Bangladesh:
Agricultural insurance solutions appraisal technical report

WORLD BANK GROUP
GFDRR Global Facility for Disaster Reduction and Recovery
Ministry of the Interior and Kingdom Relations
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Abbreviations

ADB	Asian Development Bank
AI	artificial insemination
AYII	area yield index insurance
BBS	Bangladesh Bureau of Statistics
BFID	Bank and Financial Institutions Division (Ministry of Finance)
CCE	crop-cutting experiment
CIRM	Centre for Insurance and Risk Management
CLP	Char Livelihoods Programme
CV	coefficient of variation
DIISP	Developing Inclusive Insurance Sector Project
DLS	Department of Livestock Services
DOF	Department of Fisheries
DRFIP	Disaster Risk Financing and Insurance Program
EMS	early mortality syndrome
FMD	foot and mouth disease
GIC	General Insurance Corporation of India
HIES	Household Income Expenditure Survey
HYV	high-yielding varieties
IBLI	index-based livestock insurance
IDRA	Insurance Development and Regulatory Authority of Bangladesh
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IRDP	Integrated Rural Development Program
IWM	Institute of Water Modelling
MFI	microfinance institution
MOFL	Ministry of Fisheries and Livestock
MPCI	multiple peril crop insurance
MTT	million metric tons
NDVI	normalized difference vegetative index
NGO	nongovernmental organization
NLDP	National Policy for Livestock Development
NPCBB	National Project for Cattle and Buffalo Breeding
OIE	World Animal Health Organization
PCR	polymerase chain reaction
PICC	People's Insurance Company of China
PKSF	Palli Karma-Sahayak Foundation
PL	post-larvae
PLCF	Participatory Livestock Compensation Fund
PMT	proxy means test
PPP	public-private partnership
RFID	radio-frequency identification
SAARC	South Asian Association for Regional Cooperation
SBC	Sadharan Bima Corporation
SSNP	social safety net program
TSU	technical support unit
VGF	vulnerable group feeding
WII	weather index insurance
WSSV	white spot syndrome virus

Executive Summary

Agriculture is a key sector in Bangladesh, but it is highly exposed to risks. While agriculture is a source of employment and livelihood for nearly one in two adults in Bangladesh and contributes about 16 percent to GDP, it is highly exposed to natural hazards. Indeed, Bangladesh is commonly ranked as one of the most vulnerable countries in the world to natural disasters[1] with agriculture heavily exposed to floods, cyclones, and drought. In 2007, for instance, Cyclone Sidr destroyed 0.69 million ha of cultivated crop lands and killed over 460,000 head of livestock and poultry.

In the past, the government of Bangladesh and development partners have provided substantial support to farmers in the aftermath of large disasters, but this approach has disadvantages in that support is not guaranteed to farmers and may be slow. In the aftermath of Cyclone Sidr, recovery and reconstruction needs were estimated at US$1.3 billion, or 28 percent of government expenditures.[2] In spite of efforts by the government of Bangladesh, the gap between available funding and needs is often large and can reach more than US$1.5 billion in bad years (Air Worldwide and ADPC 2014). Bangladesh often relies on international assistance, as over the past ten years, only 33% of disaster-related expenses has been met by domestic resources. In addition, disaster relief transfers often take substantial time to reach beneficiaries and require to divert resources away from long term development projects.

Agricultural insurance offers the government a planned, fast, ex ante alternative to ad hoc disaster response, one that (1) reduces the ex post fiscal burden on the government, (2) improves farmers' resilience to shocks, and (3) supports the expansion of agricultural credit. Every five years on average in Bangladesh, production shocks lead to a drop of up to 50 percent in crop income available for consumption in average rural households. This drop pushes many small- and medium-scale farmers into poverty. Although many Bangladeshi farmers can access credit, their exposure to risks makes formal financial institutions reluctant to lend to them, so that most farmers borrow from informal lenders at average annual interest rates ranging from 19 percent to 30 percent.[3] Agricultural insurance transfers risk away from farmers, and therefore benefits financial institutions and the government of Bangladesh as well as the farmers themselves.

International experience shows that government can play a variety of roles to support the responsible scale-up of agriculture insurance. Government can invest in a robust legal and regulatory framework, data collection and management, support outreach (through awareness raising or subsidizing of premiums), undertake financing of catastrophic layers of risks, and support insurers in technical tasks such as product design.

1 For example, World Risk Report 2014, United Nations University ranks Bangladesh as the 168th most vulnerable out of the 172 countries in the analysis

2 General government final consumption expenditure in 2008 amounted to US$4.7 billion, according to the World Bank. This category includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures for national defense and security, but excludes government military expenditures that are part of government capital formation.

3 Details on the welfare impact analysis model can be found in the accompanying technical report (*Bangladesh: Agriculture Insurance Solutions Appraisal Technical Report).*

In consultation with the Bank and Financial Institutions Division (BFID) of the Ministry of Finance, the Ministry of Livestock and Fisheries, and other key public and private sector stakeholders, the World Bank Group team has identified four potential types of agricultural insurance to offer in Bangladesh, all of which would require implementation through a partnership between the public and private sectors. The four types are dairy cattle insurance, aquaculture insurance, crop insurance, and fully subsidized agricultural insurance for the most vulnerable. All of these include a variety of design and distribution options, and for three selected options, a detailed fiscal costing and welfare impact analysis has been conducted to serve as a basis for policy decisions.

For the 36 percent of rural households that own cattle, dairy cattle insurance could help unlock access to credit and higher-yielding breeds while stabilizing income in bad years. Welfare impact analysis shows that dairy cattle insurance can reduce expected default rates of financial institutions' livestock lending portfolios and therefore crowd in more productive credit, especially to smallholder producers[4]. By 2020, assuming 10% of national dairy cattle (i.e. approximately 1.1 million cattle) were insured under the program the annual fiscal cost to be borne by the government has been estimated at over US$4 million.

