	66	0	0	507	0	42		755	6.09%	11	12,394	17
Barisal	104	26	500	43	81	418	10			1,182	7.53%	3	15,692	14
Jessore	543	44	12	37	12	582		90		1,320	4.64%	21	28,435	3
Khulna	358	12	178	5	4	249	5			810	5.29%	17	15,324	15
Kushtia	268	0	0	15	16	257		96		652	6.30%	9	10,349	19
Patuakhali	75	0	364	103	52	0				594	7.28%	4	8,160	20
Bogra	386	0	73	24		539		12		1,034	4.93%	20	20,956	8
Dinajpur	794	0	103	18		514		248		1,677	6.18%	10	27,114	5
Pabna	175	103	18	0	23	436		159		915	5.62%	14	16,287	12
Rajshahi	509	59	105	129	18	864		234		1,919	5.19%	18	36,980	1
Rangpur	991	0	83	0		889		155		2,118	5.80%	13	36,494	2
Total Crop	7,251	798	2,232	842	443	12,194	335	1,383		25,478	6.37%		400.304	

Source: World Bank CRAMR.

3.46. *The loss exposure varies by crop and by region.* The most risky areas for pre-Kharif paddy crops are Jamalpur and Sylhet Great Districts, respectively, with 16.7 percent and 10.9 percent annual average losses. On the other hand, the lowest annual average losses in pre-Kharif paddy crops, with loss costs of between 4 percent and 6 percent, apply to the southeastern great districts of Jessore, north of Khulna, Kushtia, and Barisal. For Kharif paddy crops, the highest annual average losses of between 8 percent and 10 percent are in the central great districts of Fradipur, Dhaka, and Comilla. Conversely, Kharif paddy grown in the Great Districts located in the hill tracks have the lowest annual average expected losses, between 4 percent and 6 percent of the VAR. Rabi crops, with annual average loss cost in the range of 4 percent to 6 percent, tend to be less risky in central and northwestern parts of the county; in the northeastern and southern areas of the country Rabi crops are more exposed to risk and the annual average loss cost is as high as 13.23 percent of VAR. The geographic distribution of annual average crop losses per crop and Great District is presented in map 3.6. Annex 6 provides further details of the pattern of losses in all of the eight assessed major crops.

3.47. In the design of any future crop insurance program in Bangladesh, the analysis of the geographical distribution of losses by crop type and by region (District) will be very important for portfolio planning, achieving a balanced spread of risk, and ensuring that crop insurance does not focus only on the most risky crops in the most risk-exposed Districts.

Map 3.6. Bangladesh Spatial Distribution of Crop-loss Costs for 100 percent Insured Yield



Source: World Bank from BBS yield data.

Trends in Crop Production Losses and Claims Costs: 1969–70 to 2007–08

3.48. *The 39-year analysis of crop losses in Bangladesh shows a high vulnerability of crop production in the country to natural catastrophes.* Figure 3.6 shows the World Bank’s estimates

of annual crop losses at the 100 percent insured yield coverage level by cause of major losses over the past 39 crop years (1969–70 to 2007–08).

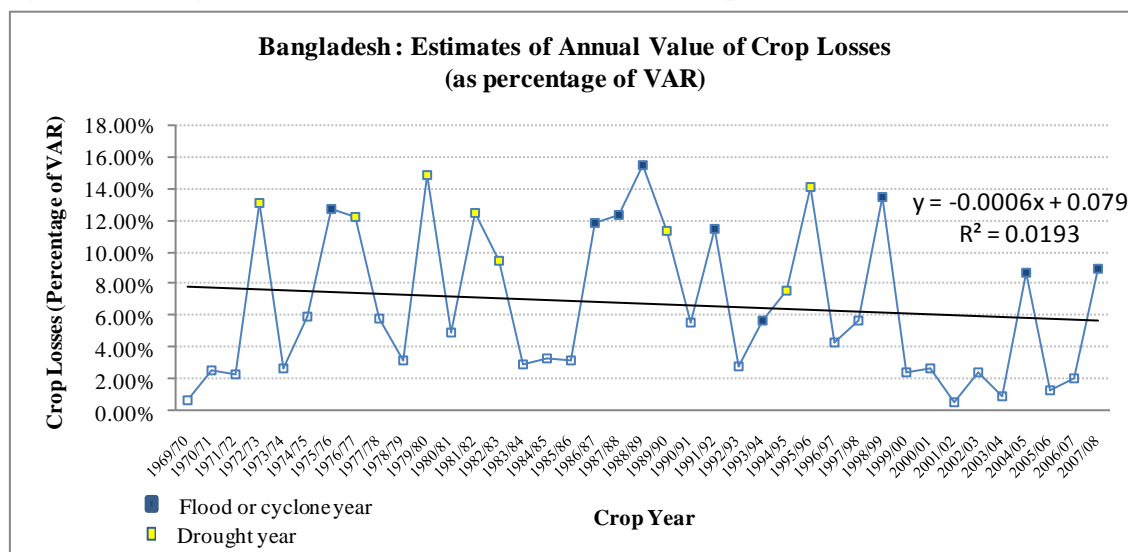
3.49. Several droughts, cyclone, and flood events with severe effects on crop production in the country occurred during the analyzed period, 1969–70 to 2007–08. The worst events in the analyzed period were the 1998–99 floods combined with a tropical cyclone and would have caused a loss on the eight crop portfolio at 100 percent insured yield coverage level of Tk 62,130 million (US\$914 million or 15.52 percent of the total value of production (VAR). Other catastrophic years of crop production losses include the severe drought in 1979–80, which would have caused a loss of Tk 59,173 million (US\$870 million); the drought in 1995–96, which would have caused a loss of Tk 56,195 million (US\$826 million); and the floods of 1998–99, which would have caused a loss of Tk 54 billion (US\$795 million).

3.50. *There is a slight decreasing trend in the frequency and severity of annual crop production losses over the past two decades in Bangladesh, but this trend is not statistically significant.* During the period 1990–91 to 2007–08, the annual average losses were above 10 percent loss cost in three years only. Conversely, during the period 1969–70 to 1989–90, there were nine years with annual average losses above 10 percent loss cost. The main reasons for the reduction in yield variability over the past 20 years may include (i) the improvement in flood control infrastructure, (ii) the major expansion of the irrigation facilities, and which has been accompanied by (iii) the switch out of pre-Kharif or Aus paddy, which is very exposed to drought and cyclone, into the irrigated Rabi season Boro paddy, which exhibits much greater yield stability. Between 1969–70 and 2007–08 the area planted with irrigated Boro paddy increased from 19 percent of the gross cropped area to 37 percent of the gross cropped area. An extended network of river embankments and drainage channels was built in the country to mitigate the effect of floods. Nevertheless, in light of the number of the flood events which have occurred in recent years and their effects on crop production, some authors have argued that these kinds of flood mitigation measures have not reduced the level of crop losses due to floods.³²

3.51. *Flood events have been more frequent during the past two decades.* The analysis of the annual value of crop losses shows that whereas drought events were more frequent during the seventies and eighties, flood events have been more frequent during the past two decades. The analysis of annual crop losses shows that, whereas seven drought events (with a return period of 1 in 3 years) occurred during the 21-year period from 1969–70 to 1989–90, only 2 drought events (with a return period of 1 in 9 years) occurred during the 18-year period from 1990–91 to 2007–2008. The same analysis shows that, whereas only 4 flood events (return period 1 in 5.2 years) occurred in Bangladesh during the period from 1969–70 to 1989–90, they occurred on 5 occasions (return period 1 in 3.6 years) between 1990–91 and 2007–2008.

³² See also Embankments for Flood Protection: Success and Failures (Saifullah, 1988)

Figure 3.6. Bangladesh: Estimates of Annual Value of Crop Losses (% loss cost)



Source: World Bank, from BBS Great District Yield Data and BBS Crop Damage Data.

Preliminary Analysis of Probable Maximum Loss

3.52. The analysis of 39-year regional yields for major crops—Aman HYV, Aman LBV, Aman LTV, Aus HYV, Aus LV, Boro HYV, Boro LV, and wheat—shows that 1998–99 was the worst loss year in this series, with total crop losses valued at Tk. 62,130,000,000 (US\$924,000,000) or 15.52 percent of the total value of production. Although 1997–08 was a severe loss year in Bangladesh, even worse crop losses could occur in the future. From an insurance viewpoint, underwriters need to know with a high degree of confidence the maximum losses that they might incur (called the Probable Maximum Loss, PML³³) either 1 in 100 years, or if it is necessary to be even more conservative, 1 in 250 years. This information is critical to structure any insurance program and to determine how much capital is required to cover the PML loss year.

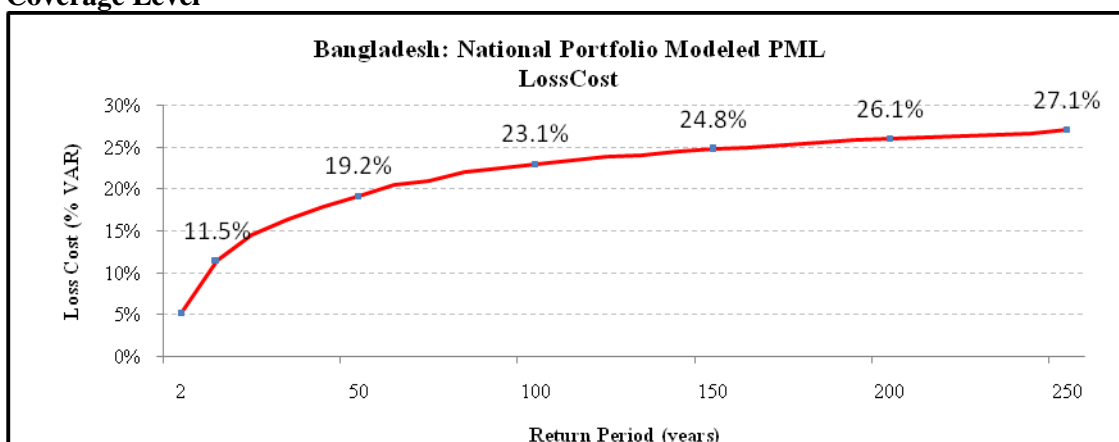
3.53. Figure 3.7. and table 3.4. show the results of the World Bank’s PML loss cost analysis³⁴ for return periods of 1 in 2 years up to a maximum of 1 in 250 years for the Bangladesh eight-crop national portfolio 39-year yield data assuming a 100 percent insured yield coverage level. The analysis shows that:

- The losses in 1998–99 with 15.52 percent loss cost at 100 percent coverage level, equate approximately to a 1 in 30-year return period;
- The 1 in 100 year estimated PML loss cost is 23.63 percent at 100 percent coverage level, equivalent to a financial loss of Tk 94,000,000,000 (US\$1.4 billion).

³³ 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”.

³⁴ The PML Loss Costs are calculated by fitting the “best fit” distribution (which is Lognormal) to the 39-year overall loss costs for 100% coverage level of de-trended and readjusted to an expected yield based on the most recent 5-year average and then using “At Risk” statistical software to simulate the expected loss costs with 10,000 iterations.

Figure 3.7. Bangladesh: National Crop Portfolio Modeled PML Loss Cost at 100 percent Coverage Level



Source: World Bank from BBS.

Table 3.4. National 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 (Tk Millions)	20,822	46,118	76,917	93,902	99,207	104,441	108,626
Loss Cost	5.20%	11.52%	19.21%	23.46%	24.78%	26.09%	27.14%

Source: World Bank from BBS.

3.54. Under any future crop insurance program in Bangladesh, it will be very important to perform a refined PML analysis based on the portfolio of crop and locations to be insured in order to be used to structure the crop insurance company's risk retention and reinsurance programs.

Conclusions on Crop Risk Assessment

3.55. *Agricultural crop production in Bangladesh is exposed to weather risks, especially flood, tropical cyclones and droughts.* This is evidenced by the great district average loss cost for a 39-years period, 1969–70 up to 2007–08, estimated at 6.37 percent of the total gross value of production and a calculated 1 in 100 year PML of 23.1 percent of the national crop gross value of production.

3.56. *Different crops grown in different seasons have different susceptibilities to natural calamities.* In general, pre-Kharif crops, with a gross value of production weighted annual average loss cost of 7.4 percent, are more vulnerable to natural calamities than Kharif crops, which have a gross value of production weighted annual average loss cost of 6.9 percent. In turn, Rabi crops are less risky than Kharif and pre-Kharif crops, with a gross value of production weighted annual average loss cost of 6.0 percent. Boro HYV and Aman HYV, which are the main paddy crops sown in Bangladesh, show annual average loss cost as of 5.7 percent and 6.4 percent, respectively. Conversely, Aman LBV and Boro LB, which are opportunistic crops representing only 3 percent of the assessed portfolio, show high annual average loss cost as of 12.4 percent and 9.0 percent respectively.

3.57. *Risk exposure varies by region:* Almost the whole of Bangladesh is prone to floods. The central regions of Bangladesh are particularly prone to floods due to drainage congestion in the Kharif season. There the annual average loss cost for Kharif crops, with average loss cost ranging from 8.8 percent to 10.0 percent, are higher than the national average of 6.9 percent for Kharif

crops. Coastal areas of southern Bangladesh are prone to floods due to storm surges, which affect pre-Kharif and Kharif paddy crops; the annual average loss cost for Kharif crops in this region is 7.4 percent, which is slightly above the national average. Northern areas of the country, in particular Sylhet region, are prone to flash floods affecting Rabi crops; the annual average loss cost in the areas affected by flash floods is 8.40 percent, which is far above the national average loss cost of 5.7 percent. Northwestern regions are prone to drought in pre-Kharif and Kharif crops and for hailstorms and tornadoes in pre-Kharif and late Rabi crops.

3.58. ***Flood is a regular, predictable, and foreseen event in certain areas of Bangladesh and in these areas cannot be considered as an insurable peril for crop insurance purposes.*** Particular care should be taken in the eventual design of an area-yield index product for flood-prone areas. In certain cases the risk of flood is a certainty. The provision of area-yield index insurance should be targeted to those areas where flood is an unforeseen peril.

3.59. ***The analysis of crop losses shows a slight decreasing trend in the frequency and severity of annual crop losses in the past two decades.*** The main reasons that explain these phenomena are related to the improvement in risk mitigation infrastructure. The expansion of the irrigation facilities has changed the predominant cropping pattern to winter crops and aimed to mitigate the effect of droughts. An extended network of river embankments and drainage channels was also built in the country to mitigate the effect of floods. Nevertheless, in light of the number of the flood events that have occurred recently and their effect on crop production, it appears that these kind flood mitigation measures did not improve the reduction of crop losses due to floods.

Weather-Risk Assessment and Impact on Crop Production and Yields

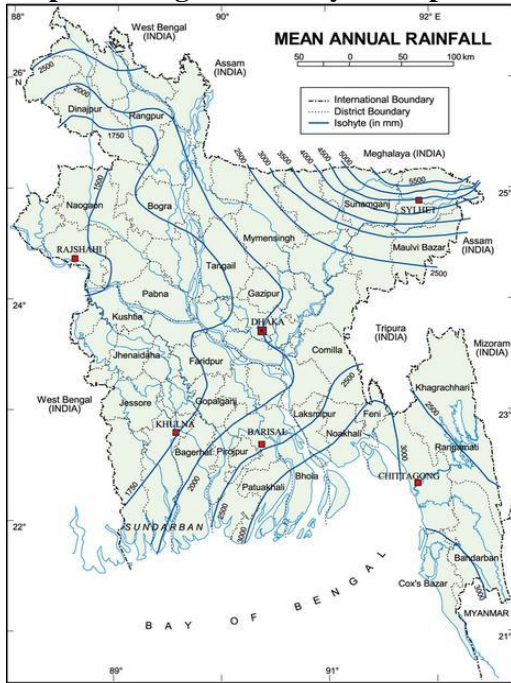
National Climate Profile

3.60. ***There are three main seasons recognized in Bangladesh:*** (i) the summer season (March to June), with high temperatures and erratic rainfall; (ii) the monsoon season (June to October), characterized by heavy rains (two-thirds of annual rainfall); and (iii) the winter season (November to March), with drier conditions, cooler temperatures, and low rainfall.

3.61. The premonsoon or monsoon onset period, starting in March, is marked by northwesterlies³⁵ and the occurrence of localized cells of high winds and heavy rainfall. Monsoonal rainfall starts in the middle of May and lasts until the end of October, reaching its peak intensity at the end of June, and accounts for 80 percent of the cumulative annual precipitation. The monsoons, or South-West Trades, form powerful moisture-loaded convection cells and lead to annual rainfall of between 1,200 mm in northwestern Rajshahi to over 5,000 mm in northeastern Sylhet, and 2,600 mm in southeastern Chittagong. The isohyets map of Bangladesh shows increasing cumulative rainfall from the northwest to the south and the northeast (map 3.7).

³⁵ The Northwesterlies develop mainly due to the encounter of a flow of North-West cool air with Southern humid and warm air as well as katabatic winds from surrounding mountains.

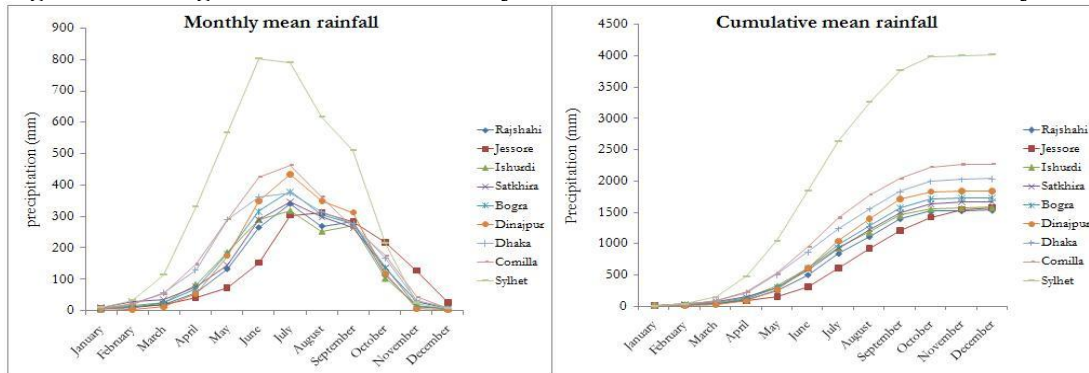
Map 3.7. Bangladesh Isohyets Map



Source: Biodiversity Research Group of Bangladesh

3.62. Monsoonal rains in most regions of the country peak a second time during September before rapidly dropping after the middle of October. Following this, the winter season, between October and March, has little rainfall, except some light winter rains, typically between 10 to 40 mm, between mid January and mid February. Annual rainfall patterns are shown in figure 3.8.

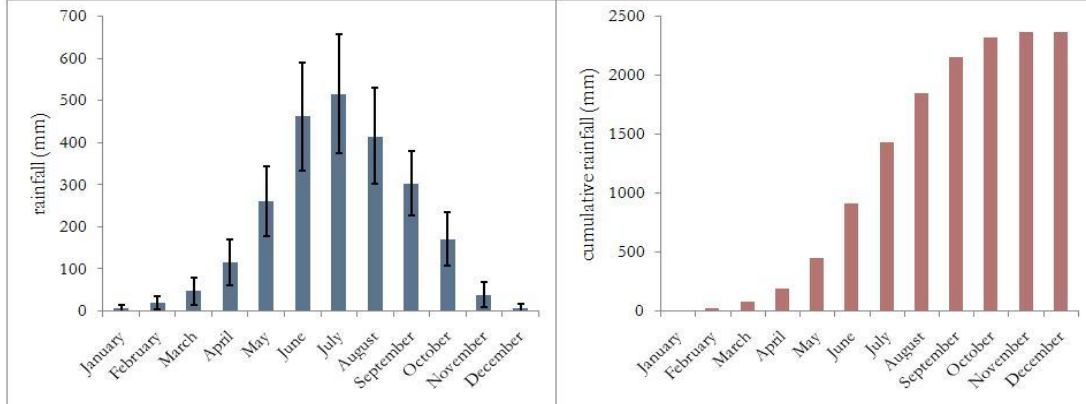
Figure 3.8. Bangladesh: Annual Monthly Cumulative Rainfalls across the Country



Source: Authors.

3.63. *Annual average rainfall levels vary greatly across Bangladesh.* The average annual rainfall in Bangladesh is generally high; areas over most of the country receive more than 2,000 mm, but the variation in the rainfall levels ranges from 1,500 mm to more than 5000 mm. The monthly rainfall variability (figure 3.9) indicates the need, in the context of the present study, to examine the exposure of the rural rice economy to weather-driven stresses such as drought or excess rainfall.

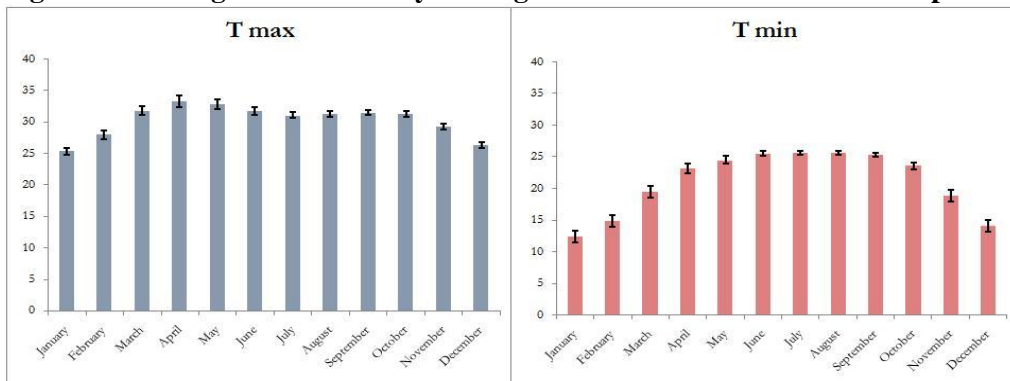
Figure 3.9. Bangladesh: Monthly (A) Average and (B) Cumulative Precipitation in Bangladesh.



Note: Each error bar in graph A represent one standard deviation.
Source: Authors

3.64. **Bangladesh is characterized by a uniform tropical to subtropical warm and wet climate.** Temperatures have small mean monthly variation and exhibit three distinct annual periods (figure 3.10). The hot March–April premonsoonal period contains the annual highest temperatures, which peak over 40°C during five or more days and with mean national temperatures of over 34°C. With over 75 percent of the annual cumulative rainfall, the May–October monsoon season is characterized by a drop in temperature (ranging from 20 to 36°C) in June due the precipitations and a mean national temperature of 31°C. The dry November–February winter period shows cooler temperatures that drop to an average lowest at the end of December and can reach the lowest of 5°C in the north.³⁶

Figure 3.10. Bangladesh: Monthly Average Maximum and Minimum Temperatures

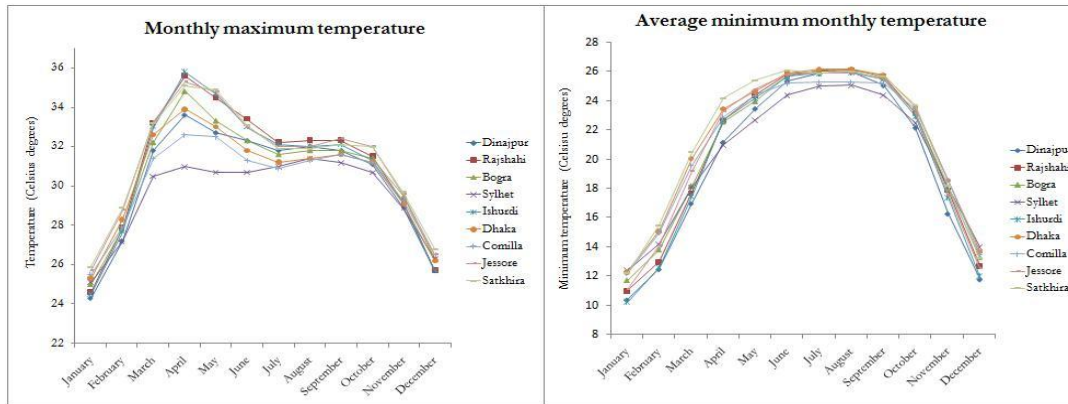


Note: Each error bar represents one standard deviation.
Source: Authors.

3.65. Although temperatures are generally homogenous throughout the Bangladeshi territory, lower temperatures are recorded in the northeastern districts while the highest temperatures are recorded in the northwest region of the country (figure 3.11).

³⁶ Additional information concerning the weather patterns of Bangladesh can be found the UNEP’s Regional Resource Centre for Asia and Pacific at http://www.rrcap.unep.org/pub/soe/bangladesh_part2.pdf.

Figure 3.11. Bangladesh: Monthly Average (A) Maximum and (B) Minimum Temperatures in Nine Districts



Source: Authors

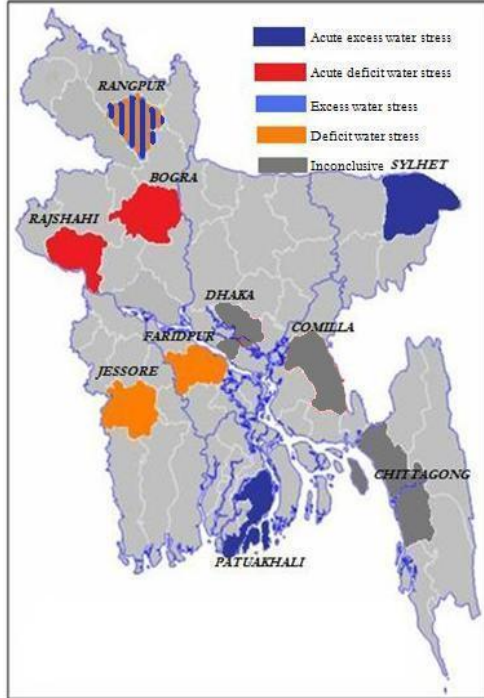
3.66. A weather-indicator-based³⁷ production-risk analysis enables the isolation of simple climate variables (e.g., precipitation, maximum or minimum temperatures, or windspeed) among all the abiotic environmental parameters that influence yields in order to study each variable's positive or negative impact. The selected indicators for this study were designed to capture the potential negative impact of weather-driven stresses on the studied rice varieties that ultimately lead to yield loss.

3.67. As a preliminary weather-risk assessment on rice production, a national-scale rainfall indicator-based analysis was carried out in order to obtain a preliminary overview of the indicators' ability to capture weather-driven production risk on Aman HYV rice across Bangladesh. The analysis was conducted based on data from selected Districts from all regions of Bangladesh. All rainfall-based indicators were based on year-wise monthly cumulative precipitation data covering the whole Aman rice growing season (i.e., April to October) in each of the studied districts. Three indicators were built in order to measure (i) cumulative, (ii) deficit, and (iii) excess rainfall. Deficit and excess rainfalls were calculated from the meteorological data in each district based on the deviation from the mean average monthly rainfall. Subsequently, the obtained year-wise indicator data sets were statistically analyzed against Aman HYV District-level aggregated yield records in order to detect vulnerabilities of the yield to deficit and/or excess as well as to situate them in time. More detail concerning the structure of the rainfall and other weather-based indicators that were used in the present study can be found in annex 8.

3.68. Map 3.8 presents the results of this analysis and shows its overall consistency with the multicriteria drought risk evaluation and mapping conducted by BARC. Generally in accordance with the BARC drought risk assessment, the present rainfall indicator-based risk assessment found four main categories of rainfall-linked production risk for HYV Aman rice production: (i) acute water deficit vulnerability, (ii) acute excess rainfall vulnerability, (iii) "mild" deficit precipitation sensitivity, and (iv) "mild" excess precipitation sensitivity. It is noteworthy that in three Districts (Dhaka, Comilla, and Chittagong) this preliminary indicator-based risk assessment proved inconclusive, reflecting the complexity of the intertwined nature of environmental parameters driving yield variation and the limit of indicator-based analysis.

³⁷ An indicator refers to the analysis of variability of a weather parameter (such as rainfall) occurring annually in specific time windows, and the relationship with recorded yields.

Map 3.8. Rainfall-based Indicators of HYV Aman Production Numerical Risk Assessment Map in 9 Selected Regions (Great Districts) of Bangladesh



Source: Authors.

3.69. *Bogra and Rajshahi appear as acutely vulnerable to water deficit.* In particular, Rajshahi HYV Aman rice production appears as sensitive to rainfall shortage in April, suggesting a high vulnerability to erratic rainfalls and dry spells during the seedling and/or transplanting periods. Similarly, Bogra exhibits acute sensitivity to water deficit during April but also presents “mild” vulnerability during May; suggesting a more spread seedling/transplanting period.

3.70. *Jessore and Faridpur HYV Aman productions appear as “mildly” sensitive to rainfall-deficit-driven stress.* Specifically, Jessore Aman yields respond negatively to deficit rainfall during May, June, and July. In addition to being consistent with the BARC risk map that classifies the Jessore region as “moderately” vulnerable during the Kharrif period, this result also reflects the rainfall season’s historic temporal distribution (figure 3.9) that shows a later monsoon onset in Jessore than in other regions in Bangladesh. Likewise, Faridpur Aman production appears to be more vulnerable to May rainfall deficit.

3.71. *The southern area of the northeastern Districts of Patuakhali and Sylhet, bordering Bengal Bay, are markedly vulnerable to acute excess rainfall.* In effect, as shown in the Bangladesh isohyets map (map 3.7), while Sylhet is situated in the highest precipitation region of Bangladesh (receiving over 5,000 mm of rainfall annually), the Patuakhali region is also one of the regions receiving higher rainfall (over 3,000 mm annually). Sylhet HYV Aman production appears as particularly vulnerable to excess rainfall during July, which is during the monsoon’s peak rainfall period. In effect, severe rainfall can impinge upon the highly sensitive yield-formulating reproductive stage of rice. On the other hand, the rice production in Patuakhali is acutely vulnerable to excessive rainfall in April, during the transplanting period.

3.72. In the analysis, Rangpur stands out as the only District where HYV Aman rice production is vulnerable to both deficit and excess rainfall. However, the cultivation is found to be exposed

to these different rainfall-driven risks during distinct time periods. On the one hand, the selected indicators show a “mild” vulnerability to deficit rainfall during May and June (the monsoon rainfall peak period), which coincides with the water-stress-sensitive reproductive stage. On the other hand, the Aman cultivation appears as “acutely” vulnerable to excess water stress during October. Excessive rainfall during this grain maturing and/or harvesting period can cause grain germination or rotting, both reducing yields.