For the 4 million finfish producers and 300,000 shrimp producers, named-peril or all-risks aquaculture insurance products could help intensify production and make coping with large shocks easier. Shrimp insurance is identified as a potential entry point for aquaculture insurance. If the government of Bangladesh decided to explore this option, a formal risk assessment and insurance demand and contract design study would be needed as a first step towards developing and implementing a program.

For the 57 percent of rural households that are small- and medium-scale farmers, area yield index insurance (AYII) for aman and boro paddy (rice)[5] could help unlock access to credit and higher-yielding varieties while stabilizing farmers' income in bad years—and could do so more effectively than current ex-post disaster relief. Welfare impact analysis shows that insurance can mobilize larger compensation to farmers following catastrophic shocks than can existing disaster relief programs; insurance compensation is found to increase crop income by 17 percent in bad years relative to disaster relief programs. In addition, AYII could increase loan repayment by up to 35 percent in bad years and thus allow banks to expand access to formal credit and therefore unlock productive investments. The combined effect of enhanced protection and increased productivity is estimated to result in a 100 percent increase in small- and medium-scale farmers' crop income in bad years, compared to current disaster relief. The annual fiscal costs to be borne by the government for supporting the development of a national AYII program are estimated at between US$6 million and US$9 million in 2020, when about 10 percent of the cultivated area would be insured.

For the most vulnerable households, such as char[6] populations, fully subsidized insurance may offer a cost-effective alternative to traditional ex post disaster relief. For example, using 100 percent subsidized flood index insurance to scale up social protection for the poor and vulnerable bottom 50 percent of char populations could reduce long-term welfare impacts of catastrophic floods, and so result in 5 percent reduction in the averaged long-term poverty rate relative to a traditional social protection program with the same expected budget. Indeed, timely and adequate compensation provided by insurance can reduce the need for destructive coping strategies (such as asset sales or consumption reduction) that can have long-term damaging effects. The estimated total costs for scaling up the current Oxfam flood index insurance program, for example, which would cover 30,000 particularly vulnerable households over the next two years, are about US$1.6 million, or an average of about US$55 per beneficiary.

If the Government of Bangladesh decided to go ahead with support for agriculture insurance, high-level buy-in from a broad range of stakeholders will be necessary, as will partnerships with the private sector. Government may consider: strengthening the overall legal, regulatory, and supervisory insurance environment; developing a centralized database of data for agricultural insurance

4 Interviews with main milk cooperative "Milk Vita" highlighted that cattle loans repayment performance over the past decade has averaged 85%.
5 Paddy accounts for 83 percent of crop income for rural households.
6 River islands formed from sedimentation

purposes; provision of financial support to the program, particularly in the early stages of the program; and establishing a dedicated technical team within government with responsibility for implementation and for providing input to policy. One option for consideration would be for some or all of these activities to be carried out through a project with technical support and/or financial assistance of a development partner with adequate expertise in this field, such as the World Bank Group.

Table 1. Summary of Suggested Policy Options for Design and Distribution of Agricultural Insurance

	Design options	Distribution options	Fiscal cost & welfare impact
Dairy Cattle insurance	Traditioinal indemnity-based livestock accident and mortality cover • Cattle are owned by 36% of rural households (or 10.4 million households), the vast majority of which are small scale producers	5 distribution options: (1) Government-sponsored bundling of insurance with credit for select banks, (2) partner agent model with MFIs and NGOs and commercial banks, (3) partner agent model with dairy cooperatives, (4) underwriting and distributions by MFIs, and (5) community based schemes	A 50% subsidized national dairy cattle insurance program would cost between US$4 million and US$16 million in 2020: • When insurance can unlock credit and induce smallholder producers to switch to haigh value or hybrid breeds and improved inputs, this could allow them to double their productivity
Aquaculture insurance	Named-perils or all-risk insurance cover • 300,000 shrimp producers • 4 million finfish producers	To be assessed (e.g., value chaing stakeholders, banks)	Further research to be undertaken • Potential to double shrimp yields with significant impact on smallholders' income.
Crop insurance	Area-yield index insurace or weather-based index insurance • Paddy accounts for 83% of crop income of rural households	Distribution bundled with agricultural credit: • On voluntary basis or under legal requirement	A %0% subsidized national AYII program for aman and boro paddy would cost between US$6 million and US$9 million in the 2020: • AYII could increase loan repayment by up to 35% in bad (1-in-10) years and therefore unlock productive investments • The combined effect of enhanced protection and increased productivity is esetimated to redsult in a 100% encrease in small and medium-size farmers' crop income in baad years, compared to current disaster relief.
Fully subsidized insurance for most vulnerable	Fully subsidized insurance for the poorest households could be based on a flood index • 83 million people are poor • 30,000 households are particularly vulnerable	to be assessed • Currenbt flood index-based program piloted by NGO distributes payouts through an MFI	Estimated cost of scaling up currect flood-indez program (fromn less than 2,000 to 30,000 beneficiaries) is about US$2 million at the start of the program (2015-2017). • using 100% suybsidized flood index insurance to scale up social protection for the poor and vulnerable bottom 50% of char populations could reduce long-term welfare impacts of catastrophic floods and result in 5% reduction in averaged long-term poverty rate

1. Introduction

In November 2014, the World Bank Group received a letter of request from the Secretary of the Bank and Financial Institutions Division (BFID), Bangladesh Ministry of Finance, for a diagnostic study to investigate the potential of agricultural insurance to do the following: (1) reduce the ex post fiscal burden on the government; (2) improve farmer's resilience to shocks; and (3) support the expansion of agricultural credit.

The World Bank Finance and Markets Global Practice is responding to this request by conducting an agricultural insurance diagnostic study led by a team of Bangladesh-based financial sector experts and international agricultural insurance experts, and primarily financed by the Disaster Risk Financing and Insurance Program (DRFIP), a partnership between the World Bank Group and the Global Facility for Disaster Risk Reduction (GFDRR). The mission of the DRFIP is to support financial strategies to minimize the cost and optimize the timing of meeting post disaster funding needs without compromising sustainable development, fiscal stability, or well-being.