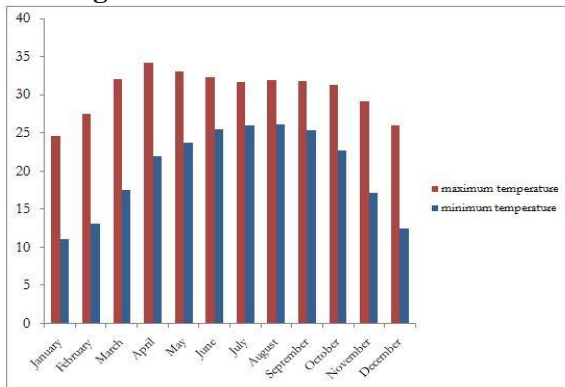
3.73. *The indicator-based, rainfall-driven production-risk-assessment approach allows a meaningful capturing of the risk deriving from a single weather parameter.* Nevertheless, this method also presents constraints as exemplified in the three Disitrics where the risk assessment was “inconclusive.” For the purpose of studying the feasibility of weather-index insurance, this highlights the need to carry out more detailed analyses at the sub-District level in order to understand the more localized effect of weather on crop production. The climatic profile of the three Districts chosen for this study is presented below. The result of the detailed indicator analysis for rice production in each of these areas is presented in chapter 4.

Climatic Profile of the Studied Areas

3.74. The present study focused in three Districts in order to characterize and study the weather-driven rice production risk. The Districts are Dinajpur, Bogra, and Pabna.

3.75. Figure 3.12 shows the monthly temperature variation, which is similar in the three studied areas. The average maximum temperature reaches a peak of 34.1°C in April (before the Aman transplanting period) before dropping below 32°C at the end of June and reaching a minimum of 24.7°C T_{max} in January. On the other hand, with an average of 20.3°C, the minimum temperatures stay above 20°C from April to November and reach an annual low of 11.1°C in January).

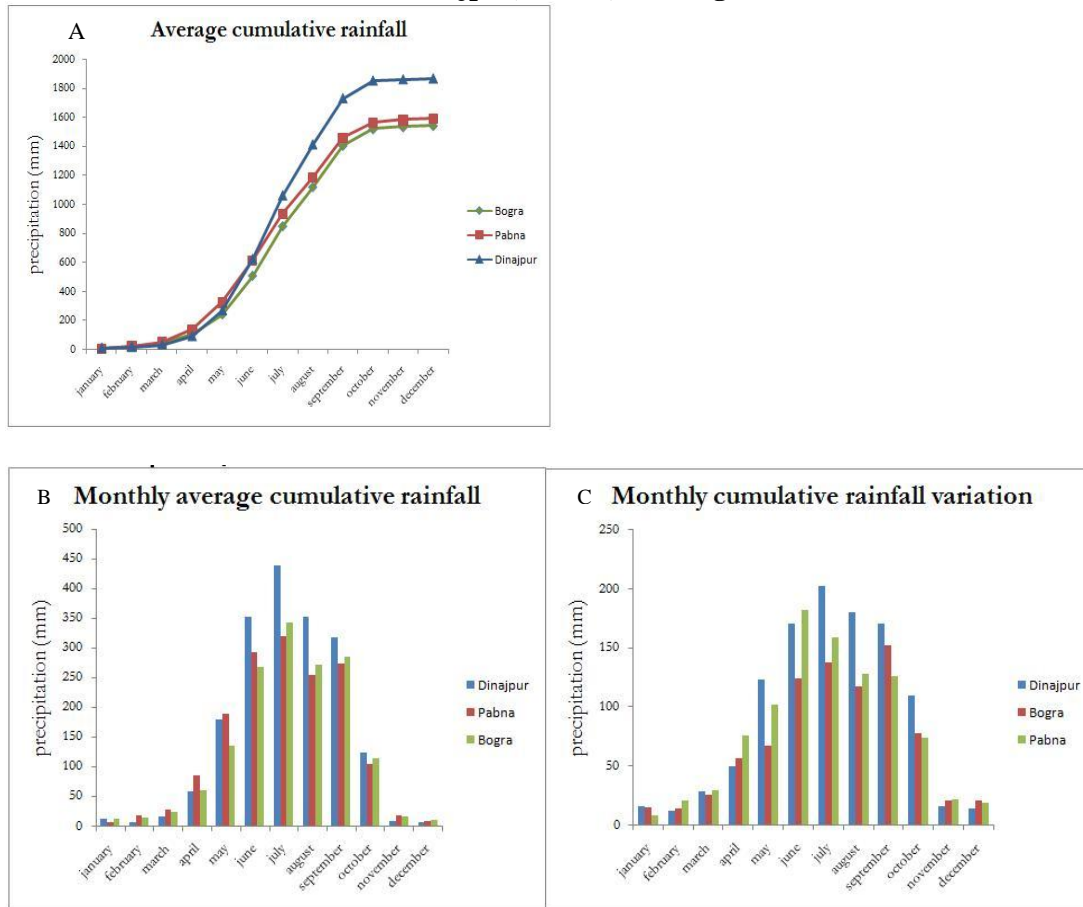
Figure 3.12. Average Monthly Maximum and Minimum Temperatures in Dinajpur, Pabna, and Bogra



Source: Authors.

3.76. Dinajpur, Bogra, and Pabna are, from north to south, situated in the northwestern region of Bangladesh. With an average annual rainfall of 1,866 mm, the northern District of Dinajpur receives higher rainfall than Pabna and Bogra, which receive annual average rainfall of 1,590 mm. and 1,542 mm, respectively (figure 3.13 A, B and C).

Figure 3.13. (A) Annual Cumulative, (B) Mean Monthly Average, and (C) Mean Monthly Rainfall Standard Deviation in Dinajpur, Pabna, and Bogra



Source: Authors

3.77. Although receiving a higher rainfall of 270 mm more than Pabna and Bogra, Dinajpur’s monthly and annual rainfalls are also more erratic.³⁸ Nevertheless, in spite of the slightly higher rainfall and more intra- and interannual rainfall variability, Dinajpur in general is not characterized as a flood-prone area in Bangladesh; only a northern third of the District is classified as low “flash flood” prone.

3.78. Instead, Dinajpur’s data suggest more exposure to rainfall deficit. In particular, the monsoon onset period of April–May displays the highest rainfall variability among the three studied Districts (figure 3.13 C). This period coincides with the transplanting of Aman rice. However, according to the drought risk mapping carried out by BARC,³⁹ the pre-Kharif period (March to the end of May) is less drought-prone than the Kharif period (June–October). While during the pre-Kharif period, the District ranges from “slightly” to “moderately” drought-prone from the northeast to the southwest, with a pocket of “severely” drought-prone in the Dinajpur-

³⁸ Mean cumulative annual rainfalls show an average variation of 430 mm, 411 mm and 322 mm in Dinajpur, Pabna and Bogra, respectively. Besides, average monthly rainfalls exhibit an average variation of 91 mm, 79 mm and 70 mm in Dinajpur, Pabna and Bogra, respectively.

³⁹ Drought risk maps for Kharif, pre-Kharif, and Rabi seasons are shown in Annex 8.

Sadar Upazila, the District is characterized uniformly as “moderately” to “severely” drought-prone from June to October.

3.79. With an annual average rainfall of 1,590 mm, Pabna’s precipitation level is lower than Dinajpur (figure 3.13 B). Rainfall is somewhat more variable than the two other Districts studied during the monsoon’s peak period of June and July (figure 3.13 C).

3.80. The Ganges-bordering area of the District is classified by BARC as “severely” (in the south, river border area) to “moderately” prone to river flooding. The pre-Kharif period is classified as uniformly “moderately” drought prone, but with pockets in the northwest and the west of “severely” drought-prone areas. On the other hand, the District is uniformly classified as “not” to “moderately” drought-prone during the Kharif period,

3.81. While Bogra has overall lower but more stable intra- and interannual precipitations, the monsoon season’s second peak rain in September in Bogra is more pronounced than in the two other studied Districts (figure 3.13 B and C). Concerning drought risk, the rainfall data indicate, in contrast with Pabna and Dinajpur, that the District is subject to higher rainfall variation in Kharif than in the pre-Kharif period.

3.82. The East Jamuna river-bordering area of the District is classified by BARC as a “severely” to “moderately” river-flood-prone area, while the east of the District is not classified as flood prone. From the northeast to the southwest and during the Kharif monsoon period, the District is classified as ranging from “slightly” to “moderately” drought prone with small patches of “severely” drought prone areas in the centre of the District. Another half of the area in the eastern and the western parts of the District are uniformly classified as “slightly” and “moderately” drought-prone areas with no “severely” drought prone areas during the pre-Kharif period.

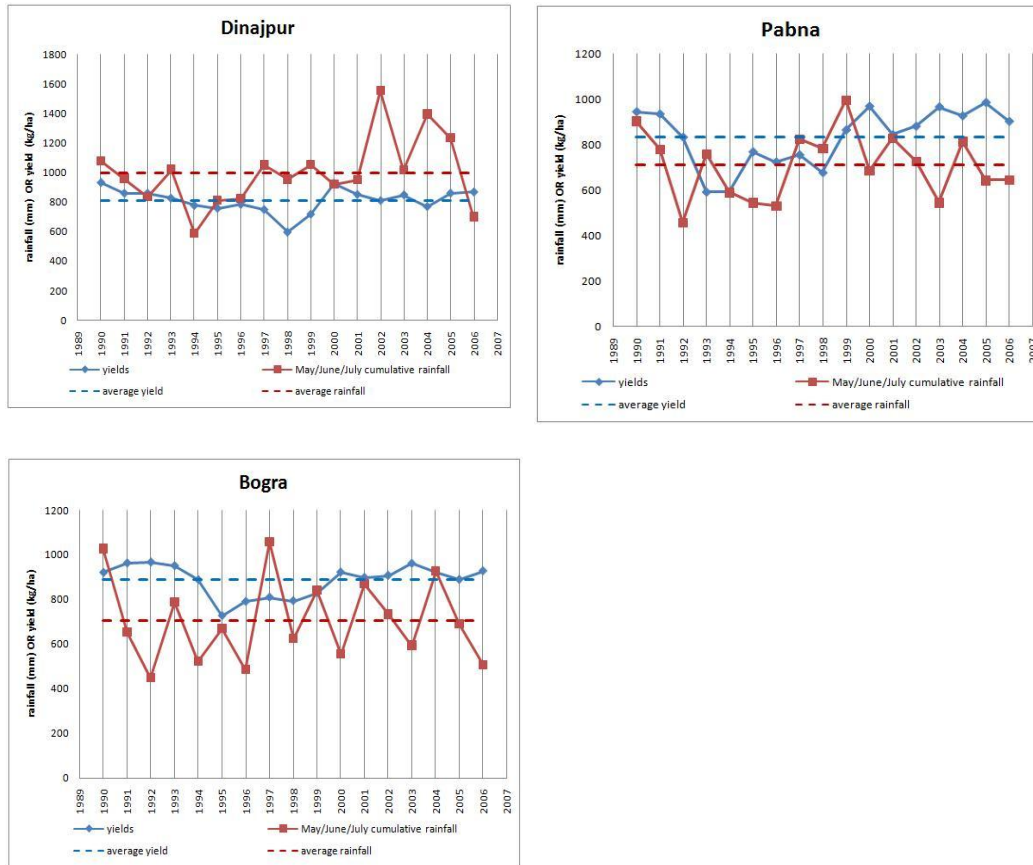
Weather-Risk Assessment for Rice Production in the Three Selected Study Areas

3.83. *The primary objective of the weather-risk assessment was to evaluate the viability of weather-index insurance schemes for rice in the studied Districts of Dinajpur, Pabna, and Bogra.* This requires that there are clear signals of weather-driven production risk at the local level. The analysis of localized weather and yield variability allows an insight into the weather risk experienced by rice farmers. The production of the three rice crops (Boro, Aman, and Aus) is adapted to the monsoon rain regime. While the average rainfall determines the varieties, planting dates, and practices, it is the soil water balance that is the driver of risk of water deficit (agricultural drought) or surplus moisture and, therefore, the ultimate yields. The annual variability of available water is determined by the reliability of rainfall and its timing. However, crop water management in Bangladesh is highly complex due to the frequent use of full or supplemental irrigation and the adaptation of the crop varieties to reflect the levels of risk. Aman rice production, carried out during the monsoon season, can be expected to be sensitive to the interannual rainfall variation, whereas Boro rice production is dependent primarily on irrigated water sources, either stored, groundwater, or riverine. Hence, the focus of the weather risk assessment has been the impact of rainfall on Aman rice.

3.84. A simplified comparison of annual Aman rice yields with the growing-season’s cumulative rainfall, as well as with the pre-season rainfall, can provide preliminary insight into the relationship of rainfall to Aman yield in the three areas. In particular, it can indicate if years of severe drought were associated with severe and widespread yield loss. Figures 3.14 A, B, and C provide a visual overview of these relationships in the three areas studied. These show that (i)

years of low rainfall during the growing season were not the same in each District (1994 and 2006 in Dinajpur; 1993, 1996 and 2003 in Pabna; and 1992, 1996, 1998 and 2007 in Bogra), and (ii) that significantly below-average rainfall years generally coincided with poor yields Pabna, less so in Dinajpur, and not obviously so in Bogra.

Figure 3.14. May to July Cumulative Rainfall and District-level HYV Aman Yield Records for (A) Dinajpur, (B) Pabna, and (C) Bogra



Source: Authors.

3.85. *The above analysis of broad relationships between seasonal rainfall and yield gives an overview of risk but is not adequate to interpret fully the impact of rainfall (and other parameters) on yield.* In particular, the timing of rainfall is critical in determining the actual planting date within each season and subsequent plant growth. In addition, the degree of localization or aggregation of the yield data can mask these correlations. To determine the impact of water stress on yield, water balance is more reflective of water availability, and stress on the plant, than rainfall alone. Therefore, a series of detailed weather, soil moisture, and water balance indicators were developed, as described in further detail in chapter 4 and annex 8.

3.86. *The temperature reliability and the maximum and minimum temperature norms are favorable for rice cultivation across Bangladesh,* and therefore a priori do not represent a determinant abiotic stress leading to production risk. Nevertheless, given their potential importance in influencing the yield outcome, temperatures were included as an indicator in the

analysis of the weather-risk-yield relationship for the three Districts. However, no systemic exposure of the rice production to extreme temperature was found in the three studied areas (annex 8).

3.87. ***Recent research indicates that climate change has an impact on the temperature pattern in Bangladesh.*** It is also reported that temperature increase driven by climate change is likely to increase the maximum temperature exposure and contribute to increasing river flood risk due to the accelerated retreat of Himalayan glaciers.⁴⁰ The impact of future climate-change-driven temperature changes on rice production in Bangladesh is a subject of further research.

3.88. ***The general outcome of the weather-risk assessment conducted for this study indicates that the relationship between weather and rice production in Bangladesh, at least in the areas studied, is very complex.*** For Aman rice, which is grown in the Kharif period, the crop would generally not be expected to suffer water stress due to the availability of monsoonal rainfall. However, the crop is still exposed to rainfall risk if the growing season is curtailed by the late onset of rains during the pre-Kharif period. Another form of exposure is due to the intra-annual variability of monsoonal rainfalls, which can potentially affect the yield-sensitive growth phases of Aman rice such as dry spells during flowering or pollination. On the other hand, the Boro rice is grown during the Rabi season when rainfall is low. As a result, the production of Boro relies on supplementary water resources through local storages or underground tube wells. Apart from irrigation, farmers in the studied areas also practice diversified farming systems, which in turn help reduce farm-level production risks through measures such as crop and livestock diversification and nonfarming activities. Such complexity in the farming systems, as well as their response measures to mitigate the weather variability, accounts for the difficulty of establishing clean correlations between specific weather parameters and the crop-yield data.

Livestock-Risk Assessment

3.89. This section presents an overview of livestock production (including cattle, buffalo, sheep, goats, and poultry) and fisheries production (in this case restricted to shrimp), in Bangladesh and the services provided by public, private, and NGO sectors. This section also reviews the limited information and statistics available on livestock mortality rates in Bangladesh.

Livestock Production in Bangladesh

3.90. ***Livestock play an important role in the economy of Bangladesh,*** with 2007 livestock GDP valued at US\$1.6 billion or 2.9 percent of GDP and 13 percent of agricultural GDP.⁴¹ Livestock is the third largest export earner, mainly in the form of hides. The growth rate in livestock GDP in 2004–05 was the highest of any agricultural subsector at 7.23 percent, compared to 0.15 percent for crops and 3.65 percent for fisheries.⁴² Shrimp (and prawn) farming is also very important in Bangladesh, and shrimp exports are the second largest export commodity from Bangladesh, valued at US\$300 million in 2005.⁴³

⁴⁰ World Bank 2009, South Asia: Shared Views on Development and Climate Change

⁴¹ FAO 2005: Livestock Sector Brief, Bangladesh, July 2005; MOFL, 2007, National Livestock Development Policy 2007, Livestock Section -2, MOFL, GOB

⁴² MOFL 2007, National Livestock Development Policy 2007, Livestock Section – 2, MOFL, GOB

⁴³ AABM, 2005, Shrimp Seal of Quality program: Bangladesh, AABM Consulting Group, Dec. 6 2005

3.91. *A very high proportion or about 75 percent of the population relies on livestock for its livelihood.*⁴⁴ Livestock are highly integrated into the rural farming systems and have multiple uses. They are a source of power for crop tillage, a means for transport and threshing, and a source of manure which can either be used to fertilize crops or as a source of fish feed or fuel (methane gas plants or dry fuel). They can be sold to provide cash, and they are an important source of protein in the form of meat, milk, and eggs.

3.92. *Livestock is a critical income source for poor farmers and landless households in Bangladesh,* as evidenced by the fact that 63 percent of households that possess less than 2.5 acres of land rear large ruminants (cattle and buffalo), 76 percent rear small ruminants (sheep and goats), and 80 percent rear poultry.⁴⁵ GOB recognizes that livestock and fisheries are essential elements in connection with poverty reduction, food security, and income generation for the rural poor and especially for landless households, as few have any options other than livestock to improve their livelihoods.

3.93. In 2005 the livestock population of Bangladesh consisted of 25.1 million head of cattle and buffalo, 17.5 million head of sheep and goats, and 188 million head of poultry (chicken and ducks).⁴⁶ The average size of livestock holding was small in 2005 with 2.5 cattle/buffalo per owning HH, 2.6 sheep/goats per HH, and 10.5 birds per HH. (table 3.6).

Table 3.6. Estimated Livestock Population in Bangladesh: 2005

Item	Cattle + Buffalo	Sheep + Goats	Poultry (Chicken & Ducks)
No. HHs Owning	10,192,504	6,626,684	17,989,084
Total Number Heads	25,135,338	17,459,065	188,398,295
Average Number Head/HH	2.5	2.6	10.5

Source: BBS 2005.

3.94. *Livestock production in Bangladesh is characterized by the predominance of local breeds and low levels of husbandry.* Productivity is generally very low.⁴⁷ Livestock producers face major constraints in terms of access to animal feeds, especially during times of seasonal flooding, and poor access to livestock extension and veterinary services.

3.95. *There are about 220,000 ha of shrimp and prawn farms in Bangladesh,* of which 170,000 ha (77 percent) is allocated to saltwater shrimp farming and 50,000 ha (23 percent) to freshwater prawn farming. There are two main areas of shrimp farming: (i) Khulna region, accounting for about 70 percent of all production and (ii) Cox's Bazar region (25 percent of production), while the remaining 5 percent of shrimp production is located in other coastal Districts. Average farm size varies from 0.5 ha to 50 ha on the largest commercial farms. There are two main production systems: (a) *traditional extensive*, which is typified by low levels of technology, management, and purchased inputs and low stocking densities; and (b) *traditional improved*, under which stocking densities are somewhat higher.⁴⁸ Semi-intensive shrimp

⁴⁴ MOFL, 2007, *ibid*, Bari, Md. E, 2008, Overview of Livestock in Bangladesh.

⁴⁵ Jahan, N and H Rahman, 2003: Livestock Services and the Poor in Bangladesh: A Case Study, edited by S. Chipeta, an initiative by DANIDA, IFAD and the World Bank, March 2003.

⁴⁶ BBS data based on sample census 2005

⁴⁷ MOFL 2007 report average weights of local cattle that are 35% lower than in neighbouring India and milk yields of only 200 to 250 litre per cow per lactation which is less than 50% of the average for India and 35% of the all Asia average.

⁴⁸ Undated. Status of Shrimp Farming

production was introduced into Bangladesh in 1992, but following severe disease losses, the area under semi-intensive cultivation has been reduced and today represents less than 1 percent of the area. Average yields of shrimps are low at between 200 and 400 kg/ha per year.

Livestock Veterinary Services in Bangladesh

3.96. The Department of Livestock Services (DLS) of the Ministry of Fisheries and Livestock (MOFL) is the main public-sector organization responsible for provision of livestock breeding services (improved breeds and artificial insemination, improved animal feed, vaccines and livestock husbandry, and extension and veterinary services to Bangladesh's livestock producers). The DLS is responsible for animal health protection, disease diagnosis and treatment of animals/birds, strict obedience of quarantine laws, and effective disease control.

3.97. *The DLS is inadequately funded and staffed and cannot provide effective veterinary services to Bangladeshi livestock producers.*⁴⁹ MOFL (2007) reports that inadequate veterinary services are one of the major obstacles for livestock development in Bangladesh with a ratio of 1 Veterinary Surgeon to 1.7 million head of farm animals and birds in 1995. In 2003 only 5 percent to 10 percent of farm animals received routine vaccination against diseases. MOFL also reports that the quantity and quality of vaccines produced and delivered by the DLS are inadequate. The Veterinary Vaccine Laboratory (VVL) of the DLS is responsible for producing vaccines against infectious diseases of livestock, but with the exception of Newcastle Disease vaccine for poultry, it is able to meet only 10 percent of the production and supply requirements of other vaccines (Nasrin and Rahman 2003).⁵⁰

3.98. Private commercial sector investment in the animal health sector remains low in Bangladesh and is expanding slowly.

3.99. *Around 20 national and 150 local NGOs/MFIs are involved in delivering livestock services to farmers*, including skill development and training in livestock and poultry rearing, microcredit provision, disease protection, and output services. In 2003 the estimated number of NGO-employed veterinary surgeons, animal husbandry officers, and livestock field assistants was 250 persons and approximately 50,000 poultry workers supervising the activities of a large numbers of program assistants (1 PA to 250 beneficiaries), servicing the requirements of around 16 million poor.⁵¹

3.100. *Several of the larger NGOs/MFIs, including BRAC, Proshika and Grameen Bank, have invested heavily in their own livestock extension and veterinary services for their members.* These organizations have developed/trained their own village-level networks of (i) livestock field assistants who provide their members comprehensive livestock treatment and vaccination programs for large ruminants (cattle and buffalo) at subsidized rates, and (ii) women poultry workers who provide primary treatment and vaccination to poultry and sometimes goats. Chapter 2 of this report showed that both Proshika and Grameen Bank have made livestock disease prevention through vaccination a precondition for their livestock insurance program and that their vaccination programs appear to be very successful, as evidenced by the very low mortality rates in insured animals.

⁴⁹ See Annex 8 for further details of DLS staffing and resources

⁵⁰ Jahan, N. and H. Rahman, 2003, Livestock Services and the Poor in Bangladesh: A Case Study, edited by S Chipeta, Danida, IFAD and The World Bank

⁵¹ Ibid page 20.

Livestock Mortality Statistics

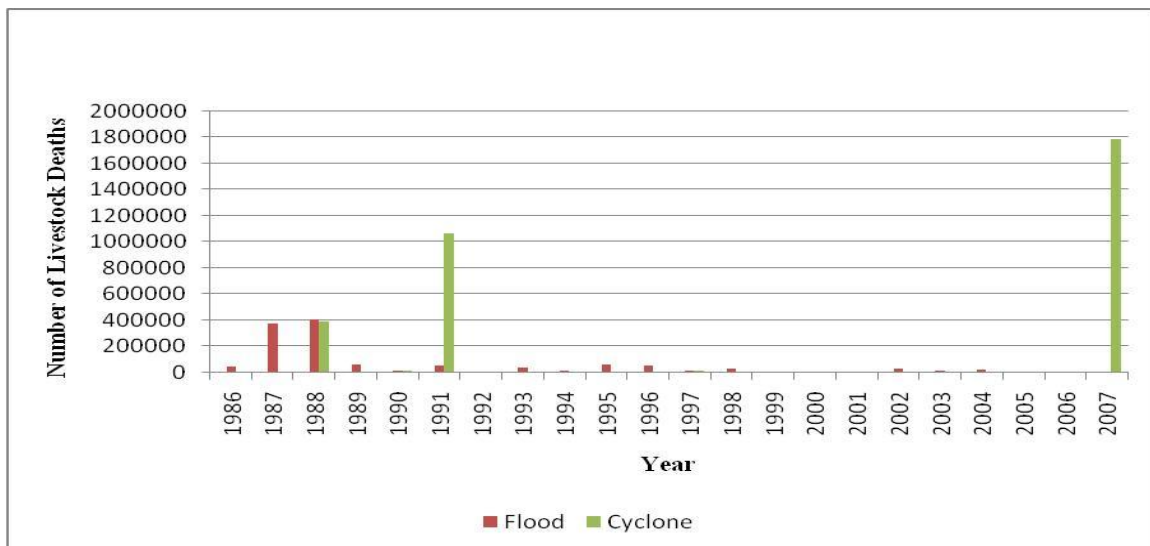
3.101. The causes of mortality in livestock include natural perils such as fire, flood (resulting in drowning), cyclone, lightning, accidental injury, starvation, birth-related complications, and death by parasites and diseases. This section reports on the limited available data for livestock mortality rates due to natural perils and diseases. It is a drawback for insurance purposes that animal deaths are not systematically reported and recorded in Bangladesh.

3.102. Livestock mortality figures are collected for compensation purposes after each major natural disaster, and BBS statistics for flood and cyclone losses in animals are reported for the 16 year period 1986 to 2007 in figure 3.15. (See annex 9 for full details).

3.103. The BBS data cover losses in large ruminants and small ruminants (but excludes poultry), and it is not possible to report losses by class of animal. The figures show that cyclones and their associated tidal surges can cause much higher death rates in livestock than riverine and flash flooding, as evidenced by the very high cyclone losses in 1991 when 1.1 million head of livestock died and especially under Cyclone Sidr in 2007 when 1.8 million head of livestock died. The annual average losses due to cyclone are slightly greater than 325,000 head of animals compared to an annual average of about 64,000 flood-related animal deaths. While relatively low numbers of animals die each yield due to drowning, the consequential effects of major flooding which are not reported in the BBS figures include lack of access to fodder and clean drinking water and death of livestock due to starvation and disease outbreaks.

3.104. Flood and cyclone can be considered for livestock insurance, but only if it is possible to (i) avoid antiselection in the case of flood (namely the tendency for livestock owners located in low-lying areas with a known and predictable and frequent flood exposure to purchase livestock insurance) and (ii) ensure that the livestock portfolio is geographically spread to avoid the concentrated deaths that may occur under a single flood or cyclone event and as occurred under Cyclone Sidr where the main losses were incurred in 4 Districts only.

Figure 3.15 . Livestock Losses due to Flood and Cyclone (No. of Dead Animals)



Source: BBS Data.

3.105. *According to MOFL 2007, in Bangladesh the livestock disease surveillance system is almost nonexistent.* The Veterinary Public Health Unit in DLS is responsible for the diagnosis, surveillance, and control of epidemic diseases in livestock, but it suffers from acute shortages of staffing, funding, and laboratory facilities. The DLS lacks the resources to maintain a regional and national database on livestock disease incidence and mortality rates. The only available information on livestock disease outbreaks in Bangladesh is from the OIE (World Organization for Animal Health).

3.106. *According to the OIE, of the 14 listed Class A diseases of livestock, four diseases are present in Bangladesh,* including (i) Foot and Mouth disease (FMD), which affects cattle, buffalo, sheep, goats, and pigs; Peste des petits ruminants (PPR), which affects sheep and goats; sheep and goat pox; and finally Newcastle disease in poultry. The OIE reported disease outbreaks in livestock for Bangladesh between 1997 and 2004 are reported in annex 9, but the data is very limited and does not provide any insights into livestock disease mortality rates.

3.107. *In Bangladesh, vaccination is used both as a preventative measure in livestock and in the event of an identified outbreak as a control measure.* However, as the production of vaccines in Bangladesh is adequate to vaccinate only about 10 percent of large and small ruminants, it is apparent that only a very small percentage of the national herd/flock is vaccinated against these Class A diseases.

3.108. The only other source of livestock mortality statistics come from the SBC livestock insurance scheme and from the NGOs/MFIs which are involved in providing livestock credit linked to livestock mortality compensation schemes. PROSHIKA has the longest experience with underwriting livestock and has incurred an average mortality rate of 3.5 percent, compared to 2.8 percent for Grameen and 5.4 percent for SBC. (Full details of these programs are presented in chapter 2 and annex 4.)

3.109. This study has not been able to access any database on losses due to natural perils and diseases in shrimp farms in Bangladesh. Shrimp production in the coastal estuarine regions of Bangladesh is highly susceptible to natural catastrophes of flood, cyclone, and tidal bore and also to diseases of shrimp. In 2001–02, the Bangladesh shrimp industry incurred very severe losses due to white-spot virus, with resulting reduced export values of 23 percent on the previous year. Under Cyclone Sidr in 2007, damage and losses to the fisheries subsector including shrimp farming amounted to Tk 463 million (US\$6.7 million). (See annex 10 for further review of losses incurred by Bangladesh Shrimp Industry).

Issues Relating to All-Risk Mortality Insurance, Including Class A Epidemic Livestock Diseases

3.110. The regulated livestock insurer (SBC) and the nonregulated livestock insurers (the NGOs/MFIs) are offering all-risks mortality cover on their livestock insurance programs. This cover includes disease protection including Class A highly contagious or epidemic diseases.⁵² In the case of the NGOs/MFIs, epidemic disease cover is conditional on the animal first being vaccinated against the disease so that in effect the disease cover is against “vaccination failure”.