This Agricultural Insurance Solutions Appraisal identifies agricultural insurance options for Bangladesh, as well as their fiscal costs and welfare impact. This report builds both on the comprehensive review of opportunities and challenges for the development of agriculture insurance in Bangladesh, conducted by the World Bank Group in 2010, and on the recent agricultural insurance situational analysis.

This diagnostic could potentially be followed by preparation and implementation. If the government of Bangladesh decides to go ahead with supporting a large-scale agricultural insurance public-private partnership (PPP), the World Bank Group could support the government of Bangladesh in the preparation and implementation phases.

2. Institutional Framework

2.1. Rationale for PPP in agricultural insurance

There is essentially no formal agricultural insurance market in Bangladesh. With the exception of a few small-scale pilots by private insurers and some cattle insurance initiatives by microfinance institutions (MFIs), the private sector is currently not providing agricultural crop and livestock insurance on a material scale. A public sector pilot crop and livestock insurance program was started in the 1980s, but this program was not successful and was subsequently terminated. In addition, there are a few isolated examples of NGOs/MFIs having developed and implemented livestock-credit protection insurance, which compensates against death of the animal during the loan period (World Bank 2015a). This chapter considers possible causes of the failure of the agricultural insurance market in Bangladesh; potential rationales for, and the potential benefits of, a partnership between government and insurers in developing pro-farmer agricultural insurance; and the potential functions that could be assumed by the public and private sectors. The final section presents policy options for consideration.

Index insurance has, in the recent past, been viewed as offering a potential solution for promoting the development of a viable agricultural insurance market. In Bangladesh, a number of small-scale agricultural insurance pilots are commencing. Recent initiatives include (1) a fully subsidized Oxfam-designed flood index insurance pilot for the poor rural farming communities in Sirajganj District, which is being offered by a private insurer, Pragati; (2) the Asian Development Bank (ADB) is starting-up a weather-based index insurance program with Sadharan Bima Corporation (SBC), the public insurer in Bangladesh, which will attract government premium subsidies; and (3) the International Finance Corporation (IFC) is working closely with a private insurer, Green Delta, to develop and pilot weather-based index insurance in Bangladesh.

While investing in the right product is important, a number of fundamental building blocks are also required for building viable agricultural insurance markets. In Bangladesh, the following problems exist:

Lack of agricultural data and statistics. As considered later in this chapter, there isn't enough data on livestock mortality in Bangladesh. This is a serious constraint on the development of a livestock insurance product.

Lack of access to appropriate, audited data by insurers. Although Bangladesh has a well-developed crop production monitoring and weather data system in place, there would need to be further investments before such data could form the backbone of a crop insurance system.

- **Lack of capacity, especially for catastrophe risk.** Insurers do not have the capacity to cover catastrophe risk associated with drought, flood, and other typical agricultural risks. Although

international reinsurance is available, it is expensive, particularly where there is a lack of good-quality data.

- **High distribution costs.** Given that farms tend to be small and spread over wide areas, agricultural insurance typically carries very high distribution costs. These are exacerbated by the lack of established branch or agent networks in the rural areas.
- **High loss-assessment costs.** In relation to traditional indemnity insurance, the costs of assessing losses are usually extremely high, particularly in relation to small insured farm units, where the premium volume generated is usually very low and insufficient to cover the costs of the loss assessment.
- **High development costs.** Index insurance, although lowering the transaction cost, carries extremely high development and other start-up costs. These start-up costs cannot usually be justified by commercial insurers, especially on an individual basis.
- **Expense of premiums.** Small farmers are unwilling, and may be unable, to pay for commercially priced agricultural crop and livestock insurance.
- **Lack of understanding of insurance.** Farmers' poor understanding of insurance reduces the demand for agricultural insurance and may lead to farmers buying, or being sold, inappropriate products.
- **Lack of an enabling legal and regulatory framework.** As considered later in this chapter, the Insurance Act does not support index insurance,[7] and a regulatory framework for microinsurance is still being developed.

Furthermore, free ex post disaster relief often results in the crowding out of insurance. If famers expect post-disaster relief from government, development agencies, or NGOs, they have little incentive to purchase insurance.

International experience suggests that sustainable, scaled up agricultural insurance programs are based on a strong partnership between the public and private sectors, with engagement, innovation, and action from both sectors. Although the lack of an agricultural insurance market in Bangladesh provides a justification for intervention by the government, private sector–only (and public sector–only) approaches could suffer from severe challenges, ranging from inefficient delivery, distribution, and claims settlement in the case of the former to underinvestment in the data necessary for the development of quality insurance products in the case of the latter. Thus, for Bangladesh, a strong partnership between the public and the private sectors is recommended in order to build on the comparative advantages of the respective sectors.

2.2. Public and private sector functions

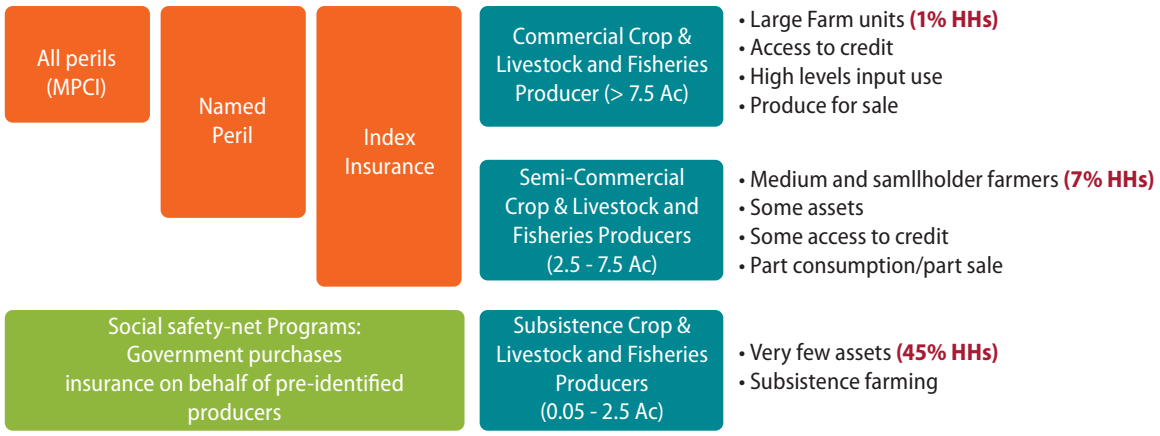
Overview

Few functions are exclusively public sector or exclusively private sector functions. Most may be considered to be shared functions. For example, both the public sector and private sector have separate functions in relation to data, marketing and outreach, and risk financing.

The framework for agricultural insurance and wider risk management will need to support public and private sector institutions to identify, develop, and distribute the appropriate risk transfer solution to each segment of the farming population (figure 2.1). Most traditional indemnity-based crop and livestock insurance products target medium-size to large commercial farmers and livestock producers. On the other hand, index insurance is promoted as a product for the entire market, including small-scale farmers.

7 Note that support for index insurance is included in a proposed bill for a new Insurance Act.

Figure 2.1. Toward an Integrated Private Risk Management and Insurance Framework for Different Segments of Bangladesh's Crop and Livestock Producers



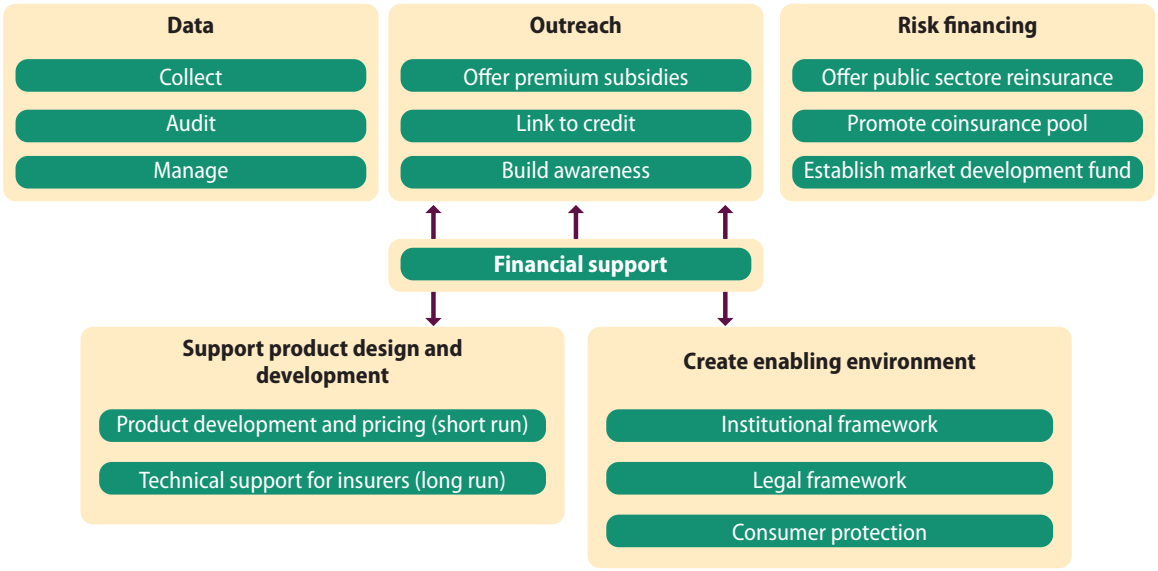
15 Million Farm HHs: Large (>7.5 Ac): 1%; Medium (2.5 - 7.5 Ac): 7%
Small (0.05 - 2.5 Ac); 45%; Marginal/landless (< 0.05 Ac): 47% (BBS 2008 Census)

Sources: BBS 2008.

Note: MPCI = multiple peril crop insurance.

The Bangladeshi agricultural insurance market is subject to market inefficiencies that the government could help to overcome through a number of mechanisms (figure 2.2). These mechanisms may include (1) the collection of reliable agricultural insurance data, (2) appropriate outreach to potential policyholders, (3) provision of or support for the risk financing of the catastrophic layer of reinsurance, (4) support for the design of appropriate insurance products, and (5) establishment and implementation of an enabling legal and regulatory environment.

Figure 2.2. Potential Public Sector Roles for Government of Bangladesh to Consider in Support of Agricultural Insurance Development



The full participation of the private sector is critical for the successful implementation of an agriculture insurance program. The following are considered to be principally private sector functions: (1) product design and rating, (2) risk acceptance and underwriting, (3) decisions over risk retention and reinsurance strategies, (4) supplementary data collection, (5) marketing, and (6) distribution of crop and livestock insurance products.

Product development and ongoing technical support is costly. Given the actuarial and other specialist expertise required to design and price new actuarially sound and sustainable agricultural insurance products and to support their development on an ongoing basis, the costs are likely to impose a

significant entry barrier to commercial insurers. Insurers expect to recover product development costs through the premium paid, over time. However, in the case of agricultural insurance, the high costs and the limited financial capacity of policyholders make this goal unrealistic. Therefore, although product development and technical support are private sector functions, the support of government together with development institutions (such as the World Bank) is likely to be necessary, at least in the short to medium term.

Care will need to be taken to mitigate the risks of crowding out private sector innovation or of providing a subsidy for tasks that the private sector is able to undertake. Once products have been developed and demonstrated to be actuarially sound, insurers should be able to support their continued development; and once agricultural insurance has reached scale, the premiums should be able to support the costs of developing new products.

Functions of the public sector

Data Collection, Auditing, and Financing

Effective insurance solutions require good-quality data, and without it, insurance markets are unlikely to develop in a sustainable manner. To be of sufficient quality for insurance purposes, data must be sufficient and adequate to enable products to be designed and rated, relevant (so that the product offers reliable protection), reliable enough to be acceptable to international reinsurers (whether through audit or otherwise), timely (so that claims can be paid quickly), and cost-effective.