⁵² The World Organisation for Animal Health (office Internationale des Epizooties, OIE) defines Class A epidemic diseases of livestock as: “highly contagious diseases with potential for rapid spread irrespective of international borders and which are of serious socio-economic public health consequences and which are associated with high mortality rates in the affected livestock and which are of major importance in the international trade of livestock and livestock products”.

However, given the facts that (i) the quality and supply of livestock vaccines in Bangladesh is identified by the MOFL as being suboptimal and (ii) four of the Class A diseases are endemic in Bangladesh, it appears that these insurers face an unknown and potentially catastrophic exposure to epidemic disease losses on their livestock insurance and credit-guarantee portfolios.

3.111. *No formal livestock epidemic disease modeling has been conducted in Bangladesh to date*, and the World Bank recommends that such analyses should be conducted now if the NGOs/MFIs intend to continue offering disease cover and indeed if they intend to scale up their livestock insurance programs.

3.112. It is also important to note that at an international level very few reinsurers are willing to provide all-risks mortality cover for livestock, and furthermore they generally impose very strict limits on the underwriting of diseases and in nearly all cases specifically exclude Class A epidemic diseases. This has major implications for the NGOs/MFIs, which are unlikely to be able to place excess-of-loss reinsurance on their livestock compensation programs while they continue to offer Class A disease cover. .

Conclusions to Livestock Risk Assessment

3.113. *In the absence of a national livestock mortality database in Bangladesh, it is not possible to conduct any formal risk assessment for risk rating and risk layering/financing purposes.* The only quantifiable data available on livestock mortality rates comes from the relatively small-scale livestock insurance initiatives with ranges in mortality rates of 2.8 percent (Grameen CLDDP for cattle only) through to 3.5 percent (Proshika for cattle, buffalo and poultry) and finally the highest mortality rates of 5.4 percent reported by SBC. These mortality rates compare with average premium rates changed in 2009 of about 3 percent to 5 percent for dairy cattle insurance and 6 percent for poultry.

3.114. *There are important differences in the average mortality rates for these three livestock insurance programs.* The Grameen and Proshika programs are managed at a local level by their own trained livestock technicians. Livestock vaccination is provided by these organizations as part of their package of services (selection of animals, provision of credit, vaccination, training for farmers in animal husbandry and nutrition, etc.) and through this highly integrated community-based approach, their average mortality rates are respectively 49 percent lower and 35 percent lower than the average mortality rates experienced by SBC, the public-sector insurer. SBC does not have its own field-level technical support team to monitor and control insured livestock risks, and it is likely that this is why the company experienced considerably higher average mortality rates.

3.115. Given the fact that livestock vaccination is a precondition of cover all three of the livestock insurance programs and considering the close monitoring of insured animals under the NGO/MFI programs, it is likely that their reported mortality rates are considerably below the national average mortality rates for livestock (cattle).

Finally, in view of the almost complete absence of any livestock or shrimp mortality statistics in Bangladesh, it will be necessary under any future livestock, poultry, or shrimp insurance initiative(s) to (i) conduct local surveys with the targeted producers in order to establish normal mortality rates by cause of loss for each class of animal and (ii) to conduct modeling for catastrophe risk exposures (cyclone, flood, and epidemic diseases if these are to be considered) in order to develop technically based premium rates which include adequate loading for catastrophe events.

Chapter 4: Opportunities for Agricultural Insurance Product Development in Bangladesh

4.1. This chapter provides a review of crop and livestock insurance products which are currently available in international agricultural insurance markets, some of which may be suitable for Bangladesh's predominantly small-scale crop and livestock producers.

Potential Crop Insurance Policy Options for Bangladesh

Crop Perils and Their Insurability

4.2. Those perils that cause damage to a crop in a defined time period and cause measurable damage, such as hail or fire, are the most simple to insure; windstorm and frost are less easy to insure and drought, excessive moisture, and pest and disease are the most complex to insure. Table 4.1 presents a peril classification guide indicating criteria of insurability, complexity, and accessibility to reinsurance cover—a key component in the development of a sustainable program.

Table 4.1. Peril Classification Guide for Crop Insurance

PERIL CLASSIFICATION				
RISK/PERIL	CRITERIA FOR INSURABILITY			
	How unpredictable or unforeseeable is the peril?	How unavoidable, uncontrollable or unmanageable is the peril?	How measurable & quantifiable is the peril?	How available is <u>commercial</u> reinsurance cover?
CLIMATIC PERILS				
Hail	☐	☐	Easy	Widespread
Frost	☐*	☐*	Difficult	Restricted
Excess Rain	☐	☐	Generally easy	Restricted
Flood	☐*	☐*	Generally easy	Restricted
Drought	☐*	☐	Difficult	Restricted
Windstorm	☐	☐	Generally easy	Restricted
BIOLOGICAL PERILS				
Pests (Insects)	☑	☑	Generally easy	Very restricted
Disease	☑	☑	Difficult	Very restricted
Pests (animal)	☑	☑	Generally easy	Very restricted
OTHER NATURALLY OCCURRING PERILS				
Fire & Lightning	☐	☐	Generally easy	Widespread
Earthquake	☐	☐	Generally easy	Available
Volcano	☐	☐	Generally easy	Available
Tsunami	☐	☐	Generally easy	Available

Source: W Dick 1998.⁵³

☐ = Perils that underwriters consider to be unpredictable, unforeseeable and/or unavoidable, uncontrollable, and unmanageable.

☐* = Perils that underwriters consider to be not as unpredictable, unforeseeable and/or unavoidable, uncontrollable, and unmanageable.

☑ = Perils that underwriters consider to be predictable, foreseeable and/or avoidable, controllable, and manageable

4.3. *A basic requirement of any type of insurance is that a peril should be unpredictable, unforeseeable, unavoidable, and unmanageable.* Hail fits these criteria requirements, it is a

⁵³ Dick, W., 1998, Key Elements & Generic Considerations in Crop Insurance Design and Operations, ARM Discussion Paper, Agricultural Risk Management Ltd, December 1998

discrete event-peril and physical loss or damage to the crop is usually easily measured in-field using sampling procedures a few days after the loss. Hail is usually a high-frequency, low-severity peril which does not lead to catastrophe losses so long as the individual risks are well spread geographically. For all these reasons it is a product for which commercial insurance and reinsurance capacity is easily available. Conversely, drought is a progressive peril and its impact can be determined only by measuring actual harvested yield against a historical average yield for the crop. Drought losses are difficult to isolate from other perils and management-related factors, and drought has the potential to correlate over wide geographic areas and result in catastrophe losses. Drought is not totally unpredictable, unforeseeable, and unmanageable and international experience has shown that many voluntary loss-of-crop-yield schemes are open to moral hazard and adverse selection. (See further discussion in the next section of the drawbacks of individual grower multiple-peril loss-of-yield insurance cover.) Outside North America many international reinsurers are reluctant to reinsure drought because of the complexities of insuring this peril.

4.4. In summary, the above peril classification table provides a useful guide to the insurability of each climatic peril which crop insurance practitioners in Bangladesh may wish to consider in the design of crop insurance products which fit the circumstances and needs of their farmers.

Traditional Indemnity Based and New Index-Based Crop Insurance Products

4.5. Table 4.2 provides a summary of the main internationally available crop insurance products and the World Bank's assessment of their suitability for smallholder agricultural conditions in Bangladesh in the start-up phase of new market-based pilot crop insurance programs.

4.6. *Four traditional individual-farmer crop insurance products are listed, of which single-peril crop-hail and named-peril crop insurance are identified as potentially being suited to further research and development in Bangladesh.* Two other individual grower products—multiple-peril crop insurance (MPCI) and crop-revenue insurance—are, however, identified as not being suitable in a start-up phase.

4.7. *Under the innovative range of index products, area-yield index insurance and crop-weather index insurance are identified as offering potential for consideration* in the start-up phase of any future pilot crop insurance initiative in Bangladesh. However, further research and development will be required before either of these products can be launched under a pilot-test program. Area-yield index insurance and crop weather index insurance products are identified as being particularly suitable for tenant farmers and sharecroppers because the crop insurance policy is linked to an external index and not to the specific plot of land they farm as tenants/sharecroppers and where they may face complications in agreeing the division of crop premium payments and settlement of claims, with their landlord.

4.8. The key features and advantages and disadvantages of these crop insurance products are reviewed in the sections below and further details are presented in annex 7 along with specimen wordings and case-study examples.

Table 4.2. Potential Crop Insurance Products for Bangladesh

Type of Crop Insurance Product	Basis of Insurance and Indemnity	Potentially Suitable for Bangladesh in Start-up Phase with Further R&D?
<i>Traditional Individual Farmer Insurance</i>		
1. Single-peril hail	% Damage	YES
2. Named Peril (e.g., hail + fire + frost)	% Damage	YES
3. Multiple-Peril Crop Insurance (MPCI) (including drought)	Loss of Yield	NO
4. Revenue Insurance	Loss of Yield and Price	NO
<i>Innovative Crop-Index Insurance</i>		
5. Aggregate Yield Shortfall Insurance	Loss of Aggregate Yield	NO
6. Area-Yield Index Insurance (e.g., NAIS, India)	Area-Yield Index	YES
7. Crop-Weather Index Insurance	Weather-index (e.g., rainfall)	YES

Source: Authors.

Named-Peril Crop Insurance (Hail, Frost, Wind)

Hail Exposure to Crop Production in Bangladesh

4.9. *Hail is a major cause of crop damage in northwestern Bangladesh, especially in the period March to May, which coincides with the harvest of Rabi season crops*, including Boro paddy, wheat, mustard, vegetables and fruit, and horticultural crops. Hail is also an exposure to Kharif crops in August and September. According to the Bangladesh Bureau of Statistics (BBS) area-damage data,⁵⁴ during the period 1990–91 to 2005–06 an average nearly 90,000 acres were 100 percent damaged by hail and tornado in the Rabi season, with an average annual loss cost of 1 percent of total cultivated area: Chittagong and Sylhet are both very exposed to hail in the Rabi season, with an annual average loss cost of 4.1 percent of cropped area. The losses in Rabi crops occur at the time of harvest of Boro paddy and wheat and other minor crops when the crops are very susceptible to hail and wind damage. Conversely, hail and tornado acreage losses in pre-Kharif and Kharif are extremely low save for Bogra, which experienced nearly 220,000 acres of crop-hail and tornado losses in 1995 and which has an annual average loss cost of 2.4 percent for Kharif crops.

4.10. *The overall annual average loss cost for hail and tornado is 0.4 percent of total cropped acreage.* The hail exposure for the study Districts varies from an annual average loss cost of 1.3 percent for Bogra or well above the national average and 0.1 percent in both Dinajpur and Pabna. (BBS hail-damage data are reported by District in annex 7.)

⁵⁴ As noted in chapter 3, caution must be exercised in interpreting the data because it is understood that the BBS figures exclude partial hail and tornado damaged area, and thus it is likely that the available data considerably underestimate actual hail and tornado losses.

4.11. ***There may be a strong demand for crop-hail insurance.*** On the basis of the World Bank Mission’s panel discussions with farmers in Dinajpur, Bogra and Pabna there would appear to be a strong demand for crop-hail insurance. In Dinajpur, farmer panels indicated that hail storm damage was their most serious climatic risk exposure to Boro season crops (paddy, wheat and vegetables) at the time of harvest in March and April.

Features of Traditional Crop-Hail Policies

4.12. ***Single-peril hail insurance is the simplest and best known type of traditional indemnity-based crop insurance product*** which has operated for over a century in Europe, North America, and Argentina and more recently in Australia and New Zealand. In these markets, hail insurance products have been developed for a wide range of crops, including cereals (e.g., wheat, barley, maize); oilseeds (e.g., mustard, soya beans, sunflower); other field row crops; leaf crops (e.g., tobacco); fibers (e.g., cotton, flax); through to horticultural and vegetable crops (e.g., tomatoes, potatoes, peppers, strawberries) and a wide range of tree fruit (apples, pears, kiwi fruit, citrus, etc.). These crop-hail products are well researched and developed and in principle could be adapted relatively easily to Bangladesh conditions.

4.13. Under a damage-based indemnity system, physical loss or damage caused to the crop by hail is measured in the field soon after a specific loss event to an insured peril and the claim is usually settled shortly after the time of loss. Normally the hail 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 downward if the actual crop is found to be below the normal production potential for uninsured reasons, for example, poor crop establishment, poor crop husbandry, or poor pest and disease control. A deductible is usually applied to the loss expressed as “percentage damage,” although this can be a fixed dollar value. This method is most applicable to programs which offer single-peril hail cover or a limited number of discrete event perils (e.g., hail, fire, windstorm, or frost).

4.14. ***Hail Insurance can be designed to offer the insured farmer a high degree of flexibility in the coverage he/she elects to purchase and at affordable premium rates.*** Key features of damage-based crop-hail policies are summarized in box 4.1., and the following points are made with respect to the flexibility of cover:

- ***Does the farmer have to insure all his crops?*** Hail incidence is generally considered to be a purely random and unpredictable phenomenon and therefore many crop-hail insurance policies allow the farmer to choose how many of his fields of the same crop he wishes to insure. This is in contrast to a multiple-peril loss of yield MPCl policy, in which underwriters generally insist on the farmer declaring and insuring all the area of the same crop in order to avoid adverse selection.
- ***When can the farmer purchase hail insurance?*** Hail-only insurance can normally be purchased at any time during the growing season subject to a waiting period of 24 to 48 hours. Conversely, crop MPCl cover can be purchased only well in advance of the crop season to avoid preexisting or developing adverse climatic conditions which would result in adverse selection.
- ***How much of the expected value of the crop can the farmer insure?*** Crop-hail insurance can be very flexible in the sums insured, which permits growers the option to select a low level of sum-insured protection per hectare—for example to protect against the loss of production credit, though to a high level of protection/high sum-insured value

based on 100 percent of the expected sale value of the expected crop-yield/output. Some policies permit the insured to elect a sum-insured value per hectare with no reference to the underlying expected crop yield, but they are usually subject to minimum and maximum insured values per hectare. Other policies may require the grower to declare his normal expected yield and in the event of loss the policy adjusts for over or under insurance of yield.

- ***Is there a choice of insured unit and deductible options?*** The principle of all crop-hail insurance is to establish a damage profile for each crop type and region and to set the policy excess or deductible at a level which will eliminate very small frictional hail events, which are of no economic consequence to the insured but which are costly for the insurer to adjust and can erode the risk premium, which is intended to cover less frequent but severe events. There are a wide range of different crop-hail policy excess types, ranging from qualifying damage franchises to conventional percentage damage deductibles. These deductibles can be applied on an acre by acre basis up to a whole crop or farm basis and deductibles may be applied to each and every loss or only once on an annual aggregate basis. (See box 4.1 and annex 7 for further details.)
- ***How much does crop-hail insurance cost?*** Crop-hail rates are highly influenced by a series of factors including the underlying hail exposure (frequency and severity of hail damage); the size of the crop-hail insurance program; and the spatial and temporal spread of risk and the deductible structure (size of insured unit and type and size of the deductible). In low to medium hail-risk environments and with a damage deductible in the order of 5 percent for each and every loss, hail rates in cereals are typically between 2 percent and 5 percent and in medium- to high-risk situations between 3.5 percent (medium-risk zones) to 7.5 percent (high-hail-risk zones). Obviously no statements can be made about indicative hail rates for Bangladesh until detailed local product design and rating studies have been conducted.

4.15. ***Crop-hail insurance is technically feasible for Bangladesh, but given the very small farm size key issues need to be addressed, including the design of low-cost operating systems and procedures*** for (i) insurance sales delivery; (ii) underwriting, policy issuance, and premium collection; and (iii) claims notification and hail loss assessment procedures. These issues are discussed further in chapters 5 and 6.

Named-Peril Crop Insurance Policies

4.16. As a step-up from hail-only cover, it is possible to add other discrete perils which cause direct physical damage to the crop and which typically include fire, wind, and sometimes excess rain or frost damage. The latter two perils are more difficult to adjust under a damage-based indemnity system. Drought, however, which is a progressive peril, does not lend itself to insurance under a traditional damage-based indemnity policy⁵⁵ and can be insured only under a loss of yield-based insurance and indemnity policy, as described in the next section.

⁵⁵ There is one major commercial exception to this rule namely the *Planta Viva* or “Live Plant” Insurance Policy developed by MunichRe for the Mexican crop insurance market in the 1990s and which provided multiple peril crop protection including drought losses, under a damage-based indemnity policy.

Box 4.1. Key Features of Crop-Hail (and Named-Peril) Insurance Policy Design and Structure

Key Features	Details
Type of Policy	Damage-Based Indemnity Policy.
Insured Perils	Hail only, or hail + named perils, e.g., fire, wind, frost
Insured Crops	Widely used to insure cereals, fibers (cotton), leaf crops (tobacco), horticultural crops, vines (grapes, kiwifruit), and tree fruit (pipfruit, stone fruit, and citrus)
Obligation to Insure	Hail underwriters may insist on the grower declaring and insuring all fields of the same crop grown at the farm location, or in a defined geographic area (e.g., county), while other underwriters may permit the grower to insure any field or fields the grower elects to insure.
Cover Period	From the time of crop emergence or full stand establishment to harvest of the crop
Sales Period	Crop-hail policies can normally be purchased at any stage during the crop season up to the time of harvest, subject to a 24 hour or 48 hour waiting period. This is permissible where hail is unpredictable or unforeseeable. Conversely, in some countries or geographical locations with a marked hail exposure, underwriters may impose sales cut-off dates prior to the onset of the main hail season.
Sum Insured	<p>The sum insured for crop-hail insurance may be very flexible to provide growers with the choice to insure against loss of the production costs invested in growing the crop to 100 percent of the expected sale value (revenue) of their crop.</p> <p>The sum insured is based on: an estimated yield per hectare valued at an agreed unit sum insured price (which may be based on anything from the costs of production up through the sale value of the crop) multiplied by the number of insured hectares.</p>
Over- or Underinsurance	Some hail policies explicitly state that in the event of loss the policy will be subject to correction for (i) overinsurance of yields or (ii) underinsurance of yields (application of the average). Other hail policies permit the grower to select his/her own sum insured per hectare with no reference to the underlying actual or expected yield and there is no adjustment for over- or underinsurance of yields.
Basis of Indemnity	<p>For most cereal and field row crops, cover insures only against physical loss or damage caused by hail, but in the case of fruit, cover normally insures both physical losses and qualitative losses—quality downgrading of hail-damaged fruit.</p> <p>Hail damage is conventionally measured using in-field damage assessment techniques to measure (i) the area damaged by hail and (ii) the percentage hail damage. The indemnity formula is given by: $\text{Claim} = \text{Sum Insured} \times \text{Percent Hail Damage, minus the Policy Excess}$</p>
Resowing Provision	Some crop-hail policies carry a replanting or resowing provision for early season hail losses which result in total plant damage in part or all of the insured area. The resowing provision typically indemnifies the grower for the cost of new seed and sowing costs.

<p>Policy Excess (Deductible)</p> <p>Per Event Deductibles</p> <p>Insured Unit for Purposes of Application of Deductible</p> <p>Source: Authors 2009.</p>	<p><i>Hail policies offer a wide range of deductible structures:</i></p> <ul style="list-style-type: none"> • No first loss excess at all. • A qualifying percentage damage franchise (e.g., 5 percent damage franchise)—if the actual measured hail damage is 8 percent, this exceeds the 5 percent qualifying franchise and the policy would indemnify the 8 percent hail loss in full). • A conventional percentage damage deductible (e.g., 5 percent damage deductible—if the actual measured hail damage is 8 percent, the policy would indemnify 8 percent minus 5 percent = 3 percent hail loss). • A fixed-value damage franchise or deductible (e.g., a policy may carry a US\$50 deductible—if the actual gross value of the hail damage is US\$200, the policy would settle a claim of US\$150: US\$200 – US\$50 deductible). • A co-insurance on the value of the hail loss (e.g., if the policy carries a 10 percent co-insurance and the value of the hail damage is US\$200, the grower would receive an indemnity of US\$200 minus US\$20 [10 percent co-insurance] = US\$180). <p>For crop hail, the deductible is conventionally applied on an <i>each and every loss</i> basis, although some policies may carry an annual aggregate deductible only.</p> <p>According to the definition of the <i>insured unit</i>, the crop-hail policy excess may also be applied on the following basis:</p> <ul style="list-style-type: none"> • Acre by acre • Individual plot or field • Damaged area basis • Whole crop insurance area
------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Multiple-peril Crop Insurance (MPCI)

4.17. ***The MPCI policy is a traditional loss-of-yield-based insurance and indemnity cover under which the final harvested yield is compared against normal average yields and the difference or loss of yield is indemnified.*** In order to underwrite an MPCI policy it is necessary to have access to individual grower time-series crop production and yield data in order to establish a normal or average yield for that farmer under his management and technology levels. An insured yield is normally fixed well below average normal yields, often 50 percent to 70 percent of the normal average yield. (This percentage insured yield is often termed the “coverage level.”) Following a loss, actual harvested yield (tons per hectare) is compared to insured yield. shortfall of harvested yield below the insured yield is then indemnified at an agreed price per ton (which can be based on an agreed cost of production valuation per insured unit through to a farm-gate sales price based valuation).

4.18. The loss-of-yield indemnity method is normally used for programs in which a wide range of perils are insured, and where there is difficulty in separating insured from uninsured causes of loss. Yield shortfall policies are normally essential if drought is to be insured, because

of the progressive nature of this peril, the effects of which can usually be measured only in terms of a reduction in expected yield. Most MPCCI policies act as a loss-of-yield guarantee cover against all perils because of the difficulty of trying to isolate and measure the impact on final harvested yield of insured versus uninsured perils.

4.19. Traditional individual grower multiple-peril agricultural crop insurance is widely practiced throughout the world. The international experience with individual grower MPCCI has, however, often had problems of low uptake, high antiselection and moral hazard, high administrative costs, and underwriting results which have generally been negative. In addition, the programs have been very exposed to systemic losses in severe drought or flood years. Most individual grower MPCCI is highly dependent on government premium subsidies and/or subsidies on claims payments. In developing countries which are dominated by very small farm sizes, the costs associated with administering individual grower MPCCI are often prohibitively high.

4.20. ***The extremely small size of holding (average <1.2 acres) and lack of accurate farm-level yield data does not lend itself to individual grower MPCCI in Bangladesh.*** In addition, the SBC experience with voluntary individual grower MPCCI during the 1980s and 1990s mirrors international experience with low levels of uptake, antiselection and moral hazard, difficulties in conducting objective loss assessment at affordable cost, and very poor underwriting results. The World Bank does not therefore recommend individual farmer MPCCI in the start-up phase of any new crop-insurance programs through the public, private, NGO/MFI, and mutual cooperative sectors in Bangladesh. Until crop insurers have gained considerable experience with underwriting other types of traditional and nontraditional crop insurance policy and have achieved a stable and balanced crop-insurance portfolio, it is not recommended that they consider individual grower MPCCI. Even later, MPCCI should only be offered on a very restricted basis for specific crops and for specific types of mainly larger commercial farmer.

Area-Yield Index Crop Insurance

Features of Area-Yield Index Insurance

4.21. ***Crop area-yield index insurance represents an alternative approach which aims to overcome many of the drawbacks of traditional individual grower MPCCI 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 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., county or department). 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 percent and a maximum of 90 percent 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 at harvest falls short of the insured yield coverage level purchased by each grower.

4.22. ***The key advantages of the area-yield approach are that moral hazard and antiselection are minimized, and the costs of administering such a policy are much reduced.*** This offers the potential to market this product at lower premium costs to growers (box 4.2.) The main disadvantage of an area-yield 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 county or departmental average yield, the grower does not receive an indemnity.

Box 4.2. Area-Yield Index Crop Insurance: Advantages and Disadvantages

ADVANTAGES	DISADVANTAGES
<p>Adverse selection and moral hazard minimized The indemnity is based on average area yields and not on individual farmers’ yields. Individual farmers cannot therefore influence the yield outcome.</p>	<p>Basis risk issues The occurrence of basis risk depends on the extent to which an individual farmer’s yield outcomes are positively correlated with the area-yield index.</p>
<p>Yield-data availability for insurance Time-series District-level or Upazila-level area-yield data is available at Bangladesh Bureau of Statistics.</p>	<p>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.</p>
<p>Comprehensive multiperil insurance suited to the insurance of systemic risk The policy acts as an all-risk yield shortfall guarantee policy and is best suited to situations where severe systemic risk (e.g., drought) impacts equally over the defined area insured unit (e.g., Upazila).</p>	<p>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).</p>
<p>Lower underwriting and delivery costs There is no need to conduct preinspections on individual farms or to collect individual grower yield data.</p>	<p>Inaccuracy of historical area yield data Methods of yield measurement and reporting may not be accurate, raising doubts about the historical area-yields.</p>
<p>Lower loss-adjusting costs There is no requirement for individual grower in-field area loss assessment, which is very time consuming and costly.</p>	<p>Problems of accurate measurement of area yields Sampling error and enumerator bias can be a major problem in determination of average area yields.</p>
<p>Affordability of product The combination of reduced exposure to yield loss and reduced administrative costs offers the potential for cheaper premiums than for individual farmer MPCI.</p>	<p>Time delays in settling claims⁵⁶ Farmers often have to wait for at least three to six months postharvest for the official results of the area yields to be published and for indemnities to be paid if applicable.</p>
<p>Source: Authors.</p>	

⁵⁶ In order to correct the negative effect of the delays on settling claims of area-yield crop insurance certain agricultural insurance schemes, like the NAIS in India, are currently analyzing how to complement or combine area-yield index insurance with crop weather insurance in order to be able to make early mid- or postseason payouts to farmers based on the weather index and to then settle the final claim once the official results of the area- yields are published.

International Experience with Crop Area-Yield Index Insurance

4.23. The origins of area-yield insurance date back to 1952 in Sweden. India introduced area-yield cover in the late 1970s and the United States⁵⁷ and Canada introduced area-yield insurance in the early 1990s. Other countries which have developed area-yield insurance in the past decade include Morocco, Sudan, Brazil, and Mexico.

4.24. Eastern India has very similar agro-climatic seasons and cropping systems to Bangladesh, and the experience of the Indian area-yield index insurance program is most directly relevant to Bangladesh. In India the Agricultural Insurance Company of India (AICI), a public-sector specialist crop insurer is responsible for implementing area-based crop insurance under the National Agricultural Insurance Scheme (NAIS). This program has operated for over 20 years and key features include the following:

- The program is targeted at small and marginal farmers (with less than two hectares) and who are highly dependent on access to seasonal crop credit. Crop Insurance is compulsory for borrowing farmers and voluntary for nonborrowing farmers;
- The insured unit is normally the block or panchayet which comprises a group of nearby villages and may include up to 10,000 ha (25,000 acres) or more of a single crop and many thousands of small and marginal farmers. Farmers may select insured yield coverage levels of 60 percent, 80 percent or maximum of 90 percent of the past five-year average area yield;
- The program is administered through the rural agricultural bank branch network in each state and department and block (group of villages). The AICI maintains a national headquarters staff and a small regional team in each state. It has not, however, attempted to establish branch offices as there is no need to duplicate the rural bank branch network. The insurers' administrative costs are kept to a minimum by linking insurance with rural finance.
- Actual area yields are established through sample crop-cutting, which is the responsibility of each state government. This is a major and costly exercise and is liable to delays in processing the results. Indemnity payments to farmers are therefore often delayed for six months or more.
- By virtue of being a mainly compulsory program, the NAIS scheme is the world's largest crop insurance program, currently insuring about 20 million Indian farmers (representing an insurance uptake rate of about 18 percent of all farmers). The program is, however, highly dependent on government subsidies and operates at a major financial loss.

4.25. Further details of the design features and experience with area-based crop insurance in India and Brazil are contained in annex 6 and for the United States in annex 10.

Crop Area-Yield Insurance for Bangladesh: Choice of Insured Unit and Yield Data Quality

4.26. In order to operate an area-yield index program it is necessary to have an objective and accurate system of measuring average crop yields for each selected crop within the defined

⁵⁷ In the United States, Area-Yield Index insurance is marketed under the name Group Risk Plan, GRP. In the United States it is possible to combine Area-Yield Index insurance with crop output price protection under the Group Risk Income Plan, GRIP. Further information on GRP and GRIP are presented in Annex 11.

geographical area or insured unit. Furthermore there should ideally be a minimum of 10 to 15 years of historical yield data on which basis to calculate (i) the normal average yield for the selected crop, (ii) the insured yield coverage level, which is expressed as a percentage of the average yield, and (iii) the underlying pure loss cost rates associated with each coverage level.

4.27. ***Crop yields are collected on a routine basis by the Bangladesh Bureau of Statistics and the Department of Agricultural Extension (DAE) using sample surveys and area estimation and crop-yield cutting and visual estimation.*** For an area-yield index crop insurance policy it is essential to have an accurate and impartial system for measuring actual yield on sample plots at the time of harvest. Visual estimation of yields is not deemed to be sufficiently objective or accurate for crop insurance purposes, and it is therefore necessary to adopt crop-cutting to establish actual yields in systematically selected random sample plots. Methods of crop cutting in Bangladesh used by BBS and DAE are reviewed further in annex 5.

4.28. ***The success of an area yield index program is very dependent on the selection of an appropriate geographic area (the insured unit) in which cropping systems and crop production and yields achieved by individual farmers are homogeneous.*** Area-yield index crop insurance determines its indemnity payouts based on the actual average yield obtained in the predefined geographic unit, namely the IU. Therefore the selection of an appropriate IU is critical for the successful operation of an area-yield index program. The IU must be homogeneous in terms of cropping systems, crop varieties, the technology levels adopted by farmers, and homogeneous in terms of the climatic and natural risk exposures affecting crop production in the IU.