The different categories of risk and the different insurance schemes in Bangladesh require different types of and investments in data. For example, crop and livestock insurance require different types of data, which may be available from different sources, such as crop yield data from the Bangladesh Bureau of Statistics (BBS) and livestock mortality data from the Department of Fisheries and Livestock. Reliable-quality data are useful for monitoring risk on an ongoing basis and informing risk management strategies and systems, but investment in these data can also lead to several additional benefits: (1) the data can be used to improve the Ministry of Agriculture's policy decisions (fertilizer, water, seed, irrigation subsidies); (2) a better understanding of risks at a farm level can empower farmers to undertake better risk management techniques, crowding in good mitigation; (3) the data can put a price on risk, which can be used for example to inform farmers if they should stop growing a crop in a given location.

The government of Bangladesh could play an important role in collecting and making available agricultural insurance data, both for livestock and for crop insurance. Given that the collection and management of most data for agricultural insurance is expensive and nonrivalrous[8], the function is usually more efficiently undertaken through a monopoly. For example, it does not make economic sense for every insurer to set up its own weather stations in the same area to capture the same data or to conduct its own crop-cutting experiments (CCEs); through the Department of Livestock Services (DLS), the government of Bangladesh could perform a very important role in helping the livestock insurers register and tag insured dairy cows and hence develop a livestock database. Thus, the public sector has a natural role to play. The government could commit to making agriculture insurance data publicly available through a transparent process. There may be other sources of data, but the main responsibility for managing data could lie with public sector institutions, as represented in table 2.1.

8 Nonrivalrous goods may be consumed or enjoyed by many at the same time at no additional cost (e.g., national defense or a piece of scientific knowledge).

Table 2.1. Agricultural Insurance Data to Be Managed by Government of Bangladesh

Data type	Public institution in charge of collection
Meteorological data	Bangladesh Meteorological Department (under Ministry of Defence)
Time series crop production and yield data	Bangladesh Bureau of Statistics Department of Agricultural Extension (under Ministry of Agriculture)
Crop and livestock damage data	Department of Agricultural Extension, Disaster Management Bureau, Department of Livestock Services (under Ministry of Fisheries and Livestock)
Further livestock statistics	World Animal Health Organization, Sadharan Bima Corporation NGO/MFIs with livestock compensation schemes

The quality of most publicly collected agricultural insurance data may not meet requirements for international reinsurance. Data are often incomplete, missing, or unavailable, and data collection coverage is low. For example, while the Bangladesh Meteorological Department operates 35 manual weather stations across the country, these are not sufficient to cover all 64 districts of Bangladesh. The DLS 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, it has not been able to establish a regional or national livestock mortality database. Some limited livestock disease data for Bangladesh are available through the World Animal Health Organization (OIE), and mortality data are also available from the SBC and NGO/MFI livestock compensation schemes.

Given the lack of reinsurance-quality agricultural data, a strong audit function is necessary in Bangladesh to ensure data quality and to access to international reinsurance markets. Agricultural shocks are covariate in nature, so access to international reinsurance markets is important to off-load some of this risk outside the country. However, reinsurers have high standards for the data they are willing to use to develop and price insurance products, and will charge significantly higher premiums if they have concerns about the reliability of the data. Therefore, it is important that agricultural data be audited through a transparent process. This will allow local insurers to leverage international reinsurance markets.

The discussion above suggests that considerable investment is required in the collection, management, and audit of data. In order to avoid wasted investment, it would be prudent to undertake a preliminary analysis of the data available from public and private sector sources in Bangladesh. This could be used to direct efforts toward the following:

1. The production of a data "gap analysis"
2. A determination of the types of agricultural insurance products that can be designed with minimum investment in the data infrastructure to fill the data gaps
3. The extent to which data can be sourced externally as a substitute for local data (e.g., satellite/remote-sensing data)

Outreach

The government of Bangladesh could provide general outreach support in relation to agricultural insurance products with the twin objectives of expanding market awareness and in encouraging uptake by farmers to achieve scale. Achieving scale is fundamental to the sustainability of agricultural insurance programs, as this enables the costs of provision to be spread among numerous policyholders. However, low levels of financial literacy in the target market and poor understanding of the potential benefits of insurance often prevent programs from reaching scale. Although the marketing of specific insurance products is a function belonging to insurers, government can play a more general role aimed at building (1) financial literacy among potential policyholders and (2) an understanding of the types and potential benefits of agricultural insurance.

Caution must be exercised by government in carrying out this function. Experience has shown that insurance products should be made available (through necessary distribution channels) before

the government embarks on consumer education campaigns. Therefore, when considering the development of financial awareness campaigns, it is important to ensure that associated products are also developed and offered in tandem.

The government of Bangladesh could consider various ways to support outreach for agricultural insurance products:

1. Linkage to rural lending. Rural banks and MFIs have the potential to reach a large number of rural farmers in Bangladesh. Linking agriculture insurance to rural credit could have the potential to achieve wide-scale outreach, while at the same time deepen access to financial services. The imposition of a legal obligation to purchase insurance on taking agricultural insurance can lead to poor incentives. However, banks may impose the requirement as part of the package that they offer to farmers, and this can be supported by government.
2. Financial literacy campaigns. Unless potential policyholders have a basic level of financial literacy, it will be difficult for insurers to sell agricultural insurance products. With a greater degree of financial understanding, farmers can better weigh the risks and benefits of insurance products. Again, it is expected that the union councils will play an essential role in this.
3. Raising awareness of insurance. Potential policyholders will not purchase insurance without an understanding of the types and benefits of agricultural insurance. Ensuring they have this understanding should be regarded as a shared role. Government may be better able to utilize the media, such as radio, newspapers, and television. However, this is not likely to be effective unless the private sector also plays a role, by providing effective training to insurance agents and by developing clear product documentation.

The government of Bangladesh and union councils also have roles to play here. In relation to financial literacy and market awareness campaigns, the development of a strategy is a government function, whereas the function of the union councils is to lead implementation through the devolution process.