4.29. ***The choice of IU should be the smallest geographical area possible for which crop area, production, and average yield data are accurately measured and reported, in order to ensure that basis risk is minimized.*** In Bangladesh, BBS reports time series crop area, production, and average yields data at two levels: for each crop type at the Great District level and then these figures are aggregated by crop at the national level. A Great District, on average, has about 1.7 million acres of cultivated land and for a single crop e.g., HYV Boro paddy, up to half a million acres. There is often major diversity within a Great District in agro-ecological conditions, flood susceptibility, land-use types, cropping systems, and different technology levels and the crop yields achieved by farmers. Given the heterogeneous yield outcomes for different farmers and locations within the Great District, any area-yield index program which tried to adopt the Region (Great District) as the IU would inevitably experience major problems of “basis risk”. Basis risk occurs when individual farmers incur severe or even total crop production losses due to localized perils (e.g., flash-flooding, riverine flooding, tornado, or hailstorm), but because the rest of the IU is not affected by these localized events, the actual average yield at the Great District level would not be lowered and no indemnity would be payable to the farmers whose crops were destroyed. The converse can also occur, namely, some farmers receive an indemnity under an area-yield index program although they have not incurred any crop-yield shortfall or losses on their own farms.

4.30. ***It is suggested to use the sub-District (Upazila) as the IU.*** The BBS reports annual average yields at the Great District level. However, upon request and on a fee service basis, BBS can also provide time series production and yield data for major crops such as paddy (by season, variety, and method of sowing) and wheat, either at a District-level or sub-District (Upazila) level. Bangladesh is divided into 476 Upazilas, each with an average net cropped area of 31,000 acres. This size of IU is similar to the Indian area-based index crop insurance scheme which is implemented by the NAIS and where the block or panchayat forms the IU and typically has an average crop area of about 25,000 acres.

4.31. For the three selected Districts, 16 years (1992–93 to 2007–08) of Upazila-level production and yield data were obtained for Aman HYV Paddy and Boro HYV Paddy in order to assess the feasibility of designing and rating an area-yield index crop insurance program for these two crops with the Upazila forming the IU. Time-series yields were obtained from BBS for a total of 33 Upazilas in the Districts: Dinajpur with 13 Upazilas, Bogra 11 Upazilas, and Pabna with 9 Districts.

4.32. In order to assess the homogeneity of crop production and yields within Upazilas, individual field crop-cut (CCE) results were obtained from the DAE from each Thana or Union in one selected Upazila in each District. The analysis of CCE yields in the selected Upazilas in the three study Districts suggests that the crop yields achieved by farmers across the Upazila are sufficiently homogeneous for the Upazila to form the IU for an area-yield index program. It will, however, be necessary to test this finding further for each crop in each District and Upazila which might be selected under a future pilot area-yield index program. The results of this analysis are shown in annex 5.

Area-Yield Index Design and Rating Methodology for Bangladesh

4.33. The Crop Risk Assessment Model at Upazila level (CRAMU) is based on an analysis of variation in Upazila-level time-series annual average crop yields for Aman HYV and Boro HYV in Bogra, Dinajpur, and Pabna Districts. This model has specifically been designed to generate technically derived pure loss cost rates (and therefore indicative premium rates) for an area-yield index program for these two selected crops in each of the 33 sub-Districts (Upazilas) located in these three Districts.

4.34. The key underlying crop production, yield, and valuation data which the CRAMU model is built on include (i) the Upazila-level Aman HYV and Boro HYV paddy crop statistics (crop area in acres, production in metric tons, and average yields in kg/acre) for the 16-year period 1992–93 to 2007–08; (ii) the assumption (in order to remove seasonal variations) that the cultivated area in each Upazila remains constant at the three-year average cultivated area for the period 2005–06 to 2007–08 for each crop and the requirement of a minimum of 10,000 acres cultivated area for an Upazila to be eligible for risk assessment and rating purposes; (iii) the use of historic yields de-trended and readjusted to an expected yield based on the most recent five-year average yield for each crop in each Upazila; and (iv) the valuation of the crop yields at the published average farm-gate gross margin sales prices, which are detailed in annex 7.

4.35. The underlying 16-year crop production and yield data is fitted with a normal distribution in order to simulate a probabilistic yield density distribution for each Upazila and crop. A correlation matrix is fitted to the Upazila annual average crop yields to estimate the covariant risk that applies between crop yields in each Upazila and District included in this crop portfolio. In addition, a catastrophe risk model is developed to estimate the losses caused by unforeseen low frequency but high severity events. The normal and the catastrophe models are simulated by using the Monte Carlo methodology in order to obtain 5,000 synthetic yields, for each crop and Upazila, under the insured portfolio to be used for risk-rating purposes. The method of risk modeling in this report is consistent with standard actuarial practice in the agriculture insurance/reinsurance market for crop risk assessment and crop insurance rating purposes.

4.36. Under an Upazila area-yield index policy, an indemnity is due when the actual average Upazila yield for a specified crop falls short of an insured yield coverage level, which is established as a percentage of the Upazila average yield (typically the coverage level is set at between 50 percent and 90 percent maximum of the long-term average yield). The CRAMU is

programmed for each crop in each Upazila to calculate for each of the 5,000 synthetic yields calculated by Monte Carlo methodology the difference between the actual historical yield and the insured yield for that year. In any year where the synthetic yield is below the insured yield the amount of yield loss is calculated as a percentage of the insured yield to derive the pure loss cost (claim/liability x 100 percent). The average pure loss cost for each crop in each Upazila is then calculated as a simple average over the 5,000 synthetic yield data. It is important to note that the pure loss-cost rates calculated by this method are technical rates as they already include a catastrophe load. Full details of the assumptions used in the design of the CRAMU area-yield index rating tool are contained in annex 7.

Crop Area-Yield Insurance for Bangladesh: Insured Yield Coverage levels

4.37. Area-yield index crop insurance policies conventionally offer insured yield coverage levels of between 50 percent and a maximum of 90 percent of either (i) the expected trended yield in the forthcoming crop season or (ii) the historical area average yield. For the purposes of this study, the insured yield has been established as a percentage of the Upazila most recent five-year average yield from 2003–04 to 2007–08. The insured yields under the Indian NAIS scheme in India are defined as a percentage of the three-year to five-year average yield depending on the crop.

4.38. The insured yield coverage levels for Boro HYV paddy and Aman HYV paddy in all the Upazilas of Bogra, Dinajpur, and Pabna Districts vary according to the crop and Upazila. For Aman paddy the Upazila five-year average yields are 907 kg/acre in Bogra; 912 kg/acre in Dinajpur; and slightly higher at 1,044 kg/acre in Pabna. Yields are very uniform across Upazilas with coefficients of variation of 12 percent, 10 percent, and 7 percent respectively, in Bogra, Dinajpur, and Pabna. Boro HYV paddy yields are considerably higher with five-year Upazila average yields of 1,407 kg/acre in Bogra, 1,498 kg/acre in Dinajpur, and 1,571 kg/acre in Pabna. Full details of the five-year average yields for Aman HYV and Boro HYV in all Upazilas in Bogra, Dinajpur, and Pabna as well as 50 percent to 90 percent insured yield coverage levels for these crops are presented in annex 7.

4.39. Under an area-yield index insurance program, farmers can either be offered optional coverage levels or a single coverage level. In the United States individual farmers may elect to insure their crops at between 50 percent and 90 percent of the published county average yield. Those electing a high level of protection (e.g., 80 percent or 90 percent yield coverage) pay a correspondingly higher premium rate than a farmer who elects a low coverage level of 50 percent or 60 percent. In India, three insured yield coverage levels are considered—60 percent, 80 percent, and 90 percent of the three- to five-year average yield—and the coverage level is fixed according to the degree of yield variation for each crop in each insured unit. As such, a single coverage level is offered in each IU and individual farmers in an IU do not have any choice in the coverage level they receive.

Area-Yield Index Indicative Technical Rates

4.40. The CRAMU-generated indicative technical rates for Aman HYV and Boro HYV in all Upazilas in Bogra, Dinajpur, and Pabna at coverage levels of 50 percent up to 90 percent of trended yield are presented in annex 7 along with full details of the rating methodology.

4.41. **Indicative Upazila average technical rates for Aman HYV and Boro HYV** have been computed. See figure 4.1 and table 4.3. Indicative Upazila technical rates for Aman HYV paddy are the highest in Dinajpur, with a range from 1.2 percent at 50 percent coverage level rising to

8.3 percent at the maximum 90 percent coverage level. Aman HYV paddy production and yields are relatively more stable in Pabna and especially in Bogra, as reflected by the lower indicative average technical rates in these Districts, which range from 0.69 percent to 6.3 percent in Pabna and range from 0.3 percent to 5.0 percent in Bogra. Conversely, for Boro HYV paddy the highest indicative average Upazila technical rates are in Pabna with a range from 0.85 percent (50 percent coverage) to 6.1 percent (90 percent coverage). The most stable Boro HYV yields and lowest indicative technical rates are also in Bogra (with a range of 0.1 percent to 3.0 percent).

4.42. *Indicative Upazila technical rates for Aman HYV paddy are about 25 percent to 33 percent higher than Boro HYV paddy technical rates.* Two reasons explain this. The first reason is that Boro HYV paddy crops are cultivated out of the rainy season, and therefore there is much lower exposure to flood damage. The second is that Boro HYV crops are irrigated; therefore, unless there are problems with water supply, these crops do not face exposure to drought. Bogra District is less risky than Dinajpur and Pabna Districts. Aman HYV average pure loss rates are higher in Dinajpur than in Pabna; Boro HYV paddy crop has higher average pure loss rates in Pabna than in Dinajpur.

4.43. *Indicative technical rates vary significantly for different crops and Upazilas,* as shown in annex 7. There is a need to set insured yield coverage levels based on the exposure to yield loss for each crop in each Upazila and the price (premiums) that farmers can afford.

Figure 4.1. Indicative Average Technical Rates for Paddy Area-Yield Insurance

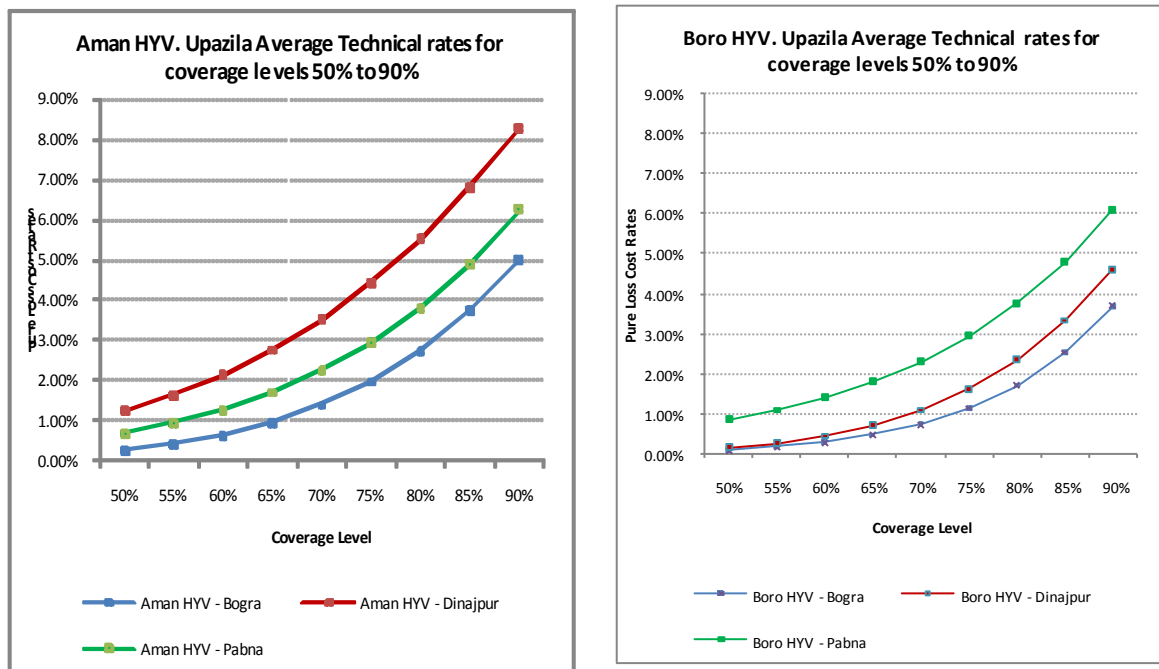


Table 4.3. Paddy, Indicative Average Technical Rates for Coverage Levels from 50 Percent to 90 Percent

Crop – Upazila	Coverage Level								
	50%	55%	60%	65%	70%	75%	80%	85%	90%
Aman HYV – Bogra	0.27%	0.43%	0.66%	0.98%	1.41%	1.99%	2.75%	3.74%	5.04%
Aman HYV – Dinajpur	1.23%	1.63%	2.13%	2.76%	3.52%	4.43%	5.52%	6.81%	8.30%
Aman HYV – Pabna	0.69%	0.94%	1.28%	1.71%	2.25%	2.93%	3.81%	4.90%	6.26%
Boro HYV – Bogra	0.07%	0.14%	0.27%	0.46%	0.73%	1.13%	1.70%	2.52%	3.70%
Boro HYV – Dinajpur	0.13%	0.24%	0.42%	0.69%	1.08%	1.61%	2.34%	3.33%	4.62%
Boro HYV – Pabna	0.85%	1.09%	1.40%	1.80%	2.31%	2.94%	3.75%	4.78%	6.10%

Source: CRAMU model using BBS Upazila yield data.

Indicative Commercial Premium Rates

4.44. In order to derive the indicative commercial premium rate, the indicative technical rates (pure loss cost rate + catastrophe loss factor) must be loaded to take into account the insurers' acquisition costs, administration costs, and a margin for profits. Under the current World Bank agricultural insurance risk study, it was considered too early to start identifying potentially interested insurance companies and to analyze their marketing and acquisition costs, internal administration costs (underwriting, loss assessment, etc.), and their expected profit margins for this type of business. As such this study has not attempted to establish commercial premium rates. However, some indicative commercial premium rates are presented for illustrative purpose under the assumption of a target loss ratio of 70 percent, which implies a loading factor of 1.43 applied to the technical rates (see annex 7).

4.45. In order to achieve affordable commercial premium rates of 3 percent to 5 percent in Aman HYV paddy, the coverage levels in most Upazilas could not exceed 60 percent coverage in Dinajpur; 70 percent coverage in Pabna; and 80 percent coverage in Bogra. The costs (premium rates) of area-yield index insurance can be reduced only by lowering the insured yield coverage level (thereby increasing the area-yield deductible).

4.46. On account of the more stable Boro HYV Paddy yields, indicative commercial premium rates at the maximum 90 percent coverage level are lower, with an average rate of 6.6 percent in Dinajpur and 5.3 percent in Bogra. In Pabna, however, the average Upazila rate for 90 percent coverage in Boro HYV paddy is higher at 8.7 percent and the rates in several Upazilas are between 10 percent and 15 percent for Boro paddy. The analysis shows that to achieve a target commercial premium rate of about 3 percent for Boro HYV paddy, coverage levels in Dinajpur and Bogra should not exceed 80 percent and in Pabna between 50 percent and 70 percent according to Upazila.

4.47. *There is considerable variation in the risk exposures and therefore in the indicative technical rates and indicative commercial premium rates by crop type (Aman and Boro paddy) and between Upazilas in each of the study Districts.* Indicative premium rates are very high for Aman crops at 80 percent to 90 percent coverage levels especially in Dinajpur. This evidence indicates clearly that for the operation of an area-yield index crop insurance program in Bangladesh, premium rates should be calculated separately for each Upazila and that maximum coverage levels which will be offered to farmers should be determined separately in each Upazila according to an affordable premium rate of no more than 5 percent to 7.5 percent for Aman crops and possibly 3 percent to 5 percent for Boro crops. Finally, it is reiterated that the commercial

rates presented in this section are purely illustrative and that all rating decisions and final commercial premium rates will be made by the crop insurer and its lead reinsurer.

Conclusions on Area-Yield Index Insurance

4.48. *Area-yield index insurance is technically feasible in Bangladesh.* The BBS and DAE both have a statistically designed and comprehensive system of annual area-yield measurement through sample crop-cutting experiments (CCEs) which are conducted for the major crops in each District. Area-yield insurance coverage should be offered only for main crops for which CCEs are conducted. Minor crops where yield measurement is based on visual estimation techniques cannot be considered for area-yield index insurance.

4.49. *It is recommended to use the Upazila as the insurance unit.* On the basis of a review of individual CCE yield results for major crops, it appears that cropping systems, technology levels, and yields are sufficiently homogeneous at the Upazila level to adopt this as the IU for an area-yield index crop insurance program. This finding can be confirmed, however, only for Dinajpur, Pabna, and Bogra Districts and their Upazilas.

Weather-Based Index Crop Insurance

4.50. *The history of weather-index insurance for agriculture in developing countries started only as recently as 2003.* There is major international interest in this product, but it has only moved from the pilot scale to more commercial implementation so far in India. In Malawi, after intensive capacity-building work, weather-index insurance is expanding in scope and product type, and has achieved a degree of sustainability due mainly to integration of insurance with supply-chain financing. Many other countries, such as Thailand, Indonesia, Guatemala, Nicaragua, Honduras, Tanzania, Kenya, Ethiopia, and Nepal, are developing or testing this product in feasibility studies and/or pilot programs for agriculture. Further details of international experience are provided in annex 8.

4.51. *Index insurance is a simplified form of insurance, where payments are made based on an index rather than on a measurement of crop loss in the field.* The index is selected to represent, as closely as possible, the crop-yield loss likely to be experienced by the farmer. Insurance payouts are made based on the index measurement without the need to measure crop losses *ex post*.

4.52. *The most common application of weather-index insurance is against drought,* where rainfall measurements are made at reference weather stations during defined periods and insurance payouts are made based on a preestablished scale set out in the insurance policy. The sum insured is normally based on the production costs. To provide effective insurance, the underlying index must be correlated with yield or revenue outcomes for farms across a large geographic area. In addition, the index must satisfy a number of properties including being objective, measurable, transparent, designed with good historical data, and sustainable over time.

4.53. *Weather-index insurance is a relatively new concept, as applied to agriculture.* The origins of weather-index insurance come from the international weather derivative market, where major corporations hedge weather risks. The interest in index insurance applications for agriculture grew from a realization that traditional insurance programs carried major challenges in developing countries, where agricultural sectors are semicommercialized and the average farm size is small. Traditional individual farmer MPCPI programs are considered feasible only for large-

scale farms, where high levels of technology are adopted. Where these MPCl products are offered, a high level of subsidies is required; the resources are often unavailable in developing countries.

4.54. *Index insurance is seen as an attractive approach because of the simplified product concept*, the strength in overcoming many supply-side constraints of MPCl, and the potential to offer insurance coverage for smallholder agriculture more affordably. The main advantage of weather-index insurance is the elimination of adverse selection and moral hazard problems, which are common to MPCl. Since payouts are made based on an objective measurement at the reference weather stations, there are few information asymmetries to be exploited, and behaviors of the insured cannot influence the extent of payouts. In addition, weather-index insurance reduces administration costs for the insurer, which could make premiums more affordable. Indexed products are also likely to facilitate risk transfer to the international reinsurance markets. However, while index insurance offers opportunities for reduced operational costs, the development phase requires intensive technical inputs, and ongoing technical inputs are required to refine products over time.

4.55. *One of the most important challenges for weather-index insurance is basis risk*, which significantly limits the applicability of index instruments. Basis risk is the difference between the payout as measured by the index and the actual loss incurred by the farmer. Because no field loss assessment is made under index insurance, the payout may either be higher or lower than the actual loss of crop suffered by the farmer. Basis risk is lower when the risk is correlated, i.e., affecting the large geographical area relatively at the same extent and simultaneously. The extent of basis risk can be mitigated by careful index design, the installation of new weather stations, and the blending of index insurance with other rural finance products. Other challenges for weather-index insurance include the need for high quality weather data and infrastructure and the currently limited product options, with most applications in developing countries so far concentrating on rainfall.

Box 4.3. Crop-Weather Index Insurance: Advantages and Challenges

ADVANTAGES

Reduced adverse selection

The indemnity is based on widely available information, so there are few informational asymmetries between the insured and the insurer to be exploited. This helps avoid the situation whereby only people with high risk insure.

Reduced moral hazard

The insured has no ability or incentive to influence the claim, since the payout is based on an independent and exogenous weather parameter.

CHALLENGES

Basis risk

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; installation of new weather stations; supplemental products underwritten by private insurers; blending index insurance and rural finance; and offering coverage only for extreme events.

Data availability and modeling accuracy

Despite simpler data requirements, accurate and complete data sets are still required for weather-index insurance. Good agronomic and meteorological data and crop modeling are needed to design good indexes that faithfully capture losses of experienced by the insured.

<p>Lower administrative costs Index insurance does not require underwriting⁵⁸ and inspections of individual farms.</p>	<p>Integrity of weather stations Weather stations used for index insurance must have sufficient security so that they cannot be tampered.</p>
<p>Standardized and transparent structure Weather-index insurance can be structured to have a uniform structure of contracts. The use of meteorological data is also very transparent.</p>	<p>Farmer extension and education Index insurance is a new concept for farmers as well as insurers in many countries. Explaining the product to clients in lower-income countries requires resources and effective campaigns.</p>
<p>Facilitation of reinsurance Index insurance can be used to more easily transfer the risk of widespread correlated agricultural production losses to the international reinsurance markets.</p>	<p>Product options still limited Most experience in developing countries concern rainfall risk.</p>

Source: Authors.

4.56. *Three geographical study areas were selected at the start of the project: Dinajpur, Pabna and Bogra.* The initial activities included the selection of crop and study areas. Rice was proposed as the crop to be insured under the pilot, provided that an appropriate prototype index contract can be designed. Three Districts—Dinajpur, Pabna, and Bogra—were selected as study sites for weather-index insurance due to (i) the large amount of rice farmers; (ii) a preliminary risk assessment based on national-level risk maps which suggested exposure to rainfall-related risk; (iii) the existence of many MFIs providing crop loans; and (iv) the existence of weather stations with historical records, though the adequacy and quality of the data had to be further investigated for the purpose of insurance contract design.

4.57. *Investigating the feasibility of weather-index insurance in the three study areas required several steps.* Weather-index insurance requires that there is a significant correlation between the occurrence of measurable weather events, which become the index, and crop loss. The first step was, therefore, to analyze meteorological and yield data, to determine if correlations exist, and to define them. Second, if and where such correlations could be found, a contract would need to be designed, to allow payouts to be made based on the index measurement which would reflect as accurately as possible the loss of yield caused by the weather event. Finally, that contract could be priced for insurance purposes, using similar principles to those shown for area-yield index insurance in this chapter. Two types of analysis were conducted for this purpose: the indicators-based risk assessment and the water balance analysis.

Indicators-based Analysis

4.58. *Specific weather indicators were investigated for rice production on Dinajpur, Pabna, and Bogra.* Rice yields are a product of each variety's genetic characteristics as well as of the biotic and abiotic stresses of the environment. The selected indicators were designed to capture the potential negative impact of weather-driven stresses on the studied rice varieties ultimately leading to yield loss. During the length of its growing cycle,⁵⁹ the crop undergoes different physiological growth stages. Each of those stages is characterized by specific and distinct sensitivities to climatic variability-induced stresses (annex 6). For instance, the transplanting and reproductive stages stand as acutely sensitive to deficit moisture stress while the grain maturing phenological stage presents higher sensitivity to excess water stress. In order to capture these

⁵⁸ The process by which an insurer evaluates, on an individual basis, the risk and exposures of potential clients in order to determine acceptable risk (eligibility), level of coverage and premium.

⁵⁹ From seedling and transplanting to grain maturing and harvesting

different physiological sensitivities, the available weather data was analyzed using dekadal or weekly time steps to build pertinent indicators. The indicators were built to search for correlations between their captured interannual variability and the rice yield's variations (annex 8) These indicators included the following:

- *Cumulative rainfall*: the aggregation of cumulative decadal precipitations captures potential deficit or excess water stress during the different growth stages.
- *Dry spells*: precipitation deficits during a varying amount of consecutive days can affect the potential reproductive or early vegetative stages in particular. Amounts of deficit rainfall below a given threshold during consecutive days are added over dekads, leading to aggregated deficits as an indicator.
- *Excess rainfall*: excess rainfall can negatively affect yields during rice maturing or at transplanting stage in particular. Similar to the dry spell indicators, excess rainfall over a given threshold during consecutive days is added to give an indicator as an aggregated amount within a given number of dekads (e.g., 1 to 5 dekads).
- *Excess temperature*: The crucial reproductive stage (pollination in particular) is acutely sensitive to consecutive days of exposure to over 35°C temperatures.
- *Groundwater level*: Given the importance of continuous or timely irrigation for Boro and Aman rice, respectively, deficit and excess groundwater levels which could lead to potential irrigation failures were crafted in a way similar to excess and deficit rainfall indicators.
- *Water balance*:⁶⁰ In order to take into account both the rainfall variability and the crop's agronomical environment (soil characteristics, wind speed, radiation, temperature) in a more comprehensive fashion, the Food and Agriculture Organization (FAO)'s Water Requirement Satisfaction Index (WRSI) was used in order to obtain more insight into the crops' real water stress⁶¹ status throughout its growing season (see the WRSI analysis below).

Data

4.59. ***Meteorological and yield data***: Weather and yield historical data sets were gathered in order to analyze the extent and importance of the related Aman and Boro rice production risk. The statistical correlation analysis was performed between the following data sets from the Pabna, Bogra, and Dinajpur Districts: Yield data was obtained from the BBS at a regional level for 39 years (1969–2008) and at Upazila level for 16 years (1992–2007) from the BBS. Weather data were obtained at disaggregated a level as possible and from daily record from the Bangladesh Meteorological Department (BMD) stations, which enabled a detailed data analysis

⁶⁰ A crop's water balance refers to the ratio of its optimal water consumption with its available consumable water.

⁶¹ The water balance is calculated as defined in the FAO's methodology to obtain the Water Requirement Satisfaction Index (WRSI). The WRSI allows determining the level of water stress endured by a crop during its whole growing season. The computation of WRSI reflects the agronomic properties of the studied crop variety by integrating parameters such as the different crop-variety specific "crop coefficients", Kc, locally measured potential evapotranspiration and soil water retention capacity.

to explore correlations with weather data aggregated at many time steps. Daily data are important to the analysis in order to relate the weather variability to the crop's growth stages.

4.60. *Data availability and reliability, applicable both to the weather data and yield data, were a significant constraint to the analysis.* First, a BMD weather station covers the radius of 80km in Dinajpur and 50 km for Bogra and Pabna. Such a sparse network is unlikely to record weather variations at the local level. Second, Regional (Great District) level data also appeared as too aggregated for the nature of the analysis. Driven by the weather pattern at the more local scale, the yield variability signals are blurred within the aggregated records and therefore cannot be captured by the specific weather indicators. Third, Upazila-level yield data were of short duration (16 years) for Aman and Boro, which was a constraint in determining robust statistical correlations between the selected indicators and the yield records.⁶² Furthermore missing data were a serious constraint both at the district and upazila levels for both Dinajpur and Pabna. Even where the District-level data were not missing (in Bogra), inconsistent data meant a high level of rejection. Together, these constraints related to data density, missing data, and data of inconsistent quality at the local level meant that the ability to find correlations between the weather indicators and rice yield was severely constrained.

4.61. *To overcome the problem with the low density of BMD stations, additional sources of data were investigated.* The team also used (i) the historical rainfall data collected from the Water Development Board's (WDB's) network of high-density rain gauges (about eight times denser than the BMD's station network); (ii) WDB's groundwater level historical data sets; (iii) the Upazila-level Agricultural Extension Office's yield time series; and (iv) the use of water-balance modeling.

Analysis and results of the Indicator-based Analysis

4.62. *A number of significant indicator-yield correlations were found, but they were scattered and not fully consistent.* Several indicators were tested using the historical weather data series during each of the studied rice variety's growing season windows: April–November for Aman and December–April for Boro rice. These indicators were tested against Great District– and Upazila-level yield-time series in order to search for significant yield-indicator correlations which could serve as the basis of a weather-index insurance contract. The results were markedly contrasted between upazila and Great District yield analysis. (For a more detailed presentation of the results, please refer to annex 8.)

- *At the Great District level,* the analysis yielded no significant results for any of the indicators. The BBS's Great District–level yield records encompass yield records aggregated from two to three Districts. This poses two significant a priori hindrances to find significant responses to weather-driven stresses. First, at such a level of aggregation, local-level yield variations are blurred by the overall pooling of yield data. Second, while the specific weather station's data can only, at most, be considered to be representative of area within the 30 km radius around the station, the Great District yield data embrace an area overreaching the station's coverage area by tens of kilometers.
- *At the Upazila level,* several responses were obtained to various climatic stress indicators. Nevertheless, these responses were scattered within the studied Districts. In particular, responses to deficit-water stress indicators (dry spell indicators) were obtained at the

⁶² The statistical correlation test's robustness is a square root function of the number of the limiting data set's points.

beginning and middle of the growing season—corresponding to the water-stress-sensitive transplanting/seedling and reproductive stages for rain-fed Aman rice in the three studied Districts.

- **Dinajpur:** In the early part of the Aman season, correlations of -71.5 percent, -69.2 percent, -59.7 percent, and -64.5 percent were found between Aman yields and a dry-spell indicator (measuring the rainfall deficit below 30 mm of cumulative rainfall during 10 consecutive days aggregated during 4 dekads from May 12 to June 21), in the Upazilas of Biral, Bochaganj, Khansama, and Nawabganj, respectively (31 percent of the District's Upazilas). In the mid part of the Aman season, correlations of -65.5 percent, -64.4 percent, -58.9 percent, -65.3 percent, -76.7 percent, and -54.1 percent were found between the same dry-spell indicator aggregated during 4 dekads from the June 22 to August 1 in Biral, Chiribandar, Phulbari, Ghoraghat, Hakimpur, and Parbatipur (46.5 percent of Dinajpur Upazilas), respectively. ***These figures reflect the significant negative effect of deficit-rainfall stress in almost half the Upazilas on local variety and HYV Aman rice yields.***
- **Pabna:** While only Ishwardi and Pabna Sadar (22 percent of the District's Upazilas) HYV Aman yield records showed significant correlations with dry-spell indicators (during the period August 21–October 15), Bera, Ishwardi, and Sujanagar showed significant correlations with dry-spell indicators (over a longer period of June 22–December 31): respectively -52.1 percent, -61.9 percent, and -54.2 percent (33 percent of the District's Upazilas). As in Dinajpur, the statistically significant correlations depict the importance of deficit rainfall as a driver impinging upon HYV Aman yields in these Upazilas.
- **Bogra:** Limited statistically significant correlations were observed between HYV and local Aman rice yields with dry-spell indicators. On the other hand, several significant positive correlations between aggregated **excess rainfall** indicators between August 23 and October 25 and local Aman yields: 60.5 percent, 60.3 percent, 69.5 percent, and 65.9 percent in Gabtali, Kahaloo, Nandigram and Sariakandi, respectively (33 percent of the District's Upazilas). These figures reflect the positive and beneficial effect of rainfall above a certain threshold for local Aman yield formation in the cited Upazilas.

4.63. Table 4.4 below summarizes the main findings of the indicator-based risk analysis carried out by showing the percentage of Upazilas in each District where Aman or Boro yield show statistically significant correlations with the different weather-risk indicators. For additional detail and the results concerning ground water and temperature based indicators, please refer to annex 8.

Table 4.4. Summary of the correlation results between the major rainfall-based indicators and the Aman and Boro Upazilla level yield records in the three studied Districts

	Dinajpur			Pabna				Bogra		
	Aman		Boro	Aman		Boro		Aman		Boro
	local	HYV	local	local	HYV	local	HYV	local	HYV	local
cumulative rainfall	7.7%	15.4%	7.7%	11.1%	22.2%	11.1%	33.3%	8.3%	0.0%	8.3%
dry spell	30.8%	46.2%	46.2%	33.3%	22.2%	0.0%	0.0%	8.3%	16.7%	0.0%
excess rainfall	7.7%	0.0%	0.0%	11.1%	22.2%	11.1%	22.2%	50.0%	8.3%	41.7%

Source: Authors

WRSI Analysis and Results

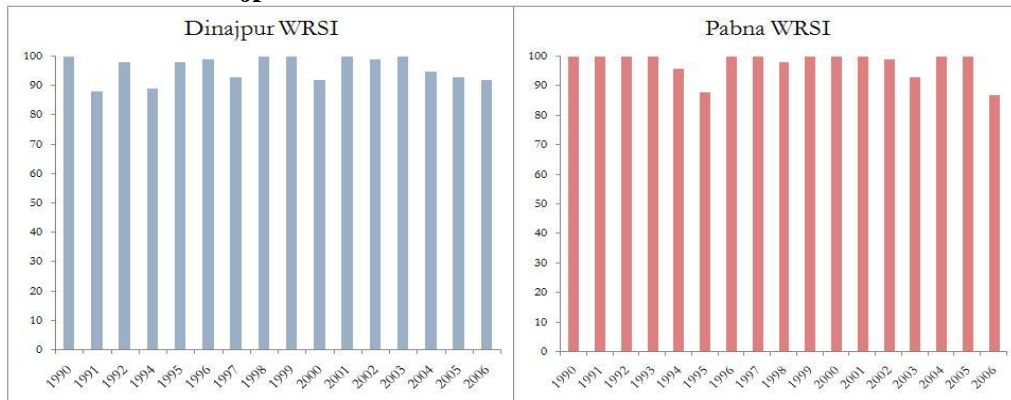
4.64. *The Water Requirement Satisfaction Index (WRSI) is a measure of the water balance and water stress.*⁶³ While the above indicator-based analysis was based on mono-dimensional indicators, this water stress indicator captures more environmental parameters, principally soil physical characteristics, crop physiological parameters, sunshine, temperature, and wind speed. (annex 8). As a result, WRSI results can demonstrate a more comprehensive view of the water-deficit stress expected to be experienced by the crop each year, as a result of the rainfall patterns in past years, during its whole growing season. This indicator, at a District-scale of analysis, reveals a useful and complementary understanding of the rainfall-driven water stress when compared to the Upazila level rainfall indicators' assessment.

4.65. The analysis of WRSI time series (figure 4.2) suggests that in Dinajpur and Pabna, the two drought-prone areas, water requirements are in most years adequately met for the Aman rice cultivation; 96 percent and 98 percent of the water volume required are met in these Districts, respectively.⁶⁴

⁶³ The water balance is calculated as defined in the FAO's methodology to obtain the Water Requirement Satisfaction Index (WRSI). The WRSI allows the determination of the level of water stress endured by a crop during its whole growing season. The computation of WRSI reflects the agronomic properties of the studied crop variety by integrating parameters such as the different crop-variety specific "crop coefficients", Kc, locally measured potential evapotranspiration and soil water retention capacity.

⁶⁴ With standard deviations of 4.6 percent and 4.8 percent respectively

Figure 4.2. Bangladesh: Water Requirement Satisfaction Index Interannual Variation for Aman Rice in Dinajpur and Pabna



Source: National Meteorological Service.

4.66. *The WRSI results have to be interpreted carefully back-to-back to the analysis based on individual climatic stress indicators discussed earlier.* While the rainfall-driven production risk (measured with the different rainfall-based indicators) is existent and heterogeneously distributed within each of the studied Districts, the WRSI results suggest only a limited annual variation in the water stress for the rice crop at the District-wide scale. This may reflect the fact that the overall environmental conditions during the Aman growing season are generally sufficient to meet the crop's physiological needs. So even in years of rainfall deficit, water stress for the plant is low and thereby may have only a limited impact on yields. However, given that there is evidence that water deficits do impact yield, the WRSI theoretical model has to be interpreted with caution. But for the purpose of this study, both the results of the indicators-based analysis and the WRSI analysis converge toward a single conclusion: although existent, the weather risk for rice production in the three study areas is not homogeneously distributed within the analyzed Districts. From the perspective of a weather-index insurance scheme, this poses the problem of a potential widespread basis risk if a weather index is constructed.

Conclusions on the Feasibility Assessment for Crop-Weather Index Insurance Products

4.67. *The study did not find indicator-yield correlations at a systemic (District-wide) level in the three study areas.* Dinajpur, Pabna, and Bogra Districts are situated in the drought-prone areas of Bangladesh. Both the national-level yield assessment as well as the analysis of the yield-rainfall relationships during this study demonstrated that the rainfall variability plays a key role in the rice-yield variability. But for the purpose of designing a simple rainfall-index insurance product applicable to a whole District, the present study did not find indicator-yield correlations at a systemic (District-wide) level in the three study areas. The scattered nature of these results does not demonstrate a clear signal of the existence of a spatially correlated or systemic weather risk within and across those Districts. The pattern of such is more localized.

4.68. *However, it is recognized that some statistically significant and agronomically sound correlations were found for Aman* between deficit and excess-water stress indicators at some individual Upazilas in each of the three Districts. In particular, in Dinajpur, dry spells during early and middle parts of the season had an effect on Aman yields, and in Pabna, dry spells over a longer window were important, but in Bogra there were fewer correlations. These correlations might indicate a potential for the rainfall-index approach to capture serious drought years for these Districts. On the other hand, the WRSI results indicate that, water stress may not be a

universal production risk, and that the weather-driven HYV Aman production risk may not be homogeneously distributed within the studied Districts. The presence of heterogeneous risk distribution raises the issue of potential basis risk in the perspective of a weather-index insurance scheme. These findings merit further research. In the case of Boro, there is limited risk from rainfall deficits in Pabna and Bogra, as the crop is reliant on irrigation or stored water resources. However Dinajpur-grown Boro rice shows limited vulnerability to water shortage. Above average rainfall falling during the Boro season can have a positive impact on yields.

4.69. ***The data constraints discussed above play a key role in the inconclusive nature of the findings.*** It became evident in the course of the study that the results from the Great District historical yield-data series are shown not to be useful to the interpretation of weather risk on yield for the purpose of contract design, given the large area (covering two to three Districts) from which the data were aggregated. Also important was the distances of the area from the meteorological stations, a fact which became clear during the field visits.

4.70. Compounding the data issues were the complex risk-management practices which are prevalent and seem to be effective in mitigating against the rainfall risk in the study areas. During the field visits, the interviews with farmers highlighted the importance of these mitigation practices. Boro rice cultivation is generally safeguarded from water stress due to irrigation. Even for a more weather-sensitive crop like the rain-fed Aman paddy, potential drought stresses are also overcome by other risk-management measures. These measures include (i) the use of Boro rice's remaining irrigation water during the Aman sowing window in case of delayed monsoon onset and (ii) the pumping of ground water into the field during an early monsoon withdrawal. The existence of such risk-management strategies enables farmers to cope well with rainfall-related risks, thus not perceiving deficit or excess rainfall stresses as a key production risk both for Aman and Boro. These practices, consequently, contribute to the blurring of any yield signal that could be captured by indicators based on weather variability.

4.71. ***This situation in three studied Districts is quite different from other countries where weather-index insurance is applied to arid or semi-arid areas without access to any form of irrigation.*** In the environment of farming systems and rural water management as complex as in Bangladesh, determining the value of a weather-index insurance product requires an elevated level of intensive research work which is by nature linked to the need for intense data and meteorological infrastructure. This situation merits a further discussion on whether the required technical work in turn diminishes the attractiveness and the costs and benefits of trying to develop and maintain this product.

4.72. ***The applicability of rainfall-index insurance products, at this stage of the analysis, appears as a potential risk-management solution for Aman, in particular for the risk of dry spells in Pabna and Dinajpur.*** While index insurance remains technically feasible, the findings of the present work are also that the local risk situation is extremely complicated by supplementary irrigation and complex risk-management practices, leading to challenges in product design.

4.73. However, opportunities for additional research exist, and further analysis could bring more certainty to the weather-risk assessment conducted in the three areas under this study. The most straightforward way to strengthen the analysis would be to assess the weather indicators with longer (ideally 25 years or more) Upazila-level yield records. A District-level analysis is not likely to add more value to the analysis given (i) the risk-pooling effect of aggregated yield records and (ii) the overall levels of rainfall, which are enough, as depicted by WRSI, for rain-fed

rice farming. Finally, further rice growth modeling using mechanistic crop models⁶⁵ would allow one to carry out a more in-depth analysis of the main drivers of rice-yield variability. Undoubtedly, the installation of more automatic weather stations in these areas would enable better understanding of localized variability in weather patterns.

4.74. ***Other regions in Bangladesh could be targeted for further study of weather-index insurance feasibility*** For instance, as exposed in the national rainfall-indicator-based production risk assessment, the western Districts of Nawabganj, Rashahi, and Naogaon (classified as “severe” drought prone by BARC during the pre-Kharif and Kharif periods) could be studied.

4.75. ***Development of a prototype weather-index contract for rice in the study areas has not been possible based on the results of the analysis at this stage.*** But for the purpose of illustrating a rainfall-indexed insurance contract, the three-phase contract developed for crops grown in rain-fed, nonirrigated agriculture in other regions of the world (where there is a strong and systemic correlation between rainfall and yield) is shown in annex 8. Currently, it is not possible to state whether the three-phase model is the most suitable for Bangladesh. But even where other than three-phase contracts are chosen, the general principles described in annex 8 on setting up contract parameters such as triggers, exits, payout rates, and maximum payouts still apply.

Livestock Insurance

4.76. This section reviews the types of livestock-insurance product available and the international experience with livestock insurance in selected countries, especially smallholder community-based livestock insurance in India and Nepal, which may be of interest to livestock insurance planners in Bangladesh. This section also draws some conclusions and recommendations for livestock-insurance product development in Bangladesh.

Types of Livestock-Insurance Product Available Internationally

4.77. Livestock insurance is internationally available for cattle and buffalo, sheep and goats, pigs, horses, and poultry. In addition there exist aquaculture insurance and even bee insurance. The types of livestock-insurance product available include traditional individual animal accident and mortality cover through to epidemic disease cover and new livestock-index products, including an innovative commercial livestock mortality-index program in Mongolia and applications of satellite imagery/NDVI to indexes of pasture-grazing livestock, which are being offered to livestock producers in several territories (box 4.4.).

4.78. ***Named-peril accident and mortality insurance is commonly offered for individual animals and cover is available in many territories,*** albeit on a much smaller scale than for crop insurance. For individual animal cover, the sum insured is usually based on the market value of the animal according to its age, breed, and use, and in the event of loss the insured is responsible for a co-insurance of between 10 percent and 20 percent of the value of the claim. The drawback of individual animal insurance is that it is exposed to first loss and in many countries rates for individual animal insurance are between 5 percent and 10 percent of the sum insured.

⁶⁵ Such as DSSAT’s CERES model

4.79. *All-risk livestock mortality insurance, including diseases, is available in only a few countries.* It is usually provided only to larger commercial farms which can demonstrate high levels of animal sanitation and disease prevention and control.

4.80. *The insurance market for livestock epidemic disease cover and livestock business interruption cover is extremely restricted,* and terms and conditions are usually determined by a small group of specialist international reinsurers of this catastrophe reinsurance class of business. Germany has one of the most developed markets for livestock epidemic disease cover in dairy cattle, and China is rapidly developing epidemic disease covers for swine and dairy cattle.

4.81. *Aquaculture insurance, including offshore marine and onshore freshwater aquaculture insurance for fish stock, crustaceans, and shellfish,* is a specialist class of livestock insurance, and the largest markets for offshore marine aquaculture insurance include Canada, Chile, and Norway (mainly sea salmon and sea trout). In South Asia there are also expanding aquaculture insurance markets in territories such as China (mainly onshore) and South Korea (offshore and onshore) and India (mainly onshore).

Box 4.4. Types of Traditional and Index-based Livestock Insurance Products

Traditional Livestock Insurance

Named-peril accident and mortality insurance for individual animals is the basic traditional product for insuring livestock and is widely available. The cover includes death against natural perils such as fire, flood, lightning, and electrocution but normally excludes diseases and specifically epidemic diseases. Premiums are set based on normal mortality rates within the permitted age range, plus risk and administrative margins, and are generally quite expensive. Further, as mortality is, to a considerable extent, influenced by management, the product suffers from adverse selection by the highest risk farmers.

Herd insurance is a variation on individual animal mortality cover for larger herds. A deductible is introduced, mandating that a certain number of animals, or a percentage of the animals, must be lost before an indemnity is paid.

All-risk mortality insurance including diseases. In some countries, all-risk accident and mortality insurance, including coverage for diseases, is provided to large commercial farms which can demonstrate high levels of animal husbandry and control over animal diseases. Such covers are normally offered for high value bloodstock or for herd insurances (as in Germany, Czech Republic, and Hungary).

Epidemic disease insurance is offered in only a few countries, most notably Germany and Italy. Insurance of government-ordered slaughter or quarantine is normally excluded. Epidemic disease insurance carries major and infrequent catastrophic claim exposures necessitating a high reliance on reinsurance for risk transfer. Due to the difficulties of modeling epidemic disease spread and financial exposures, it is difficult to develop this type of insurance and to obtain support from international reinsurers.

Index-livestock insurance

Index insurance for livestock has been applied for mortality risk in Mongolia, where there is a high correlation of livestock losses with an indexable extreme weather parameter (i.e., low temperature), and applications of satellite imagery/NDVI indexes for some pasture and rangeland products in Canada, the United States, and Spain.

Source: World Bank 2009b.⁶⁶

Reinsurance Restrictions on Epidemic Disease Cover in Livestock

⁶⁶ Mahul O. & Stutley C.J. (2009). "Public Intervention in Agricultural Insurance: Challenges and Options for Developing Countries" (draft final), World Bank. Washington D.C, December 2009

4.82. *The past and current livestock insurance schemes offered through SBC and the NGOs/MFIs insure against mortality due to epidemic diseases*, subject to the animal having a valid certificate of vaccination against the specific disease. To date none of these livestock insurance schemes have carried any form of reinsurance protection and could incur major losses in the event of a catastrophic disease outbreak. Section 3 of the report indicated that Bangladesh experiences regular outbreaks of: (i) FMD, a Class A highly infectious disease of cattle, swine, sheep, and goats; (ii) PPR, which affects sheep and goats; and (iii) sheep and goat pox. In the past, outbreaks of contagious bovine pleuropneumonia and Rinderpest have also occurred. (See annex 9 for list Class A Highly Contagious Diseases as defined by the OIE).

4.83. *The international reinsurance market for livestock diseases is very restricted*. Typically reinsurers exclude (i) all Class A epidemic diseases; (ii) consequential losses (e.g., loss of income from sales of milk or eggs), (iii) Government Slaughter order, and (iv) legal liability. A precondition for offering livestock epidemic-disease insurance in any country is the existence of a national disease prevention, disease detection and reporting, and disease control system operated through the government and private animal health services.

4.84. *Bangladesh does not have an adequately funded or staffed veterinary service either to prevent or to control epidemic disease outbreaks* in large ruminants, although it is understood that progress has been made with Newcastle disease prevention in poultry. On this basis it is highly unlikely that international reinsurers would be willing to reinsure epidemic diseases in livestock under the start-up of any new formal livestock insurance program in Bangladesh.

International Experience with Livestock Insurance

4.85. *A recent World Bank study of agricultural insurance provision in over 70 developed and developing countries showed that some form of livestock insurance was available in 82 percent of these countries*, with the largest five livestock insurance markets according to 2007 premium income being Japan, Spain, China, Iran, and Germany. Other important livestock insurance markets included South Korea, Czech Republic, and Mexico. Aquaculture insurance was available in nearly one-third of the surveyed countries and in as many as 42 percent of the Asian countries.⁶⁷

4.86. *In most of the developed livestock-insurance markets, livestock insurance is targeted at medium to large-scale commercial livestock enterprises*, and there are very few successful livestock insurance schemes specifically designed for resource-poor farmers in developing countries such as Bangladesh. These farmers typically own one or two head of cattle, a few sheep or goats, and a small number of poultry.

4.87. *The most relevant livestock- insurance schemes to Bangladesh are the community-based livestock insurance programs in India and Nepal*, which are specifically designed for small-scale livestock breeders and which are implemented with the active participation of the local community.

4.88. *India has operated a community-based livestock mortality insurance scheme for small-scale dairy cattle producers in Andhra Pradesh state since 2005, and this program contains many organizational and operational features which are relevant to Bangladesh*. The scheme

⁶⁷ Mahul O.& Stutley C.J. (2009). *ibid*

is targeted at women dairy livestock producers and is designed to protect the loans they take out to invest in dairy cattle. The scheme was conceived in 2005 on the principles of self-help groups, and it is a mutual insurance scheme administered by community development organizations at village, block, and District levels. The policy is voluntary and protects against unintentional causes of mortality (accident, named diseases subject to vaccination, surgical operations and strike, riot and civil commotion) in dairy cattle and includes coverage. It originally carried a 4 percent premium rate that applies to the sum insured, but this rate has been reduced to 3 percent in 2009. Key features of the scheme are presented in annex 9.

4.89. The community-run livestock insurance scheme operated for two full years from 2005–06 to 2006–07 as a self-financed mutual insurance scheme with no reinsurance protection and incurred an overall loss ratio of 50 percent. As the scheme was totally administered by the community, administration costs were kept to an absolute minimum—only 6 percent of premium.

4.90. On the basis of the success of the scheme, at the 2007–08 renewal Tata AIG Insurance Company Ltd has entered into a three-year insurance agreement with the scheme administrators with a premium rate of 2.0 percent. Under this insurance agreement Tata AIG issued a master policy to the self-help groups and District-level administration (Zila Samakhya, ZS) on receipt of a deposit premium. The company receives a schedule of each cow which is purchased with a bank loan and which is insured under the scheme and periodically receives a premium adjustment. On receipt of claims notifications, the company settles losses. The community organization continues to be wholly responsible for implementing the scheme in terms of identification of suitable dairy cows for beneficiaries, organizing bank loans to purchase the animal, tagging of the animal and vaccination, premium collection and payment to Tata AIG, submission of schedules of insured animals, and in the event of loss, inspection of the dead animal to verify the cause of loss is insured and notification of the claim to Tata AIG for settlement.

4.91. The livestock insurance scheme has now operated for three full years and is being scaled-up. On the basis of the success of the AP model the scheme is now being replicated in other states in India and also in South Asia with financial assistance from the World Bank. In 2007–08 more than 25,000 head of cattle were insured: the objective is by 2010 to achieve an insurance coverage of between 3 million to 5 million head of cattle.

4.92. This community-based livestock insurance model might have applications in Bangladesh where the NGOs/MFIs have already developed the necessary insurance infrastructure to implement and administer livestock mortality insurance and where their main requirement now is to access formal insurance and reinsurance protection.

4.93. *Nepal is operating several smallholder livestock insurance schemes linked to livestock investment loans*, including livestock insurance under the Community Livestock Development Program (CLDP), which is funded by the Asian Development Bank (ADB) and which is implemented by the Department of Livestock (DoLS) with technical support from FAO.

4.94. Under the CLDP there are two different models of a livestock insurance program: (i) the Community-Managed Insurance Scheme, which is provided for dairy animals and also for goats, and (b) the Cooperative Managed Insurance Scheme. The livestock insurance policy provides all-risks mortality and loss of use cover and is closely linked to livestock credit. Key features of the program are presented in annex 9.

4.95. The CLDP program in Nepal represents a mutual livestock insurance program which is managed by the community for its members, and group cohesion ensures that the insured animals

are closely monitored and managed and that mortality rates and insurance claims rates are minimized. The major issues faced by this program are that it is not formally recognized as an insurance program by insurance legislation and at present cannot attract excess-of-loss protection from local insurance companies and/or international reinsurers. These are the same issues faced by the NGO/MFI livestock insurance initiatives in Bangladesh.

4.96. ***Two types of policies are usually offered under aquaculture insurance:*** (i) named-peril coverage, which tends to be restricted to natural perils such as storm, tidal wave, and flooding resulting in the death of the fish stock; and (ii) all-risks coverage, which includes diseases of the fish stock, algae bloom, theft, machinery breakdown, etc. The policies commonly include cover against loss or death of the fish stock and physical damage to the fish ponds, fish cages (nets), infrastructure, and machinery. All-risk cover can be offered only with high rates and/or high event deductibles: the all-risks aquaculture policies typically carry per event deductibles of between 10 percent and 30 percent of the total sum insured per fish cage, and premium rates vary between 3 percent and 10 percent according to the location, management, and technology levels of the insured risk and species of insured fish. (See annex 10 for further details).

4.97. The market for shrimp insurance is very much more restricted than for fish species and is mainly restricted to large intensive commercial shrimp farms. The major issues for shrimp insurance are the following: (i) shrimp production and yields are highly influenced by technology levels and management factors, especially relating to the feeding regime and disease control, and as such it is very exposed to moral hazard; (ii) once the shrimp larvae have been sown in the ponds it is very difficult for the insurer objectively to monitor growth and productivity levels and causes of loss—indeed, normal mortality rates are extremely high in shrimp and may account for two-thirds of all the sown larvae; and finally (iii) loss adjustment can usually be conducted only at harvest time when actual harvested yield can be compared with a pre-agreed insured yield and any yield shortfall indemnified; as such it is very difficult to indemnify partial loss events.

4.98. Mexico has operated shrimp insurance for a number of years and features of the Mexican policy may have applications to Bangladesh. The Mexican policy provides comprehensive protection against loss of biomass due to climatic risks, biological risks (diseases), and environmental contamination/chemical pollution-related risks. Specific exclusions include robbery, negligence by the insured or its employees, and machinery and equipment breakdown. The policy carries very high premium rates of between 10 percent and 12 percent according to location, which is a reflection of the high exposure to natural and disease-related losses. The policy carries a qualifying franchise of 5 percent of the total sum insured of the insured shrimp farm followed by a co-insurance of 10 percent of the loss with a minimum dollar deductible. This is in contrast to the former SBC shrimp mortality policy, which did not carry a deductible but did include co-insurance. Further details of the Mexican shrimp policy are contained in annex 10.

Key Issues and Recommendations for Livestock Insurance Cover in Bangladesh

4.99. ***The review has shown that there are several drawbacks of the current livestock-credit insurance policies offered by the NGOs/MFIs.*** the products do not meet the needs of many livestock producers as the sum insured covers only the amount of outstanding loan, and furthermore, cover is terminated once the loan is repaid. On the other hand, the policies provide very comprehensive mortality protection including cover against class A epidemic diseases. None of the programs are currently reinsured, and they are very exposed to catastrophic disease losses. However, it is unlikely that the current schemes would attract insurance and reinsurance support from local insurers and international reinsurers if they continue to provide unrestricted epidemic disease cover.

4.100. On the basis of this review it is recommended that the NGOs/MFIs may wish to consider the following strengthening and improvements to their dairy-cattle livestock insurance programs:

- There is a need to introduce a simplified and standard livestock accident and mortality policy for cattle and buffalos, which specifically excludes all Class A and B contagious diseases.
- The standard livestock policy should clearly state the range of insured perils. The insured perils should include natural perils such as fire, flood, landslide, fire, and accidental injury or death.
- A technical review of the premium rates should be conducted.
- If the NGO/MFI livestock insurance programs are to attract pooled reinsurance protection in the future it will be necessary to introduce standard policy wording(s) across all the NGOs/MFIs and to agree to standard rates and discounts and uniform risk acceptance, loss notification, and loss assessment procedures.
- While most small farmers with fewer than three to five head of cattle or buffalo will probably continue to purchase individual animal insurance, options for larger livestock owners should be considered, including herd cover with explicit first-loss deductibles accompanied by rate discounts.
- Currently, very few cattle are insured under the NGO/MFI programs, and ways of scaling-up livestock insurance demand and supply need to be considered.
- It is recommended that if sufficient demand for livestock-epidemic-disease cover exists, it should be offered only as a separate policy and should be considered only in a second phase, once experience has been gained with standard livestock mortality insurance.

4.101. ***Sheep and goat insurance is very challenging in Bangladesh due to the small size of holdings.*** Sheep and goats are very important for the very poor rural households in Bangladesh, but individual size of holdings are small, with an average of only 2.6 animals per HH. This poses major challenges for insurance. From an insurance viewpoint, it is considerably more difficult to operate an individual animal mortality insurance program for sheep and goats rather than for dairy cattle because (i) animal husbandry, sanitation (e.g., vaccination levels), and management levels are usually much lower for sheep and goats, with a correspondingly higher exposure to accident and mortality, and (ii) the average sum insured value of the animal is low and thus the premium generated from each insured sheep or goat is very low, often making it uneconomical to provide insurance cover because administration and operating overheads exceed the premiums. If livestock insurance is to be developed for sheep and goats, it will be necessary to design low-cost administrative procedures for enrolling and tagging animals and for premium collection, loss notification, and settlement of claims. The most obvious low-cost delivery channel would be to market cover through the NGOs/MFIs.

4.102. ***Poultry insurance also poses a major challenge in Bangladesh,*** because of the small number of birds (about 10) owned by the average HH and the very low levels of husbandry and management of these birds. It would not be economical to design an insurance scheme for small-scale HH poultry operations. While there may be some potential to develop poultry insurance for the large-scale commercial poultry sector, the scope of cover requested by these producers is likely to include disease protection (e.g., against Newcastle disease and even avian influenza), and this poses major challenges for insurers. It is recommended that poultry insurance should be

considered only in a second phase, once livestock insurance for cattle has been well established and implemented on a commercial basis.

4.103. ***Key challenges for the provision of shrimp insurance in Bangladesh include the very small average size of farms and their low technology levels.*** Ninety percent of shrimp production is under low-management extensive production systems, and only 10 percent is classified as improved extensive. Regarding the introduction of any new pilot shrimp insurance scheme the following conclusions and recommendations are made:

1. Shrimp production in Bangladesh is located in the southern coastal regions and is highly exposed to tropical cyclone, flood, and diseases. The frequency and severity of such events may mean that in many areas it is difficult to design an economically feasible shrimp farm insurance product.
2. Most shrimp are produced under low-management extensive production systems and many farms probably do not meet the minimum technical and sanitary standards required by insurers. Shrimp insurance is probably suitable only for a subset of the improved extensive and semi-intensive shrimp farms.
3. If GoB decides to promote shrimp-farming insurance, the implementation of the program should be carefully targeted at selected farmers who can demonstrate: that they (i) have sufficient scale to be suitable for insurance and (ii) they are applying shrimp management and health care practices according to the best practices in the industry .
4. The insurance should be limited, at its first stage, to cover input cost and losses due to natural perils (for example, storm, flood, and tidal surge). Coverage against additional perils such as pollution or diseases should be analyzed in detail prior to making any decision to offer these perils.
5. Any shrimp insurance policy should carry a suitably high deductible to ensure that only catastrophe losses are indemnified.
6. If GoB decides to promote shrimp insurance, it will be necessary to begin by providing capacity building to the local insurers and to bringing in international consultants with experience in shrimp insurance to provide technical assistance in the design and rating of suitable shrimp insurance products for Bangladesh.
7. Linkages with credit provided by the NGOs/MFIs and development banks (e.g., BKK) should be considered if shrimp insurance is to be scaled-up.

Chapter 5: Operational Issues for Agricultural Insurance

Introduction

5.1. This chapter aims to identify the key administration and operational (A&O) requirements and procedures for agricultural crop and livestock insurance. The first part briefly reviews the A&O requirements for traditional crop-hail and area-based-yield crop insurance. This is followed by a review of A&O requirements for crop-weather index insurance. The final section deals briefly with livestock insurance operating requirements and procedures.

5.2. Chapter 2 noted that private commercial insurers in Bangladesh have no previous experience with implementing agricultural insurance and currently do not have a rural network with which to distribute, underwrite, and manage smallholder crop and livestock insurance in a cost-effective manner. Conversely the NGO/MFI network is extremely well developed in Bangladesh and currently provides credit and savings products and in some cases microinsurance products and services to over 30 million households. As such there appears to be a considerable potential to develop crop and livestock insurance under (i) a conventional partner-agent model whereby insurance companies authorize the NGOs/MFIs to market their insurance products and policies to the MFI members and the MFIs collect premiums and notify claims on behalf of the insurer(s), and (ii) a provider model in which the NGO/MFI directly underwrites its own microinsurance products, usually linked to microfinance. These insurance delivery models are considered further in this section and in chapter 6.