FInancial support

Any subsidies to agricultural insurance should be designed with a clearly stated and well-documented policy objective, and should be designed to address a market failure or equity concern. Subsidies on agricultural insurance premiums should be carefully considered and targeted. Policymakers should carefully identify their objectives, such as which beneficiaries, crop or livestock sectors, and regions to target, and whether the subsidies will be provided for a limited period or in perpetuity. This ensures that the subsidies are "smart" in that they minimizing distortions in the market and mis-targeting of clients, whilst crowding in the private insurance industry.

Premium subsidies are widely used by governments to support agricultural insurance markets, but are not always the best way to structure financial support to agricultural insurance. A review of agricultural insurance programs in 65 advanced and emerging countries finds that almost two-thirds of the surveyed countries, including low, middle and high income countries, provide substantial agricultural insurance premium subsidies (Mahul & Stutley, 2010). Premium subsidies can reduce the cost of insurance to the farmer, and thereby increase utilization of insurance particularly for more vulnerable farmers and herders, and can support insurance companies to develop a minimum sustainable market size. However, if not used carefully, subsidies can distort price signals and provide inappropriate incentives to farmers and herders (e.g. have an adverse effect of encouraging them to take more risks or continue engaging in risky activities).

Instead, during the early years of agricultural insurance programs, a combination of investing in data and providing public reinsurance to complement private sector reinsurance can be a cost effective alternative to premium subsidies. Like premium subsidies, such a combination can reduce the cost to the farmer, and support the development of a minimum market size, but can also address a market inefficiency typically faced by new programs: New agricultural insurance programs will typically require substantial investments in infrastructure for collecting, auditing and managing data to the standard demanded by international reinsurers. However, it will take some time before sufficient data is available to fully access international reinsurance on competitive terms. For example,

building a reinsurable dataset for area yield index insurance will take about three to five years. In the interim period, whilst new data is being invested in, government can supplement international reinsurance to ensure that farmers are able to purchase reliable insurance at attractive prices. Over time, as international reinsurers become more comfortable with the new data collection procedure and reinsurance becomes affordable to insurers, government may revert to channeling financial support through premium subsidies.

The government of Bangladesh could discuss catastrophic risk with private insurers and reinsurers, and if needed might consider the provision of some form of excess of loss reinsurance to help manage the covariate nature of catastrophic risk. Given that much agricultural risk is associated with weather risk, pests, or disease, all of which can have widespread effect, insurers writing agricultural insurance are exposed to potentially significant catastrophic risk. Catastrophe risk is usually the most expensive layer of risk due to the need for a higher capital loading, even where high-quality data are available. The loading is increased significantly if the data are of poor quality, as insurers and reinsurers must add an uncertainty loading into the price. International experience has demonstrated the efficiencies gained by splitting the risk into layers and by having government participate in risk financing through reinsuring the catastrophe layer. For example, under the Mongolian livestock insurance scheme, which has now reached national scale, the layers are handled in this way:

1. The first layer of risk (up to 6 percent livestock mortality), which covers the more frequent low-impact events, is borne by the insured livestock herders.
2. The second layer of risk (between 6 percent and 30 percent livestock mortality) is covered by commercial insurers, through a pool, for which the policyholders pay a fully priced rate[9] (the noncatastrophic layer of risk).
3. The third layer of risk (over 30 percent), (i.e., the catastrophic layer of risk) is covered by the government under a stop loss agreement entered into with the commercial insurers. The Government does not make any charge for the stop-loss agreement.

The commercial insurers reinsure part of their liability under the commercial layer to the international reinsurance market, and similarly, the government reinsures a portion of its risk under the catastrophic layer to the international reinsurance market (Mahul and Skees 2007).

This risk financing approach could be considered for livestock insurance in the Bangladesh context. Given the limited availability of data and need to develop affordable products for farmers, the government's involvement in risk financing could allow for significant benefits for a livestock insurance program. In order to achieve the most efficient pricing for the risk, the government could consider in the medium term a risk layering approach similar to that used in Mongolia, where government provides support for the higher layers of risk.

The merits of providing agricultural insurance through some form of a coinsurance or pool arrangement are reviewed later in this chapter. Although the establishment of nonstatutory coinsurance pools is a private sector function, the initial drive for this may need to come from the public sector. See below for more details.

Setting and Implementing an Enabling Legal and Regulatory Environment

A number of general considerations should be taken into account in regard to an enabling legal and regulatory environment. Traditional indemnity-based agricultural insurance is a line of general insurance that should be regulated just as any other line of insurance, although special regulatory provisions may be required in relation to catastrophe risk. Recognizing that the current Insurance Act and Regulations do not enable Bangladesh to comply with international standards, the Insurance Development and Regulatory Authority (IDRA) could develop a new Insurance Bill and Insurance Regulations that would enable substantial compliance with international standards.

9 The fully priced rate includes the full price of the risk and an administrative loading to cover the ongoing costs of the insurers, although not the development costs.

It is necessary to establish an appropriate legal framework for index insurance. The position in relation to index insurance is somewhat different than for traditional indemnity-based insurance. Given that index insurance pays against an agreed index rather than on the basis of actual losses, there has been considerable discussion internationally as to whether index risk transfer products can be properly classified and recognized as insurance at all. As the current Insurance Act does not recognize index-based insurance, the introduction of index insurance products carries both legal and regulatory risk. The new Insurance Bill should state that index risk transfer products are classified as insurance. The bill should also provide for the authority to make supporting regulations concerning index insurance. The enactment of such a bill would significantly reduce the legal risks associated with the development of new index insurance products.

The primary responsibility for the implementation of the legal and regulatory framework for insurance lies with the IDRA. Once a new Insurance Act has been enacted, the IDRA will need to issue appropriate regulations.