Traditional Named-Peril Crop Insurance and Area-Yield Index Insurance

Underwriting Requirements

5.3. *The design of crop-hail and area-yield index crop insurance policy wordings for Bangladesh is a specialized task and will probably require external technical assistance.* Specimen crop-hail wordings are available from international hail associations (e.g., Swiss Hail or the US National Crop Hail Association, NCIS) and in the case of area-yield index cover, wordings can be downloaded from the US Risk Management Agency website.⁶⁸

5.4. *Under conventional crop insurance programs, the individual grower is responsible for completing an application form* providing full details of the location, crop(s), and varieties for which insurance is requested. The grower also supplies planting dates, planted area, yield history and required insured yield, basis of valuation and required sum insured, and possibly loss history details, which are then transmitted to the insurance company. On the basis of the supplied information the company decides whether to accept or reject the application for crop insurance. In developed countries the farmer often uses an insurance broker to complete the application forms on his behalf.

5.5. *For smallholder agriculture in Bangladesh, it would not be practical or cost effective to require individual growers to complete and submit application forms to an insurer.* The

⁶⁸ www.rma.usda.gov

alternative would be to transfer this responsibility (under a partner-agent model as illustrated in chapter 6) to the NGOs/MFIs and for them to identify those farmers who wish to purchase insurance, their cropped area, and the required sum insured levels. They would submit a schedule of insurance applicants to the insurer with their own recommendations on risk acceptance or rejection. A further option is to devolve responsibility for risk acceptance to the NGO/MFI under a set of pre-agreed conditions between the insurer and NGO/MFI.

5.6. Once the insurance company has received application(s) for crop insurance, the company has to decide whether a preinspection is required or not. For simple named-peril crop insurance against hail or wind, which are outside the management control of farmers, there is very little need for an insurance company to conduct an in-field preinspection to verify (i) that the crop has been correctly sown/has emerged to produce a normal stand density and (ii) that there are no preexisting conditions (e.g., drought stress and or pest and disease damage), and to confirm the yield potential for that crop. It is therefore standard practice to accept crop-hail applications without any requirement for preinspections.

5.7. Conversely, for individual-grower MPCCI loss-of-yield cover, preinspections are usually a precondition of cover and are necessary to minimize moral hazard and antiselection. Preinspections are very time consuming and expensive for an insurance company to carry out. For these reasons, individual grower MPCCI is not recommended for Bangladesh in the start-up phase on any new crop-insurance initiative.

5.8. *A major advantage of area-yield index insurance is that preinspections are not required*, because the basis of insurance and indemnity is the area yield for the defined insured unit and not the performance of the crop on individual farmer's fields. An individual farmer who elects to purchase area-yield insurance cannot therefore influence the area-yield outcome and moral hazard and antiselection are not an issue for this crop insurance product.

Policy Issuance and Premium Collection

5.9. *The private insurance companies in Bangladesh do not have a network of field agents to deliver cost effectively the policy certificate of insurance* or cover note and wording to individual smallholder crop producers. Nor do they have mechanisms of collecting crop insurance premiums from small farmers. While the principle of any form of insurance is to collect premiums at the time of policy inception, the MFIs experience with microinsurance has shown that many small rural HHs cannot afford to pay premiums up front and the preferred solution is a system of weekly or monthly payments by the insured.

5.10. *There would be major cost advantages for the private insurers to implement their crop insurance programs through the NGOs/MFIs*, under a suitable partner-agent model. Under such an agreement, the following procedures could be adopted:

- The insurer would issue a *master crop insurance policy* to the MFI, which would be responsible for training and educating its members on the terms and conditions of this crop policy.
- A *schedule of insurance* would be issued showing for each farmer the insured crop, area, sum insured, deductible or insured coverage level, and due premium. This schedule could be updated on a regular basis during the season, for example, in the case of crop hail where policy sales could continue during the crop season. In the case of area-yield insurance, all insured's would need to be confirmed prior to the

sowing of the crop or a final sales closing date agreed between the insurer and the MFI.

- Each insured grower would be issued with a *certificate of insurance* stating their insured crop, area, sum insured, deductible or coverage level, and due premium.
- The *MFI would be responsible for paying a deposit premium* to the insurance company at the start of the crop season and for then collecting premium from their individual insured members in accordance with the MFIs' internal protocols. The premium would be adjusted over the season until the full due premium had been paid over by the MFI to the insurer.

Bundled Services (Crop-Credit-Insurance Linkages)

5.11. Chapter 2 showed that to date all crop and livestock insurance through the public-sector insurer SBC, and livestock insurance through the NGOs/MFIs, have been linked in one form or another to seasonal crop credit and livestock investment loans. SBC's insurance covers were linked on a voluntary basis to state bank lending to agriculture, but in the case of the NGOs/MFIs the livestock loans made to their members to purchase dairy cattle appear to be conditional on the producer purchasing livestock mortality insurance—in other words, compulsory credit and insurance services.

5.12. The 2009 World Bank survey of agricultural insurance provision identified that in 11 percent of the surveyed countries public- or private-sector credit to agriculture is protected by compulsory insurance cover. Examples of compulsory crop-credit or livestock-credit insurance schemes in Asia include India, the Philippines, Nepal, and Bangladesh. From an insurer's viewpoint there are major advantages to automatic or compulsory crop-credit insurance: (i) antiselection is reduced, (ii) there is less need for preinspections, (iii) the costs of promoting and marketing the agricultural insurance program are reduced, and (iv) the insurance uptake and spread of risk and premium volume is generally much higher than under a purely voluntary program.

5.13. *Wherever possible agricultural insurance should be demand-led and the ideal situation is for voluntary agreement to be reached by farmers and service providers to bundle input supply, credit and agricultural (crop) insurance.* The bundled approach is much more acceptable to farmers than compulsory linkage of credit provision and insurance and offers a potential win-win situation for all parties. The farmer has timely and easy access to inputs of seeds and fertilizers and credit while the input supplier's and credit provider's financial exposures to climatic-induced crop failure and potential non-repayment is protected.

5.14. *Where agricultural credit and insurance are bundled together 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 in which the lending banks have reduced their interest rates to those producers who agree to purchase drought-index insurance.

5.15. *In the design of any future crop and livestock insurance schemes in Bangladesh the planners will need to consider whether to offer insurance on a purely voluntary basis or to bundle* this as part of a package of services to farmers including input supply and production credit.

5.16. ***International experience suggests the bundling crop insurance with input supply and credit is often a key to the program's success.*** Insurance is only one tool to mitigate the risks of agricultural production, finance, and supply chain relationships. Therefore, other measures and complementary investments are needed to ensure risk is comprehensively managed and the value of insurance realized. In addition, without linking these insurance programs explicitly to finance, such as bundling the insurance with agricultural production loans or inputs, many farmers will lack both the capital to pay the insurance premium and sufficient incentive to use scarce resources on risk management. Placing these products within complementary systems with broader linkages can also facilitate simpler contract design, as other mechanisms can deal more efficiently with the noninsurable risks.

Loss Reporting and Crop Loss Assessment

5.17. Any standard crop insurance policy wording specifies the insured's obligations for notifying the insurer within a specified time period of any event which may give rise to a claim on the policy. Conventionally, initial notification is usually by telephone and then the insured is required to submit a subsequent full written statement on the circumstances and cause of loss and the estimated damage to the insured crop.

5.18. ***Under a smallholder crop insurance scheme for Bangladesh, alternative loss notification and reporting procedures*** may need to be considered because farmers may not have direct telephone access to the insurer and may or not be able to complete and submit claims advices. Under the partner-agent model, preliminary loss inspection and loss notification and reporting functions can be assumed by the NGO/MFI at low cost.

5.19. ***Traditional indemnity-based crop insurance:*** The design and operation of a fair and independent system of loss assessment is essential for the long-term viability of any indemnity-based crop insurance program. There must be adequate field representation, preferably in the form of trained agronomists in a supervisory role, with less-qualified persons carrying out field assessments (Dick 1998).

5.20. ***Crop damage-based loss assessment:*** Different types of programs require different approaches to loss adjustment. Crop-hail loss adjustment is usually relatively simple and can be conducted in-field in the individual growers' insured field shortly after the time of loss and involves a sampling of the percentage damage to the crop using standardized procedures. Similarly, the adjustment of wind storm damage in crops involves simple damage-based procedures. A damage-based indemnity system needs the capability to bring together manpower effectively to enable a quick response to a loss and carry out effective in-field measurement of losses usually within a week to 10 days of the loss.

5.21. In the context of Bangladesh, where the average farm size is less than 1 ha, it will be necessary to design low-cost, crop-hail loss-adjusting systems and procedures. It is anticipated that under a possible partner-agent model, the insurer(s) will assist the NGOs/MFIs to develop standard hail-loss assessment procedural manuals for each crop type and to then provide assistance in training key staff of the MFIs in the application of these loss assessment procedures, following which the MFI would be largely responsible for assessing crop-hail losses under the supervision of the insurer.

5.22. ***Yield-based loss assessment:*** An individual grower yield-based indemnity program requires timely field inspections during the course of the growing season, regardless of requirements in the event of loss. This can be a significant organizational and administrative cost

burden. Depending on the structure of the scheme, estimates of crop data are needed from field inspection of the crop, backed up, where possible, with delivery records from processing plants, wholesalers, or other crop buyers. Under a loss-of-yield policy, losses can be finally adjusted only at the time of harvest, when an estimate of actual yield is made, and where this falls short of the insured yield established at the start of the season the yield difference or amount of loss is indemnified. A major drawback of yield-based loss assessment is that it is practically impossible to isolate and adjust insured causes of yield shortfall or loss from uninsured causes, for example, failure by the insured to carry out adequate weed control or pest and disease control.

5.23. ***Area-yield indexes:*** The procedure for estimating the actual average yield in the insured unit usually involves sample crop cutting and yield measurement in representative plots and locations throughout the IU and to then calculate the average yield. Where the actual area yield falls short of the insured yield, all insured growers in that area receive the same indemnity irrespective of the actual yield performance on their own plots. While this system of yield assessment is much less costly than an individual grower MPCI program, key issues include (i) the need to ensure that the crop cuts are located at random and are not deliberately located in areas of poor crop stands and low yields, (ii) that the crop-cuts are conducted impartially and accurately, and (iii) the sample of crop cuts is sufficiently large to estimate the true mean to a high degree of statistical confidence. In India, where area-yield index insurance has operated since 1980 on a massive scale, a key issue is the delay in processing and publishing the results of crop cutting, which means that losses may be indemnified more than six months after the close of the season. One option to overcome this problem would be to make early payments based on an index (either weather index or satellite index) and to then adjust the final settlement according to the area-yield.

5.24. ***Bangladesh has a well-established system of area-yield estimation through crop cutting,*** conducted by BBS and the DAE of the MoA, and this could provide the basis of indemnity under a future area-yield index insurance program for paddy and other major cereals.

Crop-Weather Index Insurance

5.25. ***Weather-index insurance is an attractive option for insurers wishing to offer a form of agricultural insurance in lower-income countries,*** because it has the potential to address correlated risk affordably and is operationally less challenging than other forms. While use of index-based products for managing risk in the agricultural sector is still in its nascent stages, experience in many developing countries suggests that sustainability and scalability of farmer-level programs are feasible, provided that the product is introduced following a proper risk identification and quantification process and in an environment where technical, operational, and regulatory conditions are met.

5.26. The investigation of weather-index insurance for Bangladesh during this study, while being inconclusive, reveals many challenges related to the rainfall risk quantification for rice production in the studied areas. However, it also highlights opportunities for further research in a subsequent phase, which potentially would include (i) more focus on the rain-fed Aman rice crop (as opposed to the “speculative” Aus and the irrigated Boro); (ii) the feasibility assessment for other rain-fed crops (such as maize and wheat) not covered during the study; (iii) the selection of areas where rainfall risk is predominant and where principal and supplementary irrigation methods are not available; (iv) the design of a contract which combines dry-spell and excess rainfall indexes (as the single coverage for drought might be of limited value to many areas in Bangladesh); and (v) the use of more disaggregated yield data and higher reliance on the synthetic yield data for risk analysis.

5.27. To implement a weather-index scheme in the future, this section briefly reviews some of the key operational issues and recommendations for Bangladesh. Many of the underwriting and claims administration requirements and procedures are the same as those for the crop insurance products discussed earlier. However, there are also prerequisites, procedures, and recommendations which are unique to weather-index insurance. Considerations related to pilot planning and implementation are presented in the annex 8.

Prerequisites for Underwriting Weather-index Insurance

5.28. *While a named-peril policy is suitable for perils that cause measurable and sudden damage (e.g., hail), weather-index insurance requires that hazards have a slow onset and be long acting* (e.g., drought, cumulative excess rainfall, low temperature, etc). The hazard needs to have a high degree of spatial correlation to minimize basis risk. Localized hazards are also not suited to indexation, and would need to be insured by named-peril policies, if feasible.

5.29. *Standing annual field crops where the impact of the hazard is yield loss rather than quality loss are most suitable to indexation*, although there is insufficient experience so far to classify crop types as feasible or infeasible for weather-index insurance. Information or some understanding is needed on the relationship between the hazard and the yield loss to be able to design an appropriate index insurance contract. In the context of Bangladesh, the hazard-yield relationship needs to be analyzed taking into account the low level of technology employed in high-risk areas and the existing risk-mitigation strategies that people have devised to cope with risks.

5.30. *Effective index-based weather insurance contracts require the presence of a dense, secure, and high-quality weather station network.* Nearly all weather contracts are written on data collected from official National Meteorological Service weather stations. Ideally, these are automated stations that report daily to the World Meteorological Organization (WMO) Global Telecommunication System (GTS) and undergo standard WMO-established quality control procedures. The data must adhere to strict quality requirements, including reliable and trustworthy ongoing daily collection and reporting procedures, daily quality control and cleaning, and use of an independent source of data for verification, e.g., GTS weather stations or potential for third party data verification.⁶⁹ The nature of risk covered under an index contract can also imply different requirements for the weather data infrastructure. For example, rainfall requires a denser network of observations than temperature, as the latter is more spatially homogenous. Most rainfall insurance programs underwrite only farmers whose plots are within the 20–25 km. radius of the reference weather station.

5.31. *Also required is a long, cleaned, and internally consistent historical data record to allow for a proper actuarial analysis of the weather risk(s) involved*—ideally, at least 30 years of daily data with less than 3–5 percent missing. The strict nature of these criteria is in part to control for potential moral hazard within an index-based insurance scheme through data tampering.⁷⁰ Yield data and additional information on crop calendar, farmer practices, and the local growing environment and conditions (such as soil characteristics) are also needed for risk identification and index product design

⁶⁹ Erin Bryla and Joanna Syroka 2007. “Developing Index-based Insurance for Agriculture in Developing Countries” *Sustainable Development Innovations Briefs* . Issue 2. March 2007. United Nations.

⁷⁰ Ibid.

5.32. ***The currently sparse network of weather stations in Bangladesh seems to present the most fundamental limitation for a weather-index insurance program in the short run.*** The current density of 35 meteorological stations run by BMD, of which some are GTS stations but all are manual, covers the whole country, which comprises 478 Upazilas and more than 30 cropping patterns. As one Upazila contains approximately 31,000 acres of crop production on average, the current network seems inadequate even for the purpose of risk assessment in many crop-producing areas of the country. Without an improvement of the current BMD infrastructure, a weather-index insurance program in Bangladesh is likely to be very limited in scale if implemented. This is because the ultimate size of any index-based weather insurance program is limited by the density of rainfall stations, preferably automated. The sparse station coverage also raises a concern of high basis risk.

5.33. ***The GoB, with a view to supporting the development of such an insurance program, could assist by accelerating the BMD's plan to upgrade the existing stations and to install new automatic stations.*** The plan is expected to be executed over five years, but it could be accelerated with more dedicated resources from the GoB. In addition, the existing denser manual rain gauges network (two or three gauges per District) maintained by the Bangladesh Water Development Board (BWDB) could be considered for upgrade and automation with the GoB's support. Apart from supporting activities related to disaster-risk management and food-security monitoring, the expanded and improved network of BMD stations and BWDB rain gauges will enable weather-index insurance to be considered in other areas in Bangladesh currently not feasible during this study.

Policy Issuance, Premium Collection, and Program Administration

5.34. ***The same procedures, and major cost advantages, apply to weather-index insurance if the insurance companies in Bangladesh introduce the product through the partner-agent Model.*** As in the case of the area-yield index, preinspections are not required by the insurer for weather-index insurance. The purpose of issuing the master insurance policy, the certificate of Insurance, and the schedule of insurance is the same for weather-index insurance as for other products. However, there are two key distinctions to be noted. For weather-index insurance, the schedule of insurance has to state clearly the reference weather station and a method of back-up measurement. Another distinction is that the schedule does not contain a separate clause on deductibles, because the chosen level of contract triggers serves as inbuilt deductibles within the policy.

5.35. ***To administer a weather-index insurance program, both the insurance company and MFI must pay careful attention to the timing of sales and policy issuance.*** It is a rule of thumb that the sales period should close sometime before the insurance coverage period actually begins and, for weather insurance, before farmers are able to foresee the concerned weather event for the insured period. This grace period between contract purchase and coverage is meant to control adverse selection whereby farmers buy insurance only in bad years. If this occurred, it could lead to the destabilization of the insurance system. And since the sale of index products does not involve individual underwriting, or the process of screening individual prospective policy holders or farms for insurability, the sales timing is critical as it is the only mechanism available to control adverse selection for weather-index insurance.

5.36. ***If a weather-index contract has multiple phases, it is recommended that the insurer require the farmers to buy coverage for all phases of the contract.*** This will prevent a situation whereby farmers realize at the end of phase one that a drought has set in or is imminent, thus prompting them to buy insurance for the remaining phases of the season in order to receive

payouts. For some reasons if the insurer allows farmers to buy coverage for only certain phases of the contract, then the farmers should be required to make such a decision prior to the sale-coverage grace period.

Contract Monitoring and Loss Assessment

5.37. *As in the case of the area-yield index product, there is no loss assessment in the field for weather-index insurance.* Loss assessment is based solely on the measurement of the index at a reference weather station. In case the index has been triggered, all insured farmers around the same station are treated identically. Payouts are made based on a scale agreed *ex ante* as documented in the schedule of insurance. Since payouts for indexed contracts are automatically triggered, the insured farmers receive timely payout, which in many cases is within days. The automatic trigger also minimizes administrative costs for the insurer and the MFI.

5.38. *Contract monitoring by all parties is key to ensuring a transparent loss assessment process.* Contracts are monitored throughout a production season following a “mark-to-market” model which provides ongoing, up-to-date information on any potential payout from the contract. It is important that the insurer develops a contract monitoring sheet which is easily understood and shared with its project partners. The most important party with which to share this is the MFI which could further distribute the information periodically to the insured MFI clients. In some countries, the regulator might wish to see the contract monitoring sheet.

5.39. *The BMD will play a key role in any future implementation of a weather-index insurance program in Bangladesh, especially in relation to contract monitoring and loss assessment.* During the insured crop season, the BMD, under a service provider agreement, will provide the insurance company and the MFI with data from the reference weather station(s) in the insured area(s) on an agreed frequency (usually daily) over the contract coverage period. The current practice of the BMD is for the Climate Division in Dhaka to collect, clean, and centrally archive all the historical and new data from individual weather stations around the country. To support a further weather-index insurance program, a system must be devised for the Climate Division to further provide the data to the insurance company in a timely manner, and/or to improve capacity for weather stations in the field to provide quality data directly to the user. In addition, the rainfall data recorded at the BWDB rain gauges may be useable, but the quality and integrity of the data needs to be analyzed in relation to the international requirements on index insurance.

Livestock Insurance

5.40. This section briefly reviews some of the key operational issues for livestock insurance. Many of the underwriting and claims administration requirements and procedures are the same for livestock and for crop insurance and therefore these procedures do not require repeating.

Livestock Registration, Identification, and Certification Procedures

5.41. For the operation of individual animal livestock insurance the following preconditions apply:

- The need for preinspections of each insured animal by a qualified veterinarian and certification that at the time of registration each animal is in sound health and that its vaccination records are up to date.

- A system of animal identification typically involving ear tagging or branding.
- A monthly or quarterly system of stock control, notification of the insurer of any changes in the number of insured animals, registration of new purchases, and collection additional premium due. (This requirement applies mainly to larger commercial herds, where animals are purchased and sold during the policy period).

5.42. The cost implications can be very high for the insurer of livestock veterinary preinspections, tagging, and registration of the insured animals. Conversely, this report has shown that the NGOs/MFIs which have developed their own livestock veterinary services including Grameen CLDP, Proshika, and BRAC are able to provide vaccination and animal health certification services at less than 2 percent of the sum-insured value of the insured livestock. This evidence provides a strong argument for promoting the role of the NGOs/MFIs under a partner-agent delivery model for livestock insurance and building on their existing livestock services networks. In this case it would be reasonable for the insurer to pay a commission fee to the NGOs/MFIs for their services.

Policy Issuance and Premium Collection

5.43. Under a partner-agent model for livestock insurance, the insurer could again issue a master policy to the NGO/MFI and individual certificates of insurance to each livestock owner and for each insured animal. The MFI would be responsible for paying a deposit premium and for then collecting premiums for its insured members. Premiums would be adjusted on a monthly or quarterly basis according to the updated schedule of insured animals which the MFI would submit to the insurer. As noted in chapter 4, this is the procedure adopted under the Andhra Pradesh community-based livestock insurance program, which is insured by Tata AIG and which operates very successfully.

Livestock Loss Assessment

5.44. Under a conventional full-service delivery model in which the insurance company is responsible for appointing a veterinary inspector to report on each and every accidental injury or death of the animal, the costs of inspecting losses often amount to more than 50 percent of the premium charged.

5.45. Under the proposed partner-agent model the NGOs/MFIs veterinary staff would be responsible for inspecting each claim and for verifying (i) that the tag corresponds to an insured animal and (ii) that the cause of death is due to an insured peril. The veterinary officer would prepare a claims report and recommendations which would be submitted to the insurance company for approval and settlement of the claim either directly to the insured or through the MFI.

Operating Systems and Procedures for Aquaculture (Shrimp) Insurance

5.46. It was outside the scope of this study to visit and report on the organization of the shrimp-farming sector. If shrimp farmers are members of NGOs/MFIs it should be possible to design insurance operating systems and procedures for shrimp farmers along the lines of the partner-agent model outlined above for crops and livestock.

Chapter 6: Institutional and Financial Considerations

6.1. This chapter presents a review of the potential roles that the Government of Bangladesh, the private commercial insurers, and the banking, microfinance, and cooperative sectors might play in the future under a public-private partnership (PPP) for agricultural insurance in Bangladesh.

Public-Private Partnerships in Agricultural Insurance: International Experience

Origins of Agricultural Insurance

6.2. The origins of agricultural insurance can be traced back to France in the 18th century, when groups of livestock farmers came together to form cooperative or mutual livestock insurance companies. Similarly, crop-hail mutual insurers started in many European countries in the 19th century, and these products were transferred by emigrants to the United States, Canada, and Argentina in the late 19th and early 20th centuries. The tendency since then has been for many of the mutuals either to fail because they lacked reinsurance protection against catastrophe losses, or to be replaced by private commercial companies. However, leading examples of mutual insurers that continue to operate today include Austrian Hail, Groupama in France, the National Farmers Union in the UK, and several mutual insurers in the United States, South Africa, and Argentina. In Mexico, the Fondos program for self-insurance groups represents an interesting mutual crop-credit insurance model for small crop and livestock producers and may have applications for Bangladesh.

Rationale for and Types of Government Intervention in Agricultural Insurance

6.3. *The US Federal Crop Insurance Program represents one of the earliest examples of government intervention in the provision of public-sector crop insurance.* Its origin's date to the early 1930s. In the 1980s there was a major expansion of public-sector crop insurance in developing countries including several in Central and Latin America, India, and the Philippines. Most recently, since 2000, governments have increased their intervention in agricultural insurance both in developed markets in the United States and Europe (e.g., subsidized MPCIs in France, and efforts in emerging markets of Poland and Romania) and especially in developing countries (e.g., new subsidized programs in China, South Korea, Brazil, Chile, and Turkey).

6.4. Reasons cited as to why governments should intervene in agricultural insurance often include (i) Poorly developed insurance markets and nonavailability of private-sector agricultural crop and livestock insurance; (ii) financial capacity constraints of private commercial insurers, particularly for systemic risk (drought, flood, epidemic diseases, etc); (iii) high costs of insurance administration; and (iv) inability of farmers to afford agricultural crop and livestock insurance premiums.

6.5. *In 2009, agricultural crop and/or livestock insurance is available in over 100 countries.* Agricultural insurance is most developed in high-income countries in North America, Europe, and Australasia. The programs in the United States and Canada carry very high levels of government financial intervention in the form of premium subsidies and subsidies on the operating and administration costs and reinsurance programs. In Europe 15 of the 27 countries

with agricultural insurance have public-private–supported programs, of which the largest program is the Spanish national agricultural insurance scheme. In the remaining 12 European countries the programs are implemented exclusively by private commercial insurers with no form of government subsidy.

6.6. *In Asian developing countries, public-sector agricultural insurance has a lengthy tradition in India and the Philippines*, and public-private subsidized agricultural insurance is now being heavily promoted by government in China and South Korea. In Latin America many countries introduced public-sector agricultural insurance programs in the 1970s and 1980s, most of which have now been terminated and/or privatized. Today agricultural insurance is found in about 15 Latin American countries. The largest programs are located in Mexico, where the commercial insurers receive a high level of support from government, and in Argentina, which is a private crop-hail insurance market and until recently had received no government subsidies. Agricultural insurance is poorly developed in most of Africa, the main exceptions being Mauritius, Sudan, and Morocco, where the programs operate with government support, and South Africa, which has a well-developed private and mutual company crop-hail and MPCI insurance market with no government intervention.

6.7. Table 6.1 provides a summary of the types of government support in a sample of the major national agricultural (mainly crop) insurance programs from developed and developing countries.

6.8. *Public-sector versus private-sector agricultural insurers*: In the 1970s and 1980s many governments in developing countries created public-sector agricultural insurers to underwrite highly subsidized multiple-peril crop insurance for small-scale farmers. These public-sector programs tended to act as a major disincentive for the entry of private commercial insurers into agricultural insurance. The majority of the public-sector agricultural programs performed very poorly, prompting governments to (i) terminate the programs, (ii) take measures to strengthen and reform the public-sector programs, or (iii) transfer responsibility for implementation to the private insurance sector. It is noticeable that most of the new crop and livestock insurance programs which have been introduced in the past decade have been implemented by private commercial insurers with or without support from government, including those in Chile, Brazil, Colombia, Honduras, Sudan, South Africa, and Turkey.

6.9. In 2009, Canada was the only major high-income country where crop insurance continues to be provided through the provincial government public crop insurers. Conversely, a higher number of developing countries currently have public insurance companies, including India, Philippines, and Brazil (table 6.1.).

Table 6.1. Government Support to Agricultural Insurance in 2009: Major Territories

Forms of Government Financial Support							
Country	Year of Inception	Agricultural Insurance POOL (co-insurers)	Public-sector MPC I Insurer	Premium Subsidies	Subsidies on Administrative Costs of crop Insurance	Financial Support to R & D and Training	Public-Sector Crop Reinsurance
<i>Developed:</i>							
United States	1930s	No	No	Yes	Yes	Yes	Yes
Canada	1970s	No	Yes	Yes	Yes	Yes	Yes
Spain	1980	Yes	No	Yes	No	No	Yes
Portugal	1979	No	No	Yes	No	No	Yes
Italy	1970s	No	No	Yes	No	No	No
France	2005	No	No	Yes	No	No	No
<i>Developing:</i>							
India	1985	No	Yes	Yes	Yes	No	Yes
Philippines	1980	No	Yes	Yes	Yes	No	No
China	1950s	Yes	No	Yes	Yes	No	Yes
Brazil	1950s	No	Yes	Yes	Yes	No	Yes
Mexico	1990	No	No	Yes	No	Yes	Yes
Chile	2000	Yes(No)	No	Yes	No	Yes	No
Colombia	2000	No	No	Yes	No	No	No
S. Korea	2001	No	No	Yes	Yes	No	Yes
Turkey	2005	Yes	No	Yes	No	No	Yes

Source: Stutley (2007).

6.10. **Co-insurance pools in agricultural insurance:** In several countries, government has promoted the formation of agricultural co-insurance pools, of which the largest is the Agroseguro, Spain pool program formed in 1980. Since 2000, co-insurance pools have also been formed in Chile,⁷¹ Turkey, and China (table 6.1.). A pool is a legally binding risk-sharing agreement entered into by a number of independent insurance companies for the purposes of collectively underwriting an agreed class(es) of insurance. Each insurer participates in the premiums, claims, profits, and losses according to its proportionate interest (percentage share of 100 percent) in the pool. The potential benefits of an insurance pool include (i) the ability to underwrite a much broader and larger book of business; (ii) the potential to achieve a much better geographical spread of risk than if the each company operated independently; and (iii) the opportunity to take advantage of economies of scale in the costs of developing new products and programs and in underwriting risks and adjusting claims where a single lead co-insurer is appointed (or a separate technical support unit is created) to administer the business on behalf of the pool members. There are also major potential cost savings in the purchasing of reinsurance protection for a pooled co-insurance program.

6.11. 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 co-insurance program may be a much more attractive proposition to commercial insurance companies than if

⁷¹ The Chilean Crop Insurance Pool has now been disbanded and the 2 main insurers operate independently.

they were to try to operate independently. Indeed, a pool approach may be the only economically viable solution by which barriers to entry by individual companies can be overcome. These barriers include the following scenarios:

- ***The company has a low capital and reserves base the ability to participate in and to share in the results of the business by taking up a very small share in the pool.*** For example, in Spain there are about 35 participating co-insurers, some with shares of less than 1 percent, and in Turkey the 16 participating commercial insurers each have an equal 6.5 percent share in Tarsim, the managing insurance company they created to underwrite crop and livestock business in 2006.
- ***The companies share the costs of the centrally based technical and underwriting staff and claims adjusters as opposed to having to recruit these staff to their own company.***
- ***The companies share the costs of staff training, product design and development, the creation of marketing, and loss adjustment infrastructure and systems and procedures.***
- ***The companies share the costs of the pool reinsurance program.***

6.12. Currently the most common form of government support to agricultural insurance is through direct insurance premium subsidies, applicable to all the countries listed in table 6.1.⁷² Governments often justify premium subsidies as a means of making crop insurance affordable to all farmers and especially small farmers.