It is recommended that the IDRA consider including at least the following in relation to index insurance:

1. Detailed criteria for determining whether an index product can be classified as insurance
1. Provision for composite (i.e., index and traditional) products and dual-trigger products
2. General requirements in relation to indexes aimed at reducing basis risk
3. Restrictions on persons to whom index insurance may be sold (aimed at ensuring an appropriate insurable interest)
4. Key requirements for issues to be included in the policy document
5. Specific provisioning requirements
6. Consumer protection requirements

The issuance of regulations will significantly mitigate the regulatory risk associated with index insurance.

Consumer protection is relevant to both traditional and index insurance. Consumer protection concerns are often exacerbated in a rural context, where farmers lack financial literacy and a full understanding of both the product's details and its broader implications. It is recommended that the IDRA issue consumer protection regulations that cover, at least, the following:

- **Poor-value products: low client value, minimal basis risk, etc.**
- **Disclosures: product, benefits, premium rates, etc.**
- **Unfair contract terms**
- **Delays in insurance payments**

A number of countries have specific agricultural insurance legislation. Agricultural insurance legislation is not usually intended to cover regulatory and supervisory issues, but rather to make statutory provision for a specific institutional framework (such as a statutory coinsurance pool or statutory reinsurance arrangements) and to govern the provision of subsidy. In relation to subsidy, the legislation may obligate government to provide a certain level of subsidy, to take the subsidy outside the usual budgetary process, and/or to establish a framework or arrangements to govern the use of the subsidy to ensure that it is not improperly channelled or used inefficiently. Such a legislation could include establishing a body to make decisions relating to the subsidy, audit processes, etc. In Turkey, the agricultural insurance legislation covers the establishment of a coinsurance pool, risks to be insured by this pool, its income and expenses etc. It clearly specifies the governmental body who is responsible for calculating subsidies, and the inclusion of these subsidies in the budget (The Agricultural Insurance Law 2005). In USA, the federal crop insurance act addresses establishment of a federal agency that offers crop insurance (Federal Crop Insurance Act 2009). The Spanish government enacted legislation to create a national agricultural insurance program to provide subsidized agricultural insurance to farmers (Mahul and Stutley 2010). Whether or not such legislation is required in Bangladesh will depend on the institutional framework that is eventually adopted and the level and types of subsidy that are to be provided for in the long term. It is therefore too soon to make recommendations in relation to this issue.

Driving the process for change

Considerable work would be required to build the necessary foundations for agricultural insurance, to design and market appropriate products, and to establish an appropriate institutional framework. As discussed, meeting these objectives would require the active involvement of both the public and private sectors, without which it will not be possible to develop a mature, scaled-up agricultural insurance market in Bangladesh. However, it is unlikely that the process will even commence unless the government of Bangladesh takes the initiative and drives the process by encouraging insurers to engage and to collaborate at the initial stages for establishing an agricultural insurance market.

Functions of the private sector

Data

Private sector insurers play a primary role in the collection of some product-specific data. Although the collection, management, and audit of aggregate weather and agricultural data are primarily public sector functions, commercial insurers have functions in relation to the collection and storage of product-specific data, such as data relating to sales, distribution, and claims.

Data collection, auditing, and / or management require both public and private sector engagement. International reinsurance companies will require that a party other than the government be involved in either the collection or auditing of the data; this will ensure data are collected and audited independently and in a transparent manner. This leaves a key role to play for the private sector.

The private sector could also contribute toward the cost of collection and management of agriculture data. For example, an access fee could be levied on all who wish to use the data. This approach is, for example, adopted for motor third-party liability insurance in Turkey, where the government is responsible for the collection and management of data. All insurance companies that wish to use this data to develop and price insurance products must pay an (equal) access fee. What is important here is that the data are equally available to all users on the same terms, to encourage competition.

As the design and rating of agricultural insurance products are also private sector functions, private sector insurers should play a role in advising the government of Bangladesh on their data needs i.e., (1) the data they require; (2) the form in which the data are required; and (3) the necessary quality of the data.

The private sector can play a key role in developing and providing commercially available data. Data that are publically available from commercial providers, such as livestock mortality data from MFIs, may be an acceptable substitute or proxy for data that are not available through the public sector and line ministries in Bangladesh. If products can be designed using data from the commercial providers, it may be more efficient to use these data than to establish systems for collection, management, and storage of the same data in Bangladesh, even if the public sector contributes toward the cost of building such a database. The feasibility of using such data should form part of the data gap analysis recommended later in this chapter.

Outreach

Outreach and product marketing are primarily private sector functions. As indicated, the public sector may have a role to play in raising financial literacy and general awareness concerning agricultural insurance, but outreach should be regarded as part of distribution, which is clearly a private sector function. Insurers sell insurance and, even if public sector agencies are used as part of the distribution process, overall responsibility for marketing and sales should remain with the private insurer. Furthermore, the private sector can (1) better employ innovative distribution channels (e.g.. using mobile phones as a point-of-sales device[10]); (2) leverage the significant outreach infrastructure in place; (3) respond quickly to shifts in the market; and—most importantly—(4) increase speed, scale, and the effectiveness of outreach through competition among private insurers.

10 Other distribution channels include cash-based retailers, utility companies, or third-party bill payment providers. For a discussion of innovative distribution channels, see Smith, Smit, and Chamberlain (2011).

Design and Development of Agricultural Insurance and Related Tasks

Insurers are responsible for the design and development of agricultural insurance products, but there may be public sector support in the short to medium term. There may be a strong argument for the public sector providing financial and other support for the design and development of agricultural insurance products, particularly in the early years when the costs would be unsupportable through the farmer premiums.[11] However, design and development remain private sector functions. Insurers are required to take full responsibility for the insurance products that they sell, including the actuarial pricing of those products, which needs to be approved by IDRA as per regulation.

Specialized professional and technical skills and experience are required to design, develop, and price all insurance products, including agricultural insurance products. Where insurers do not have the resources in house, they are permitted to use outsourced resources, which could include a publically funded body or unit; but insurers remain fully responsible for all outsourced services, including those provided by or through the public sector. The institutional framework must be designed with this in mind.

Claims adjustment and settlement are also private sector functions, due to their complexity and highly specialised nature.