6.13. ***The costs of government premium subsidies are extremely high in most countries.*** In 2007, MPCPI premium subsidies in the United States amounted to US\$3.8 billion for crop MPCPI and US\$0.8 billion for livestock premium subsidies. In Spain total premium subsidies were US\$581 million; for crops premium subsidies amounted to 70 percent of the total premium cost and for livestock, premium subsidies were 74 percent of premium. In Japan, which has a very large crop and livestock insurance market, total 2007 premium subsidies amounted to US\$549 million with an average premium subsidy level of 49 percent of premium. In Canada, crop insurance premium subsidies amounted to US\$546 million (50 percent premium subsidy level). In Europe, Italy and Portugal provide extremely high levels premium subsidies to their farmers, while France and Turkey introduced premium subsidies in 2005. In Asia, high levels of premium subsidies apply to almost all the major programs, including India, Philippines, China, and South Korea. In Latin America, Chile introduced premium subsidies in 2001, and in Brazil, the federal government ratified the reintroduction of premium subsidies in 2005.

6.14. ***India provides heavy crop insurance premium subsidies*** for the national area-yield index insurance program (premiums for food crops are capped at about one-third the actuarially determined rates, but premium rates for horticultural and commercial crops are charged at the full commercial premium rates). In Nepal, government provides 50 percent livestock insurance premium subsidies on the small farmer cooperative livestock insurance scheme. In China government is also providing very high levels of crop and livestock premium subsidy support. In 2007 premium subsidies amounted to US\$283 million. It is apparent, however, that most

⁷² Legislation passed by the World Trade Organization, WTO over the past twenty years has been directed at phasing out all direct price support subsidies on agricultural commodities. Conversely, agricultural insurance premium subsidies are exempted (permitted) under Green Box legislation and many governments, especially in Europe, have used this loophole to increase their support to agricultural insurance premium subsidies.

developing countries, including Bangladesh, could not afford such high crop and livestock premium subsidy levels.

6.15. *The next most common form of government support is to the reinsurance of agriculture.* In India, government excess-of-loss reinsurance protection is free of charge, while in Canada, the United States, and South Korea this is provided at favorable (subsidized) terms.⁷³ In Spain, Mexico, and Brazil, agricultural reinsurance protection is provided at commercial market rates by the national reinsurers, Consorcio de Compensacion de Seguros (Spain), Agroasemex (Mexico), and the Brazilian Reinsurance Institute (IRB). This also applies to Portugal, where government offers a voluntary crop stop loss reinsurance program.

6.16. *Governments also offer subsidies on the insurance company's administration and operating expenses.* In the most comprehensive form in the United States, government effectively subsidizes 100 percent of insurer's acquisition costs, administration costs, and the costs of adjusting crop losses. These subsidies are paid directly to the insurance company and the farmer bears only his share of the pure risk premium. In some countries, government provides financial subsidies for product research and development and for training and education programs.

6.17. Further information on the structure and features of a selection of these public-private crop insurance programs is presented in annex 11. The lessons from international experience can provide useful insights for insurance planners in Bangladesh as it develops its own private-public partnership for agricultural insurance.

Public-Private Partnership Options for Agricultural Insurance in Bangladesh

6.18. *International experience suggests that wherever possible, implementation of crop and livestock insurance should be through the private commercial insurance sectors and/or cooperative mutual insurance companies and microfinance/microinsurance entities, possibly supported by government.*

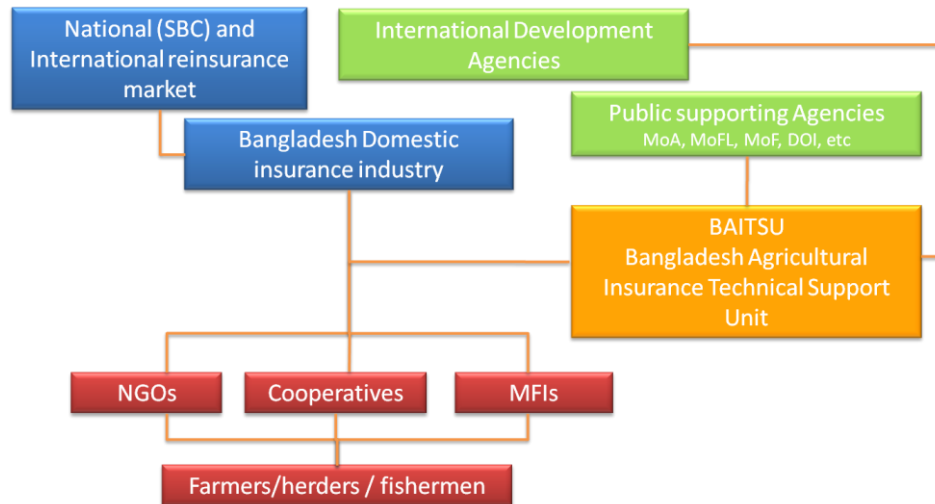
6.19. *The private commercial (non-life) insurance sector in Bangladesh has indicated that it is unable to support any crop insurance initiative without strong support from government,* and although some of the NGOs/MFIs are expanding their microinsurance activities, it is unlikely that they will be able to scale up their operations without public-sector support.

6.20. *Public-private partnerships for agricultural insurance may be further explored for Bangladesh.* If agricultural insurance is to be developed in Bangladesh and made widely available to the country's owners of small and marginal farms, it is therefore likely that this can be achieved only under a public-private partnership. The key stakeholders under a PPP arrangement for agricultural crop and livestock insurance are likely to include the Bangladesh private commercial insurance industry working closely with the main rural institutions (cooperatives, NGOs and MFIs), with support from a "steering committee" representing the public sector and including Ministries of Agriculture, Livestock and Fisheries, and Finance and the Department of Insurance. (An outline institutional framework for Bangladesh is presented in

⁷³ In China, ChinaRe the national reinsurer participates in agricultural reinsurance on a strictly commercial basis. There are, however, several provincial pilot programs in 2008 where the local government is involved in providing free stop loss co-reinsurance.

figure 6.1). Other important stakeholders include reinsurance companies, potentially SBC, the national reinsurer and international reinsurers, and international aid donors.

Figure 6.1. Illustrative Institutional Framework for a PPP for Agricultural Insurance in Bangladesh



Source: Authors 2009.

6.21. *It is recommended that under any PPP a Bangladesh agricultural insurance technical support unit (BAITSU) be formed.* It would assist the insurance industry and its partners (e.g., MFIs) in the design and rating of new crop and livestock insurance products and would also act as a channel for technical assistance from the international development agencies and aid donors (figure 6.1). BAITSU would have a small technical staff of two or three agricultural insurance specialists. The suggested specific technical functions of BAITSU are presented in box 6.1. BAITSU would report to a steering committee of public and private stakeholders. Should the government and insurance industry and other potential stakeholders be interested in this proposal, the first task of the Steering Committee would be to identify the functions of BAITSU. The detailed business plan of the BAITSU (including staffing and costings and tasks and projects) could then be drafted.

Box 6.1. Suggested Functions of Bangladesh Agricultural Insurance Technical Support Unit (BAITSU)

- BAITSU would provide technical assistance to enable all insurers in Bangladesh to:
- Develop risk-assessment methodology
 - Develop rate-making methodology
 - Design crop and livestock products and policy wordings
 - Design loss-assessment procedures and manuals
 - Assist in the structuring and placing of insurance and reinsurance programs
 - Train underwriters and sales agents
 - Train field assessors and loss adjusters
 - Educate farmers and livestock producers on the role and functions and benefits of risk transfer and insurance

Source: Authors.

Agricultural Insurance Institutional and Delivery Models for Owners of Small Farms in Bangladesh

6.22. In reviewing the potential roles that government, private commercial insurers, banks, MFIs, cooperatives, and NGOs might play in developing agricultural insurance under a PPP for Bangladesh, it is useful to distinguish between the different types of institutional model for providing insurance and microinsurance products and services to Bangladesh's predominantly small-scale crop and livestock producers. ProVention (2006) identifies four main delivery models for providing microinsurance, as described in box 6.1.

6.23. The *full-service model*, whereby private commercial insurers (or occasionally public insurers) assume full responsibility for the supply of agricultural insurance products and services is the most common institutional form of insurance in the major public-private agricultural insurance programs reviewed above. In Bangladesh the former public-sector SBC crop and livestock insurance is an example of the full service delivery model. In Bangladesh the private commercial sector has yet to assume any direct role in agricultural insurance.

6.24. The *partner-agent model* has been adopted for micro-life insurance by the private commercial insurers and the NGOs/MFIs in Bangladesh, and as recommended in chapter 5, this model could provide one option for expanding and developing crop and livestock insurance in future.

6.25. *The current NGO/MFI livestock-credit protection schemes fall under either the community-based model or provider model.* Chapter 2 provided an extensive review of the livestock credit-protection sum insurance programs currently offered by several NGOs/MFIs, and this chapter explores further the potential for strengthening and developing the role of the NGOs/MFIs in providing crop and livestock insurance.

Box 6.1. Institutional Models for Small Farm Insurance (Microinsurance)

- **Full-service model:** Commercial or public insurers provide the full range of insurance services from initial development of the product through distribution to absorption of risk.
- **Partner-agent model:** Commercial or public insurers, together with microfinance 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 microfinance 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).

Role of Private Commercial Insurers

6.26. Chapter 2 showed that, to date in Bangladesh, none of the 43 non-life general private commercial insurers have been involved in the provision of agricultural insurance and that they face a series of key challenges, including the following:

- The companies lack the expert knowledge and experience to underwrite crop and livestock insurance.
- They face high start-up costs associated with designing new crop and livestock insurance products, rating these products, designing loss assessment systems and procedures, recruiting key underwriting and field staff, and training these personnel.
- The companies do not have rural branch networks to market crop and livestock insurance directly to Bangladeshi farmers or to underwrite and adjust claims for potentially large numbers of small farmers.
- They must take into account the very small average size of Bangladeshi farms and the potentially prohibitively high administrative costs of trying to implement individual farmer crop and livestock insurance.
- The companies must overcome the legal barriers which currently prevent the private commercial insurers from reinsuring the life and livestock microinsurance products currently underwritten by the NGOs/MFIs. In section 2 it was noted that current legislation does not recognize the MFIs' microinsurance products.

6.27. To counter these drawbacks the private commercial insurers have considerably larger financial reserves than the mutual or cooperative insurers and the nonregulated NGOs/MFIs. The private insurers also have a further key advantage in that they have access to international reinsurance markets.

6.28. In the future, if the private commercial insurers wish to become directly involved in underwriting crop or livestock insurance, they have three main avenues:

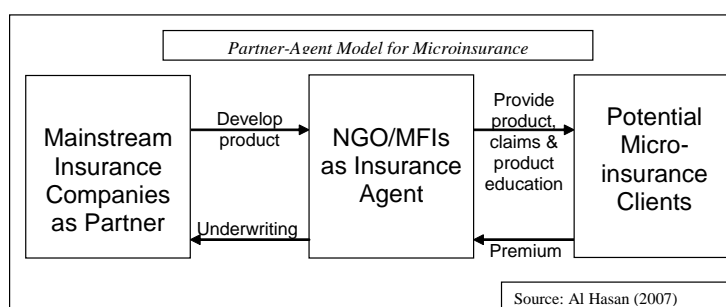
- ***As a direct insurer, operating singly as individual agricultural insurers under the full-service model, and responsible for all marketing, underwriting and claims functions:*** It is likely, however, that start-up development costs and operating costs constraints listed above will make it very unlikely that any Bangladeshi insurer will in the near future develop its own crop or livestock insurance portfolio.
- ***As a direct insurer, operating under a partner-agent model with one or more NGO/MFI:*** It is noted that the 2008 changes in insurance legislation now permit the MFIs to act as insurance agents on behalf of the insurance companies and to enter into partner-agent relationships and to receive commissions for providing services to the commercial insurers⁷⁴. Under a partner-agent model, the insurance company would issue

⁷⁴ In the conduct of this study the issue of trust was identified as a potential constraint to the introduction of a Partner-Agent model for agricultural insurance. Most rural poor are not familiar with and generally distrust commercial insurance companies and similarly several NGOs/MFIs indicated their preference to act as a direct microinsurer of their own products rather than entering into an Agent agreement with a commercial insurer. For a Partner-Agent model to operate successfully for agricultural insurance in Bangladesh, communication, capacity building and a strong supervisory framework will be keys to establishing trust among the stakeholders.

its own crop and livestock insurance policies and set terms and conditions of cover and premium rates and deductible levels, etc. The insurance company would then receive premiums and settle claims and be fully responsible for organizing its own reinsurance. The NGO/MFI would act as the insurance agent responsible for: promoting and selling the crop and livestock insurance products to its members (clients), collecting premiums, and facilitating claims notification and claims settlement processes. (See figure 6.2. for partner-agent insurance delivery model).

- *As a direct insurer participating in a coinsurance pool*, thereby benefiting from economies of scale through shared costs of (i) product design and rating, (ii) policy marketing and sales, (iii) underwriting and claims control and loss adjustment, and (iv) purchasing of a common (pooled) reinsurance protection program.

Figure 6.2. The Partner-Agent Delivery Model for Crop and Livestock Microinsurance



6.29. If the general insurers elect to form a co-insurance pool, they will need to consider the institutional framework for the pool. In some countries including China and Malawi, the co-insurers have elected to appoint one company as the lead co-insurer responsible for staffing and managing a specialist agricultural underwriting and claim administration department or unit, and the co-insurers have then contributed to the running costs of the lead co-insurer.

6.30. In Spain and Turkey the private commercial insurers elected to form a new specialist insurance company or managing underwriter to underwrite the pooled crop-and-livestock insurance business on behalf of the co-insurers, namely, Agroseguro in Spain and Tarsim in Turkey. This latter option is considerably more expensive in the start-up phase as it is necessary to capitalize, staff, and equip the completely new agricultural insurance company.

6.31. *A further role that the insurance companies may wish to consider would be to provide excess-of-loss insurance to the NGOs/MFIs crop and livestock insurance programs.* It is understood, however, that current insurance legislation would first have to be amended to permit the private commercial insurers to insure the MFIs.

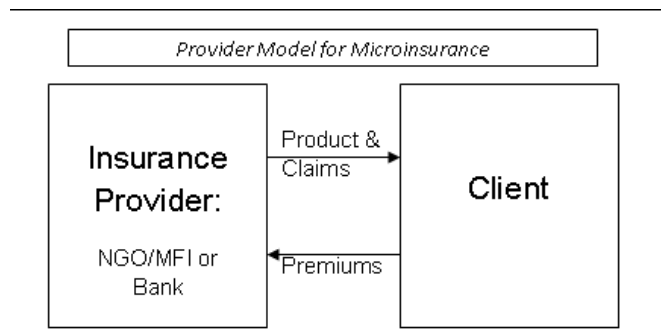
Roles of NGOs/MFIs as Agricultural Insurance Companies

6.32. *The large number of NGOs/MFIs in Bangladesh and their major outreach to the rural poor potentially provides a major delivery channel for crop and livestock insurance products and services to small farms in Bangladesh.* The key hurdles which the MFIs currently face in developing crop and livestock insurance include (i) their relative lack of technical knowledge and expertise in the design and rating of these insurance products, (ii) legal and regulatory barriers to the provision of microinsurance products, and (iii) lack of financial capacity and access to reinsurance protection to underwrite agricultural insurance products and services.

6.33. It appears that there are two principle roles that the NGOs/MFIs could play in the future in expanding the supply of agricultural crop and livestock insurance products and services for the countries majority of small and marginal farmers:

- **Acting as an agent for the private commercial insurance sector under a suitable partner-agent model:** The 2008 changes in insurance legislation mean that in theory there are no barriers to the MFIs entering into such agreements with insurance companies immediately and to begin marketing the insurer's crop and livestock policies to their members. It is not known, however, if the largest NGO/MFIs which have established their own microinsurance services for their members would be willing to act as agents for private insurers, and also it is not known how receptive members would be to paying their premiums to a private commercial insurance company⁷⁵.
- **Acting as a microinsurer under a community-based or provider model as per the current livestock-credit insurance initiatives.** (See figure 6.3. for provider model). The major drawbacks of this approach include the following: (i) current insurance legislation in Bangladesh does not recognize the MFIs microinsurance products, and (ii) currently none of the programs are reinsured. If the NGOs and MFIs are to expand their role as microinsurers in future these twin issues will need to be addressed.

Figure 6.3. The Provider Model for Microinsurance linked to Microfinance



Source: Definition of provider model after Cohen and McCord 2003.

Role of Cooperative Insurers in Agricultural Insurance Provision

6.34. The 2008 changes in insurance legislation no longer permit mutual insurance companies to offer general insurance products and services. The legislation, however, continues to permit cooperative insurance companies to offer non-life products and services. Chapter 3 identified that in 2009 INAFI was promoting the concept of mutual or self-insurance in Bangladesh and has ambitious plans to form a crop and livestock microinsurance company which would pool the risks of Bangladesh's 12 largest NGOs/MFIs. The status of implementation of this initiative is not known nor is the legal status of the company, namely, whether it will be legally incorporated as a

⁷⁵ As noted in paragraph 6.28, the key to developing trust between private commercial insurers and the NGOs/MFIs appears to centre on clear and transparent communication between both parties over the basis of their agreement and the terms and conditions of the insurance product(s) being underwritten and in strong regulatory supervision and in fair and impartial loss assessment.

cooperative insurer now that mutual insurance companies are no longer permitted to offer general insurance products.

Future Role of SBC as an Agricultural Insurer and Reinsurer

6.35. *The future role of SBC, the public-sector general insurance and reinsurance company as an agricultural insurer and reinsurer needs to be defined by GoB.* It is understood that SBC is unlikely to get directly involved in underwriting crop and livestock insurance in the future.

6.36. *There could, however, be a very important role for SBC to play in the future as a reinsurer* of the NGO/MFI and possibly cooperative crop and livestock insurance schemes in Bangladesh. There are parallels here with the important role that Agroasemex, the national agricultural crop and livestock reinsurer, has played in developing and reinsuring the Mexican small-farm FONDOS mutual crop and livestock scheme. Further details of the Mexican Fondos program are presented in annex 10.

Role of the Government of Bangladesh

6.37. International experience tends to suggest that implementation of agricultural insurance is most efficient and effectively managed by the private commercial crop insurance sector. However, in cases of market failure (i.e., where insurance markets are poorly developed), governments may have important roles to play in promoting agricultural insurance and in creating insurance infrastructure, 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 Government of Bangladesh may wish to consider in order to promote agricultural crop and livestock insurance in Bangladesh.

6.38. *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.

6.39. This review has shown that currently one of the major constraints to developing agricultural insurance in Bangladesh is that the current insurance legislation does not permit the MFIs to act as formal microinsurance companies. Insurance legislation needs to be amended to facilitate agricultural (crop and livestock) microinsurance through the NGOs/MFIs. In addition, it is possible that the Directorate of Insurance will need to enact special legislation to permit the introduction and operation of weather-index insurance in Bangladesh.

6.40. *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 to then make these databases available to all interested private commercial insurers either free of cost or at concessionary rates.

6.41. In Bangladesh there is an efficient crop-production and yield-measurement and reporting system through the BBS and DAE/MoA. Currently crop yields are reported only at the regional level. This system could be enhanced by increased government investment in crop-cutting resources to provide reporting of yields at the Thana (Union) and sub-District (upazila) levels, in constructing a national database of individual crop-cutting results, and by increased monitoring and recording of crop-damaged area by cause of loss.

6.42. The density of meteorological rainfall and weather stations in Bangladesh is too low for crop-weather index insurance purposes. If in future crop-weather index insurance is introduced into Bangladesh, GoB could usefully support this program by investing in the upgrading and automating of the weather stations to ensure data integrity and by increasing the density of stations.

6.43. **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 in 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 government to provide financial support to product design and rating, especially where the products and rates are then made available to all interested insurers. Such a need applies specifically to Bangladesh, where there is very little experience in the design and rating of crop and livestock insurance programs. In this context it is recommended that GoB consider establishing and funding a technical support unit (TSU), which would assume key responsibility for data and information acquisition and for designing and rating crop and livestock and aquaculture and forestry insurance products on behalf of all commercial and cooperative insurers in Bangladesh.

6.44. **Education, training, and capacity building:** Governments can play an important role in the introduction of new agricultural insurance programs by supporting (i) farmer awareness and education programs and (ii) capacity building and workshops and technical training programs for key agricultural insurance staff. The field studies conducted under this mission have identified a major need in Bangladesh for farmer awareness and general education about the role of crop (and livestock) insurance. Capacity building and specialist education will also be required at the insurance company level. Currently in Bangladesh there is no agricultural insurance expertise in the private commercial companies. If the private commercial insurers are to take an active role in agricultural insurance, specific training for senior crop and livestock insurance managers and professionals will need to include product design, actuarial and rating, underwriting and claims administration, and loss-assessment systems and procedures. The company field staff will also need to receive suitable training in operating systems and procedures. Similar training also needs to be provided to staff in NGOs/MFIs which are involved in agricultural insurance.

6.45. **Catastrophe-risk financing:** Governments may perform an important role as the reinsurer of last resort where access to reinsurance capacity is limited. Agricultural insurance often has to protect against catastrophe perils of flood, drought, and windstorm in crops and epidemic disease outbreak 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 nonproportional 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. Indeed, the review of international experience shows that many governments both in developed and developing countries provide subsidized reinsurance to the crop and livestock insurers.

6.46. A key issue identified under this review of the nonregulated agricultural insurance initiatives in Bangladesh is the absence of any form of reinsurance protection for the livestock insurance programs currently being implemented by the NGOs/MFIs. If the commercial insurers

and international reinsurers are unable to reinsure these initiatives at an affordable premium, GoB may need to consider ways of participating in a structured risk financing program. (See next section for further discussion).

6.47. **Public-sector premium subsidies:** Governments justify the provision of agricultural insurance premium subsidies on the grounds that they make insurance more affordable for farmers, particularly owners of small and marginal farms, thereby increasing the rate of adoption and uptake of agricultural insurance. This argument may apply to individual grower multiple-peril crop insurance, where average premium rates commonly vary between 7.5 percent and 10 percent for coverage levels of 65 percent to 75 percent of normal average yield. However, this argument does not apply to private crop-hail insurance, which has been widely marketed in Europe, the United States, Australasia, and Argentina for nearly a century with average rates of 2.5 percent to 5.0 percent and with no premium subsidy support from governments.

6.48. Premium subsidies are the most widely practiced form of government support to agricultural insurance, and as more farmers purchase crop and livestock insurance either on a voluntary or compulsory basis (for example, compulsory crop-credit insurance programs) the annual budget for premium subsidies is increasing dramatically in many developed and developing countries.

6.49. There are, however, a series of major drawbacks of direct insurance premium subsidies. Many countries provide single flat-rate premium subsidy, typically 50 percent of the full commercial price of insurance for all farmers, all crop types, and all risk regions.⁷⁶ These undifferentiated premium subsidies disproportionately benefit the larger farmers to the detriment of small and marginal farms, and they actively promote farmers in the highest risk-rated regions to grow high-risk crops which are not best suited to that region, knowing that they are protected by their highly subsidized crop policy, and this in turn can result in severe moral hazard. Premium subsidies once introduced are very difficult to reduce or to withdraw, and in the major developed and developing economies reviewed above, the costs of premium subsidies to the taxpayer are now extremely high and could not be afforded by the smaller developing countries such as Bangladesh.

6.50. ***The costs of agricultural insurance premium subsidies for Bangladesh are potentially high.*** This is illustrated in table 6.2, assuming a nation-wide area-based crop insurance program for major cereals (paddy and wheat) providing 80 percent coverage level and an assumed average original gross premium (OGP) rate of 7.5 percent⁷⁷ and different uptake (penetration) rates from 5 percent to a maximum of 20 percent of total cultivated area (the 20 percent figure represents the current insurance penetration rate in India after 30 years of crop insurance). The analysis assumes that GoB elects to provide all farmers with a 50 percent premium subsidy, which would amount to Tk 0.6 billion (US\$8.8 million) for 5 percent uptake rate rising to Tk 2.4 billion (US\$35.3 million) for 20 percent crop insurance penetration rate. This represents a significant cost to the public exchequer.

Table 6.2. Illustrative Crop Insurance Uptake Scenarios and Costs to GoB of 50 percent Premium Subsidies

⁷⁶ Annex 10 presents a review of the different types of premium subsidy regime in different countries. Not all countries have flat rate premium subsidies. Spain and Portugal have highly developed premium subsidy scales which differentiate between crop types and risk regions and type of farmer purchasing cover etc.

⁷⁷ This is a purely indicative average OGP Rate and does not in any way represent an actuarially calculated or recommended OGP rate for an Area-Yield Insurance product in Bangladesh

Item	Crop Insurance Uptake Rate (% of total cultivated area major cereals)				
	5%	7.50%	10%	15%	20%
TSI (Tk billions)	16.0	24.0	32.0	48.0	64.0
Premium for 7.5% Rate (Tk billions)	1.2	1.8	2.4	3.6	4.8
50% Premium Subsidy (Tk Billions)	0.6	0.9	1.2	1.8	2.4
50% Premium Subsidy (US\$ millions)	8.8	13.2	17.7	26.5	35.3

Source: Authors illustrative estimates.

Assumptions: (1) Total sum insured for major cereals (paddy and wheat) for 80% coverage level valued at BTB 320.2 bio (US\$4.7 bio)

(2) Average premium rate 7.5% applied to total sum insured

(3) 50% premium subsidy paid by GoB

6.51. GoB should seek to finance premium subsidies only where a clear social need is identified and where the premium subsidies are targeted at special needs groups and are provided for a specific period of time and can be withdrawn once the program has attained a critical mass.

Government Role in Ex-Post Natural Disaster Relief Funding in Bangladesh

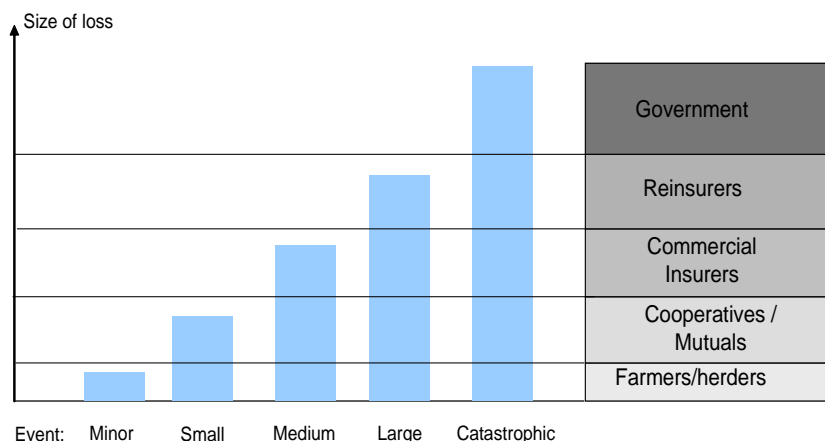
6.52. Under any public-private initiative for agricultural insurance, GoB will also need to decide on the future role of the Natural Disaster Relief Program. (Features of this program were reviewed in chapter 2). Experience shows that where free public-sector disaster relief continues to be provided after the introduction of agricultural insurance, this tends to act as a major disincentive for farmers to purchase agricultural insurance. Options for GoB to consider include phasing out disaster relief or to offer this only in the future for perils which are not covered by private sector and NGO/MFI microinsurance sector.

Risk Financing and Reinsurance Considerations

6.53. Currently in Bangladesh none of the livestock insurance programs offered through the NGOs/MFIs or the public-sector insurer SBC is protected by any form of catastrophe reinsurance, although they insure epidemic diseases. The individual MFIs are therefore extremely exposed to catastrophe loss events and there is a need to examine some form of individual or preferably “pooled” reinsurance program to cover loss events which exceed their premium plus claims reserves.

6.54. There are many options for structuring risk financing and reinsurance programs, including both proportional and nonproportional reinsurance. Figure 6.4. provides an example of a nonproportional insurance and reinsurance structure involving both mutual and private commercial insurers with protection for large-scale and catastrophe events from international reinsurers and possibly government.

Figure 6.4. Agricultural Risk Layering and Financing

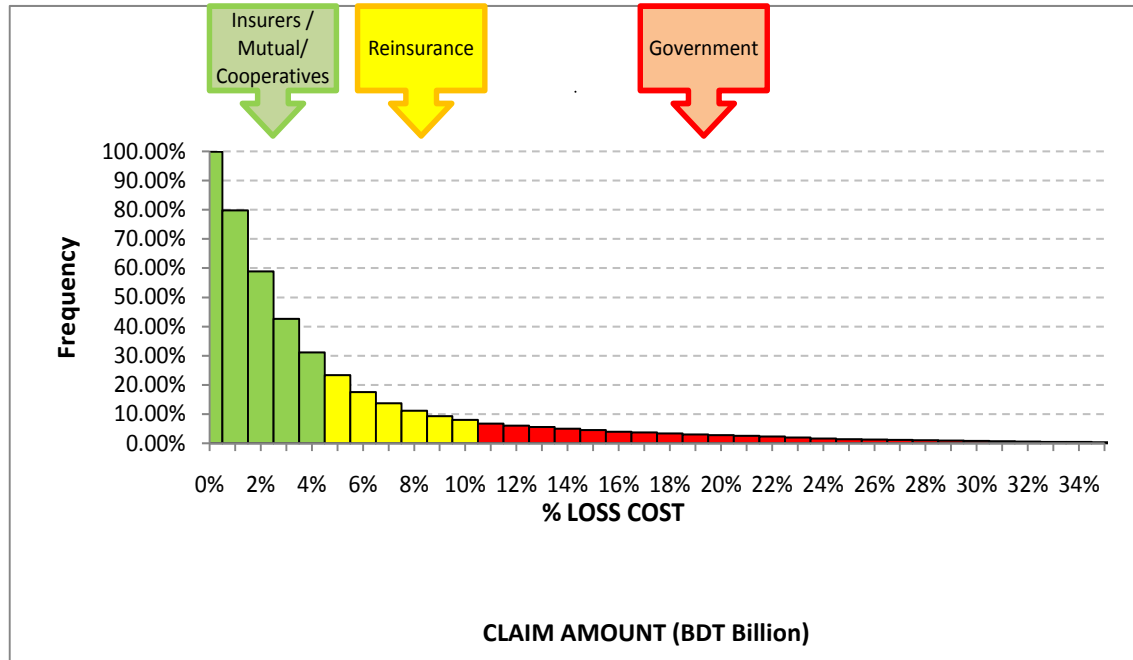


Source: Authors.

6.55. **Government might play an important role under any future agricultural insurance program in financing low-frequency catastrophe events.** Figure 6.5 provides an illustrative example of a crop-insurance risk-layering and risk-financing program for Bangladesh based on the indicative PML analysis for Aman HYV and Boro HYV grown in Bogra, Dinajpur, and Pabna Districts (full results presented in annex 6). It is assumed that an area-yield index insurance program operates for all the Aman HYV and Boro HYV cultivated area in the three Districts with an insured yield coverage level of 85 percent. The total sum insured (TSI), for 85 percent coverage is Tk 29.13 billion (US\$428 million) with an average annual loss cost (or technical rate) of 3.9 percent equivalent to an annual average expected loss of Tk 1.13 billion (US\$16,6 million). The expected value of losses and associated loss costs for return periods from one year up 250 years are shown in the loss exceedance curve for paddy with a maximum expected loss of one in 250 years of 35 percent of the portfolio or Tk 10.20 billion (US\$150 million), which prudently sets the uppermost limit which should be protected under any insurance and reinsurance program.

6.56. The insurance companies (MFIs and private commercial insurers) would retain expected losses up to 3.87 percent of TSI or Tk 1.13 billion (return period of one in three years) and then purchase commercial excess of loss reinsurance from SBC and international reinsurers up to a loss cost of 9.70 percent of the total sum insured, equivalent to a loss of Tk 2.83 billion (US\$41.6 million), and an expected return period of one in 13years. GoB would then contribute by providing catastrophe-risk financing for losses excess 9.70 percent loss cost up to the one in 250 year PML loss cost of 35 percent of TSI.

Figure 6.5. Example of Agricultural-Risk Financing for Bangladesh: Loss Exceedance Curve for HYV Paddy Rice Grown in Bogra, Dinajpur, and Pabna (85 percent coverage level)



	Insurance	Reinsurance	Government
Layer	From BDT 0 up to BDT 1.13 bio (3.87% Loss Cost)	From BDT 1.13 bio up to BDT 2.83 bio (9.7% Loss Cost)	From BDT 2.83 bio up to BDT 10.2 bio (35% loss cost)
Limit (% of TSI)	3.9%	5.8%	25.3%
Priority (% of TSI)	0.0%	3.9%	9.7%
Limit (BDT bio)	1.13	1.70	7.37
Priority (BDT bio)	0	1.13	2.83
Estimated Technical Rate (% of TSI)	2.4	0.9%	0.6%

Source: Authors illustrative estimates for Risk Layering

6.57. If GoB decides to implement a feasibility study for the introduction of crop and livestock insurance into Bangladesh, the next stage will be to conduct more detailed catastrophe-risk modeling for key natural perils, including flood, windstorm, tsunami, and possibly epidemic diseases in order to (i) establish PML (Probable Maximum Loss) exposures for given return periods (e.g., 1 in 100 years, 1 in 250 years), and (ii) assist in the structuring and pricing of an agricultural-risk-layering and risk-transfer insurance and reinsurance program.

Glossary

Accumulation	The concentration of similar risks in a particular area such that an insured event may result in several losses occurring at the same time.
Actuarial	Branch of statistics dealing with the probabilities of an event occurring. Actuarial calculations, if they are to be at all accurate, require basic data over a sufficient time period to permit likelihood of future events to be predicted with a degree of certainty.
Ad hoc Response	Disaster relief arranged in the aftermath of a disaster. Ad hoc responses are generally less efficient than planned responses or a well-designed risk-management framework.
Adverse Selection	Adverse selection occurs when potential insurance purchasers know more about their risks than the insurer does, leading to participation by high-risk individuals and nonparticipation by low-risk individuals. Insurers react by either charging higher premiums or not insuring at all, as in the case of floods.
Agricultural Insurance	Insurance applied to agricultural enterprises. Types of business include crop insurance, livestock insurance, aquaculture insurance, and forestry insurance, but normally exclude building and equipment insurance, although these may be insured by the same insurer under a different policy.
Area-Based Index Insurance	The essential principle of area-based index insurance is that contracts are written against specific perils or events (such as area-yield loss, drought, or flood) defined and recorded at a regional level (for example, at a county or District level in the case of yields, or at the local weather station in the case of insured weather events). Indemnities are paid based on losses at the regional level rather than farm level.
Asset Risk	Risk of damage or theft of production equipments and assets.
Asymmetric Information	An information imbalance due to one party in a transaction possessing more or better information than the other party (parties), such as knowledge of hidden costs or risky behavior. Buyers of insurance products typically have better information about their level of risk exposure, which they may hide from insurers in order to gain lower premium rates.
Basis Risk	The risk with index insurance, that the index measurements will not match individual losses. Some households that experience loss will not be covered, for example, and some households that experience no loss will receive indemnity payments. As the geographical area covered by the index increases, basis risk will increase as well.
Capacity	The maximum amount of insurance or reinsurance that the insurer, reinsurer, or insurance market will accept.
Catastrophe	A severe, usually sudden, disaster that results in heavy losses.
Ceding Company	A direct insurer that places all or part of an original risk on a reinsurer
Claim	An insurer's application for indemnity payment after a covered loss

	has occurred.
Cognitive Failure	In the case of decision making in risk management, cognitive failure occurs when decision makers fail to account for the possibility of infrequent catastrophic risks.
Co-insurance	1. The situation where the insured is liable for part of each and every loss, which is often expressed as a percentage of the sum insured. 2. When each of several insurers covers part of a risk.
Collective Policy	A policy issued on behalf of a number of insurers or a policy covering a number of items, each being insured separately.
Commission	A proportion of the premium paid by the insurer to the agent for services in procuring and serving the policyholder.
Correlated Risk	Risks that are likely to affect many individuals or households at the same time. A clear example is a fall in commodity price. For example, coffee growers in the same community are likely to be simultaneously affected by a decrease in price. Futures and options markets can be used to transfer these risks to parties outside the local community. Another example is a widespread drought, which can damage agricultural production over an entire region.
Country Risk Profile	The level of risk exposure of a country, determined by the occurrence of events such as price shock and adverse weather events that impact major private and public assets and economic activities within a country at the micro, meso, and macro levels.
Crop Insurance	Provides financial compensation for production or revenue losses resulting from specified or multiple perils, such as hail, windstorm, fire, or flood. Although most crop insurance pays for the loss of physical production or yield, coverage is often available for loss of the productive asset, such as trees in the case of fruit crops.
Deductible (Excess)	An amount representing the first part of a claim, which an insured has to bear as stated in the policy. The deductible is frequently expressed as a percentage of the sum insured, but may just as often be a monetary amount.
Default	Failure to fulfill the obligations of a contract.
Direct Premium Subsidy	A subsidy which is calculated as a percentage of the insurance premium paid. Such a subsidy is problematic, because it disproportionately benefits high-risk farmers who pay higher premiums. Attracting higher-risk farmers can significantly increase the costs of insurance.
Disaster-Index Insurance	An insurance contract in which payments are triggered by extreme weather events. Disaster-index insurance is a form of weather insurance, which covers catastrophic weather events or the extreme tail of the probability distribution of weather events for a region or country. <i>See also Index Insurance.</i>
Drought	One of the most commonly requested peril covers by farmers, but it is also one of the most difficult perils to insure because of problems of definition, isolation, and measurement of effects on crop production. In contrast to most weather perils, drought is a progressive phenomenon, in terms of an accumulating soil moisture deficit for plant growth, and its impact on crop production and yields is often

	extremely difficult to predict, measure, and isolate from other, noninsured causes.
Due Diligence	The responsibility of an external reviewer to perform an investigation of risk associated with a potential client, considered prudent and necessary for an adequate assessment of that client's level of risk. The process associated with due diligence in insurance includes underwriting, contract design, rate making, and adverse selection and moral hazard controls.
Endogenous Market Factor	A factor occurring within the market which impacts market transactions, such as fluctuations in local supply or demand or political instability within a country.
Ex ante Risk Mechanism	Action taken prior to a potential risk event. Making preparations before a disaster helps avoid inefficient, quick-response coping decisions. If ex ante strategies are not in place, resort will be to short-term coping strategies that have no significant benefit in the long run.
Ex post Risk Mechanism	Risk-management strategies that are developed in reaction to an event, without prior planning. Although ex post strategies have a role to play in a risk-management program, risk-management mechanisms can be more effective when introduced ex ante.
Exposure	The amount (sum insured) exposed to the insured peril(s) at any one time. In crop insurance, exposure may increase, and then decrease, during the coverage period, following the growth stages of the crop from planting to completion of harvest.
Exogenous Market Factor	A factor occurring outside the market which impacts transactions within the market, such as a shift in the global demand for a commodity.
Financial Intermediary	An institution (such as an insurance company, bank, or microfinance institution) that serves as a middle man or acts as a go-between for sellers and buyers of financial services such as credit or insurance.
Financial Risk	Risk that income will not reach expected levels, or the invested value in a crop will be lost due to adverse changes in weather and price. Many agricultural production cycles stretch over long periods of time, and farmers must anticipate expenses that can be recouped only once the product is marketed, leading to cash-flow problems that can be made even more severe by a lack of access to credit, or the high cost of borrowing in rural areas.
Fondo	According to Mexican laws, fondos are nonprofit organizations constituted by the farmers as civil associations without the need to provide any capital endowment, except their willingness to associate among themselves. From a risk-financing perspective, fondos pool crop-yield risks from farmers with similar risk profiles.
Franchise	An amount of loss which has to be reached before the insurer will pay a claim, and once this threshold is met, the insurer has to pay the claim in full. For example, a farmer insures his crop for \$1,000 with a franchise of \$100. If the claim is for \$99, then this is borne by the farmer. If the claim is for \$101, however, then the whole amount of the \$101 is paid by the insurer.
Gross Net Premium	Gross written premium of a primary insurer, minus cancellations,

Income	refunds, and reinsurance premium paid to other reinsurers.
Guaranteed Yield	The expected physical yield of a crop stated in the insurance policy, against which actual yields will be compared when adjusting any losses.
Hazard	A physical or moral feature that increases the potential for a loss arising from an insured peril or that may influence the degree of damage.
High-Probability Low-Consequence Events	High-probability, low-consequence risks are frequent risks that cause mild to moderate damage. Insurance products for high-frequency, low-consequence losses are seldom offered, because the transaction costs associated with frequent loss adjustment makes the insurance cost prohibitive for most potential purchasers. These high transaction costs are in part due to information asymmetries that cause the problems of moral hazard and adverse selection. <i>See also Moral Hazard and Adverse Selection.</i>
In-Between Risk	Agricultural production risks, such as natural disasters, that lack sufficient spatial correlation to be effectively hedged using exchange-traded futures or options instruments. At the same time, they are generally not perfectly spatially independent, and therefore traditional insurance markets cannot cover these risks. Skees and Barnett (1999) refer to these risks as “in-between” risks. Because of their unique characteristics, in-between risks require more innovative instruments.
Indemnity	The amount payable by the insurer to the insured, in the form of cash, repair, replacement, or reinstatement in the event of an insured loss. This amount is measured by the extent of the insured’s pecuniary loss. It is set at a figure equal to but not more than the actual value of the subject matter insured just before the loss, subject to the adequacy of the sum insured. For many crops, this means that an escalating indemnity level is established as the growing season progresses.
Independent Risk	Risks such as automobile accidents, fire, or illness that generally occur independently across households. Such statistical independence allows effective risk pooling across entities in the same insurance pool, making insurance possible. For independent risks, the law of large numbers suggests that, on average, the insurance indemnity paid to claimants in a particular year can be offset by the premiums received from clients who did not experience indemnifiable losses. <i>See also Risk Pooling.</i>
Index Insurance	Index insurance makes indemnity payments based not on an assessment of the policyholder’s individual loss, but rather on measures of an index that is assumed to proxy actual losses. Two types of agricultural index insurance products are those based on area yields, where the area is some unit of geographical aggregation larger than the farm, and those based on measurable weather events. <i>See also Weather-Index Insurance.</i>
Informational Constraint	Limited access to or availability of reliable data can be a significant constraint to the development and performance of risk transfer markets.
Institutional Risk	Institutional or regulatory risk is generated by unexpected changes in regulations, especially in import and export regimes, and influences

	producers' activities and their farm profits.
Insurability	The conditions that determine the viability of insurance as a method of managing a particular risk.
Insurable Interest	An insurance policy is valid only if the insured is related to the subject matter insured in such a way that he or she will benefit from its survival, suffer from loss or damage caused to it, or may incur liability in respect of it.
Insurance	A financial mechanism that aims to reduce the uncertainty of loss by pooling a large number of uncertainties so that the burden of loss is distributed. Generally, each policyholder pays a contribution to a fund in the form of a premium, commensurate with the risk he introduces. The insurer uses these funds to pay the losses (indemnities) suffered by any of the insured.
Insurance Agent	The person who solicits, negotiates, or implements insurance contracts on behalf of the insurer.
Insurance Broker	The person who represents the insured in finding an insurer or insurers for a risk and negotiating the terms of the insurance contract. A broker may also act as an agent (that is, for the insurer) for the purposes of delivering a policy to the insured and collecting premium from the insured.
Insurance Policy	A formal document (including all clauses, riders, and endorsements) that expresses the terms, exceptions, and conditions of the contract of insurance between the insurer and the insured. It is not the contract itself but evidence of the contract.
Insured Peril	The cause of loss stated in the policy, which on its occurrence entitles the insured to make a claim.
Layer	The term used to define a range of potential loss that is covered by insurance. For example, an insurance contract may pay indemnities only for losses within a specified range of magnitude. <i>See also Risk Layering.</i>
Livestock Risk	The risk of death, injury, or disease to livestock.
Loss Adjustment	Determination of the extent of damage resulting from occurrence of an insured peril, and settlement of the claim. Loss adjustment is carried out by the appointed loss adjuster who works on behalf of the insurer.
Loss Ratio	The proportion of claims paid (or payable) to premium earned. A loss ratio is usually calculated for each class of business in which an insurer participates. Analysis of loss ratios can be useful in assessing risks and designing appropriate insurance structures.
Low-Probability High-Consequence Events	Low-probability, high-consequence risks are events that occur infrequently yet cause substantial damage. Decision makers, including agricultural producers, tend to underestimate their exposure to low-probability, high-consequence losses, because people forget the severity of the loss experienced during infrequent extreme weather events. Thus, an insurance product that protects against these losses is frequently discounted or ignored altogether by producers trying to determine the value of an insurance contract.
Macro Level	The economic level at which countries and large donor agencies

	working with these countries experience risk of weather-induced humanitarian crisis or economic instability caused by price volatility.
Market Failure	The inability of a market to provide certain goods at the optimal level because market prices are not equal to the social opportunity costs of resources. The high cost of financing catastrophic disaster risk prohibits most private insurance companies from covering this risk, resulting in market failure.
Market Risk	Input and output price volatility are important sources of market risk in agriculture. Prices of agricultural commodities are extremely volatile as a result of both endogenous and exogenous market shocks, and some commodities experience shocks more frequently than others do.
Meso Level	The economic level at which banks, microfinance institutions, producers, traders, processors, and input providers experience risk due to the vagaries of weather and price.
Micro Level	The economic level at which individual farm households experience risks due to shocks such as adverse weather events, price fluctuations, or disease.
Microclimate	The climates of localized areas, which may differ considerably from the climate of the general region. These climate variations are caused by geographical differences in elevation and exposure.
Moral Hazard	In insurance, moral hazard refers to the problems generated when the insured's behavior can influence the extent of damage that qualifies for insurance payouts. Examples of moral hazard are carelessness, fraudulent claims, and irresponsibility.
Nonproportional Treaty Reinsurance	An agreement whereby the reinsurer agrees to pay all losses which exceed a specified limit arising from an insured portfolio of business. The limit is set by the reinsurer and may be monetary (for example, excess of loss) or a percentage (for example, stop loss). The rates charged by the reinsurer are calculated independently of the original rates for the insurance charged to the insured.
Personal Risk	The risk to an individual of personal injury or harm.
Premium	The monetary sum payable by the insured to the insurers for the period (or term) of insurance granted by the policy. Premium = premium rate x amount of insurance Also, the cost of an option contract—paid by the buyer to the seller.
Premium Rate	The price per unit of insurance., normally expressed as a percentage of the sum insured.
Probable Maximum Loss	The largest loss believed to be possible for a certain type of business in a defined return period, such as 1 in 100 years, or 1 in 250 years.
Proportional Treaty Reinsurance	An agreement whereby the insurer agrees to cede and the reinsurer agrees to accept a proportional share of all reinsurances offered within the limits of the treaty, as specified on the slip. Limits can be monetary, geographical, by branch, class of business, and so forth. The reinsurer has no choice of which risks to accept or decline; he is obliged to accept all good and bad risks that fall within the scope of the treaty.

Quota Share Treaty Reinsurance	An agreement whereby the ceding company is bound to cede and the reinsurer is bound to accept a fixed proportion of every risk accepted by the ceding company. The reinsurer shares proportionally in all losses and receives the same proportion of all premiums as the insurer, less commission. A quota share often specifies a monetary limit over which the reinsurer will not accept to be committed on any one risk—for example, 70 percent each and every risk, not to exceed \$700,000 any one risk.
Rapid-Onset Shock	A sudden large shock, such as a flood, hurricane, frost, freeze, excess heat, high wind speed, storm, or commodity price shock. Rapid-onset events are easier to identify than slow-onset shocks, and their impact can be easier to determine.
Rate On Line	A rate of premium for a reinsurance which, if applied to the reinsurer's liability, will result in an annual premium sufficient to meet expected losses over a number of years.
Regulatory Risk	Institutional or regulatory risk is generated by unexpected changes in regulations, especially in import and export regimes, and influences producers' activities and their farm profits.
Reinsurance	When the total exposure of a risk or group of risks presents the potential for losses beyond the limit that is prudent for an insurance company to carry, the insurance company may purchase reinsurance (that is, insurance of the insurance). Reinsurance has many advantages, including (i) leveling the results of the insurance company over a period of time; (ii) limiting the exposure of individual risks and restricting losses paid out by the insurance company; (iii) possibly increasing an insurance company's solvency margin (percent of capital and reserves to net premium income), hence the company's financial strength; and (iv) enabling the reinsurer to participate in the profits of the insurance company, but also to contribute to the losses, the net result being a more stable loss ratio over the period of insurance.
Risk Aggregation	The process of creating a risk-sharing arrangement that gathers together or pools risks, thereby reducing transaction costs and giving small households or other participants a stronger bargaining position.
Risk Assessment	The qualitative and quantitative evaluation of risk. The process includes describing potential adverse effects, evaluating the magnitude of each risk, estimating potential exposure to the risk, estimating the range of likely effects given the likely exposures, and describing uncertainties.
Risk Management	Care to maintain income and avoid or reduce loss or damage to a property resulting from undesirable events. Risk management involves identifying, analyzing, and quantifying risks and taking appropriate measures to prevent or minimize losses. Risk management may involve physical mechanisms, such as spraying a crop against aphids, using hail netting, or planting windbreaks. It can also involve financial mechanisms such as hedging, insurance, and self-insurance (carrying sufficient financial reserves so that a loss can be sustained without endangering the immediate viability of the enterprise in the event of a loss).

Risk Mitigation	Actions taken to reduce the probability or impact of a risk event, or to reduce exposure risk events.
Risk Retention	Risk retention is the process whereby a party retains the financial responsibility for loss in the event of a shock.
Risk Transfer	Risk transfer is the process of shifting the burden of financial loss or responsibility for risk financing to another party, through insurance, reinsurance, legislation, or other means.
Risk Coping	Strategies employed to cope with a shock after its occurrence. Some examples of risk-coping strategies include the sale of assets, seeking additional sources of employment, and social assistance.
Risk Financing	The process of managing risk and the consequences of residual risk through products such as insurance contracts, CAT bonds, reinsurance, or options.
Risk Layering	The process of separating risk into tiers that allow for more efficient financing and management of risks. High-probability, low-consequence events may be retained by households to a certain extent. The market insurance layer is characterized by the ability of the market to manage risks through insurance or other contracts. Low-probability, high-consequence events characterize the market-failure layer, and at this layer of risk, government intervention may be necessary offset the high losses.
Risk Pooling	The aggregation of individual risks for the purpose of managing the consequences of independent risks. Risk pooling is based on the law of large numbers. In insurance terms, the law of large numbers demonstrates that pooling large numbers of roughly homogenous, independent exposure units can yield a mean average consistent with actual outcomes. Thus, pooling risks allows an accurate prediction of future losses and helps determine premium rates.
Shock	An unexpected traumatic event such as death in the family or loss of land and livestock, which can be caused by catastrophic weather events or other unexpected phenomenon. Price shocks occur when the price of a commodity changes dramatically due to changes in local or global supply and demand, affecting the livelihood of households dependent on this commodity, for either income or caloric intake. Economic shocks can occur at the micro, meso, and macro levels and can have long-term consequences for the economic well-being of actors at each level.
Slow-Onset Shock	A shock that unfolds slowly, such as drought; it starts unnoticed, and its impact is difficult to assess or may not be recognized until high losses are realized.
Social Safety Net	Various services, usually provided by the government, designed to prevent individuals or households from falling below a certain level of poverty. Such services include free or subsidized health care, child care, housing, welfare, and so on.
Stop Loss	This term, usually applied to reinsurance business, refers to a policy that covers claims once they have exceeded a certain amount. A policy with a stop-loss provision is a nonproportional type of reinsurance, where the reinsurer agrees to pay the reinsured for losses

that exceed a specified limit, arising from any risk or any one event. For example, a reinsurer may agree to pay claims of \$200,000 in excess of \$100,000. If the claims are more than \$300,000, the reinsured (that is, the insurer) will have to bear the remainder of the claims or make additional financing arrangements to cover the remaining risk exposure.

Subsidy

A direct or indirect benefit granted by a government for the production or distribution (including export) of a good or to supplement other services. Generally, subsidies are thought to be production- and trade-distorting and to cause rent-seeking behavior, resulting in an inefficient use of resources.

Transaction Costs

Transaction costs are the financial costs or effort required to engage in business transactions, including the cost or time spent obtaining information. Transaction costs of insurance include those associated with underwriting, contract design, rate making, adverse selection, and moral hazard.

Underwrite

To select or rate risks for insurance purposes.

Weather-Index Insurance

Contingent claims contracts for which payouts are determined by an objective weather parameter (such as rainfall levels, temperature, or soil moisture) that is highly correlated with farm-level yields or revenue outcomes. *See also Index Insurance.*

Yield Risk

Unique to agricultural producers. Like most other entrepreneurs, agricultural producers cannot predict the amount of output that the production process will yield, due to external factors such as weather, pests, and diseases.

Bibliography

AABM (2005). "Shrimp Seal of Quality Program: Bangladesh". AABM Consulting Group, 6 December 2005.

Ahmed, A. U. (1999). "Vulnerability of Forest Ecosystems of Bangladesh to Climate Change, In Vulnerability and Adaptation to Climate Change for Bangladesh". Dordrecht, The Netherlands: Kluwer Academic Publisher.

Al Hasan, R. (2007). "Reducing Vulnerability of the Poor through Social Security Products: A Market Survey on Microinsurance in Bangladesh". International Network of Alternative Financial Institutions, INAFI, Bangladesh, Research Paper, February 2007.

Akter, S. and R. Brouwer. (2007). "Demand Assessment and Test of Commercial Viability of Crop Insurance in Bangladesh". Poverty Reduction and Environmental Management (PREM) Working Paper No. PREM07/15, June, 2007. Copy available at www.prem-online.org.

Bangladesh Bureau of Statistics. (2006). "Agriculture Sample Survey of Bangladesh - 2005 National Volume -1". Dhaka: Bangladesh Bureau of Statistics.

Bangladesh Bureau of Statistics. (2007). "Yearbook of Agricultural Statistics of Bangladesh, 2005". Dhaka: Bangladesh Bureau of Statistics.

Bangladesh Bureau of Statistics (2007). "Bangladesh Data Sheet". Dhaka: Bangladesh Bureau of Statistics.

Bangladesh Bureau of Statistics. (2009). "Statistical Pocket Book of Bangladesh 2008". Dhaka: Bangladesh Bureau of Statistics.

BARC. (1999). "BARC/UNDP/FAO GIS Project BGD 95/006". Dhaka: Bangladesh Agricultural Research Council.

Bryla, E., and J Syroka. (2007). "Developing Index-based Insurance for Agriculture in Developing Countries". *Sustainable Development Innovations Briefs*, Issue 2. March 2007, United Nations.

Chowdhury, M. &. (2001). "An Agricultural Statistical Profile of Bangladesh, 1947 -1999". Working Paper 54, Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses (CGPRT Centre).

Dick, W.J.A. (1998). "Key Elements and Generic Considerations in Crop Insurance Design and Operations". ARM Discussion Paper, Agricultural Risk Management Limited, December 1998.

Eastland Insurance Company (2006). "Annual Report". Eastland Insurance Company Limited.

- FAO. (2004). "FAO Statistical Yearbook - Country Profiles". Rome: FAO.
- FAO. (2005). "Livestock Sector Brief, Bangladesh". Livestock Information, Sector Analysis and Policy Branch, AGAL, Food and Agricultural Organization of the United Nations, FAO, July 2005.
- FAO, a. &. (2007). "Climate variability and change: Adaptation to Drought in Bangladesh". Rome: FAO.
- Government of Bangladesh. (2008). "Damage, Loss, and Needs Assessment for Recovery and Reconstruction after Cyclone Sidr". Dhaka: Government of People's Republic of Bangladesh.
- Islam, T. (2006). "Integrated Approach to Cyclone Wind Analysis and Disaster Planning for Bangladesh Coast". PHD Thesis Texas Tech University .
- Jahan, N., and H. Rahman. (2003). "Livestock Services and the Poor in Bangladesh: A Case Study". Edited by S. Chipeta, an initiative by DANIDA, IFAD and the World Bank, March 2003.
- Khan, S. (1993). "Geomorphic characterization of cyclone hazards along the coast of Bangladesh". *Natural Hazards* , 8:263-281.
- Milliman, J.D., Broadus, J.M. and Frank G. (1989). Environmental and Economic Impact of Rising Sea Level and Subsiding Deltas: The Nile and Bengal Examples. In *Bangladesh Quest. Vol.: 1*, pp 11-12.
- Ministry of Environment and Forests (2008). "Bangladesh Climate Change Strategy and Action Plan". Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, September 2008
- Ministry of Fisheries and Livestock. (2007). "National Livestock Development Policy 2007". Livestock Section -2, Ministry of Fisheries and Livestock, MOFL, Government of the People's Republic of Bangladesh.
- Ministry of Food and Disaster Management. (2006). "National Plan for Disaster Management. 2007-2015". Disaster Management Bureau, Ministry of Food and Disaster Management, Government of the People's Republic of Bangladesh.
- Ministry of Food and Disaster Management. (2008). "*National Plan for Disaster Management 2008-2015*". Disaster Management Bureau, Ministry of Food and Disaster Management, Government of the People's Republic of Bangladesh.
- PREM (2007). "Crop Insurance in Bangladesh: protecting poor famers against natural disasters". Poverty Reduction and Environmental Management, PREM Policy Brief No. 18., June 2007.
- PDO-ICZMP. (2003). "A Systems Analysis of Shrimp Production". Dhaka: Program Development Office for Integrated Coastal Zone Management Plan.
- PROSHIKA. (2008). "Activity Report July 2006 - June 2007". Prepared and Edited by Information and Documentation Resource Cell, IDRC, PROSHIKA.

ProVention/IIASA (2006). “Disaster Insurance for the Poor?” A review of microinsurance for natural disaster risks in developing countries, July 2006.

Quadir, D., Ali, A., & Huh, O. K. (1989). “A study of Vegetation Patterns in Bangladesh with AVHRR Data”. *Asia Pacific Remote Sensing Journal* , Vol 1, No. 2, pp 37-57.

Saifullah, A. (1988). “Embankments for Flood Protection: Success and Failure”. Floods in Bangladesh (pp. 10-12). Dhaka: Institution of Engineers Bangladesh.

Skees, J. R., J. R. Black, and B. J. Barnett. 1997. “Designing and Rating an Area-Yield Crop Insurance Contract.” *America Journal of Agricultural Economics* 79: 430–38.

Taveerul, I. &. (2008). “Tropical Cyclone Wind Characteristics for Bangladesh Coast Using Monte Carlos Simulation”. *Journal of Applied Sciences* 8 (7) , 1249-1255.

Uddin, M. (2008). “Safety standards in shrimp export from Bangladesh to the world’s market”. *Journal of Food, Agriculture & Environment*, Vol. 6 (2) 1 4 0 - 1 4 4.

Watanabe, T. (1993). “The Ponds and the Poor: The Story of Grameen Bank’s Initiative.” Published by Grameen Bank, Mirpur Two, Dhaka 1216, Bangladesh.

World Bank; SARMAP;. (2006). “Bangladesh – Crop Index-based Insurance”. Washington DC: The World Bank

World Bank. (2007)a. “Bangladesh – Increasing Access to Finance for Bangladesh’s “Missing Middle”. Report No. 40128-BD, Finance and Private Sector Development Unit, South Asia Region, Washington D.C., June 2007.

World Bank. (2007)b. “Technical Annex on a Proposed Credit in the Amount of SDR 10.5 million (US\$16 Million equivalent) to the Peoples Republic of Bangladesh for an Avian Influenza Preparedness and Response Project under the Global Program for Avian Influenza and Human Pandemic Preparedness and response”. Report No: T7695-BD, Sustainable Development Sector Unit, Human Sector Development Unit, South Asia Region. Washington D.C. 11 June 2007.

World Bank. (2009)a. “Implications of Climate Change Risks on Food Security in Bangladesh”(draft final). South Asia Region, Sustainable Development Department, ARD, Washington D.C., 10 June 2009.

Mahul O. and Stutley C.J. (2010). “Public Intervention in Agricultural Insurance: Challenges and Options for Developing Countries”. World Bank. Washington D.C, December 2009