Private insurers must have responsibility for the proper training of their insurance and distribution staff. Given the highly technical nature of agricultural insurance, it is important that insurance staff have the required skill set to carry out their tasks. Thus, appropriate specialist training, in particular for agricultural insurance underwriters and loss adjusters, should be undertaken. To ensure long-term sustainability of the approach, and given the expertise of private insurers, this function should be taken on by the private sector. However, this is another area in which public financial and other support could be provided in the early years, particularly in relation to new and technical areas, such as index insurance.

Risk Financing

Underwriting agricultural insurance products and financing the risk is a core private sector function. Insurance business is the acceptance of insurance risk and the financing of that risk. Although the public sector may have some risk financing functions, as described, the function primarily belongs to private sector insurers. Insurers are required by the legal and regulatory framework, and the IDRA, to take responsibility for the management and financing of their insurance risk.

Through pooling and diversifying their insurance risk, insurers are able to reduce the price of the risk, which should result in lower premiums to policyholders.

Insurers may reinsure their insurance risk with national, regional, or international reinsurers as a substitute for holding capital to support that risk. The negotiation and conclusion of reinsurance contracts is part of the risk management process for private insurers. Therefore, even where the public sector offers risk financing support, for example in relation to catastrophe risk, insurers must decide whether that support is adequate to enable them to underwrite the products.

2.3. Institutional framework

First steps

Establishment of a Task Force

Development of an appropriate institutional framework would require much work and important policy decisions. One issue, for example, is to what extent the government of Bangladesh is prepared to provide short-, medium- and long-term financial and other support to agricultural insurance. The considered views of stakeholders will need to be sought, including various government

11 See the discussion above.

departments and agencies, union councils, the IDRA, and insurers. The design of a firm and final institutional framework at this stage would therefore be premature.

International experience demonstrates that agricultural insurance is more likely to succeed under a PPP that is formalized in a well-designed institutional framework. International experience has also demonstrated that the establishment of the institutional framework is a necessary precondition for the design of specific agricultural insurance products. One of the reasons for the failure of many donor-funded pilots to scale up is the lack of institutions to follow through once the donors or development agencies have left. It is important, therefore, to give priority to the institutional framework even ahead of product design.

The government may wish to consider forming a task force to examine options for an institutional framework with representation from the government and the private sector.

- The duties of the task force should include the consideration of
- The appropriate functions of the public and private sectors
- The options for an institutional framework
- The institutional frameworks already operating in other countries and the experiences and lessons learned in those countries
- The applicability of international experience in the Bangladesh context
- The legal and regulatory implications, including whether specific legislation or regulations will be required

Institutions

Given that the financial sector functions are overseen by the Ministry of Finance, particularly BFID, it is important that BFID play an active role in directing public policy for agricultural insurance.

The public insurer, SBC, could play the role of an apex agricultural insurance body that assists private sector companies in developing agricultural crop, livestock, and aquaculture insurance. The role of SBC as an agricultural insurer and reinsurer needs to be defined by BFID. There could be a very important role for SBC to play as a reinsurer of the 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 small-farm FONDOS mutual crop and livestock scheme in Mexico. Given that private insurers in Bangladesh are already reinsuring part of their portfolio with SBC as per regulation requirement, they could very easily reinsure agricultural insurance with SBC under an excess of loss or stop-loss agreement for the catastrophic layer of risk (as described in section 3.2). BFID could also assign SBC to manage an agricultural insurance subsidy fund, or it could elect to distribute premium subsidies to private insurers through SBC.

The institutional framework will need to cover monitoring, supervising, accounting, and auditing for any public sector subsidy provided, and it will also need to cover advising the government of Bangladesh on the fiscal implications of premium subsidy provision. It is important that certain core functions are undertaken by the government. These functions include (1) coordinating the implementation of the PPP from a policy perspective; (2) conducting original risk assessment and risk mapping studies; (3) assisting private sector insurers in product marketing and education programs for farmers, including the allocation of subsidies; (4) providing data and statistics and assistance in design of agricultural insurance product; (5) conducting program research and development; and (6) coordinating donor technical assistance programs for agricultural risk management and insurance in Bangladesh.

The government of Bangladesh could consider establishing a Bangladesh agricultural insurance technical support unit (TSU) to develop a local center of expertise in the design, rating, and implementation of agricultural insurance; this would provide technical services to insurers that are interested in implementing crop, livestock, or aquaculture insurance programs. (World Bank 2010).The TSU would assist the insurance industry and its distribution 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. The TSU would have a small technical staff of two or three agricultural insurance specialists and would report to a steering committee of public and private stakeholders. Should the government of Bangladesh, insurance industry, and other potential stakeholders be interested in this proposal, the first task of the task force would be to identify the functions of the TSU. A detailed business plan for the TSU (including staffing, costings, tasks, and projects) could then be drafted (Mahul and Stutley 2010).

The TSU would provide technical assistance to enable all insurers in Bangladesh to do the following (World Bank 2010):

- 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, functions, and benefits of risk transfer and insurance.

However, the establishment of a technical support unit is not the only option. For example, if the private insurers went the route of a fully incorporated, capitalized, and staffed pool insurance company, the technical support unit would not be required, since it could be formed as part of the managing underwriting unit of the pool.

Coinsurance and coinsurance pools

As it is unlikely that a fully competitive insurance market will be viable in Bangladesh, the task force should give consideration to establishing a coinsurance pool.[12] The high costs of designing and distributing agricultural insurance to small farmers creates the need for some form of cooperation between insurers. Establishing a coinsurance pool would also enable the pooling of risk, which should result in lower insurance premiums.

There are many ways to structure a coinsurance pool, each with different features, advantages, and disadvantages, though all should entail the core principles detailed in box 2.1.

Box 2.1. Core Principles for Coinsurance Pool

There are four core principles for a coinsurance pool:

1. Insurers share the costs of certain core activities, such as product design and the pricing of products.
2. Certain administrative costs are shared, such as claims administration.
3. Other activities may be shared, depending on the pool design, including distribution costs.
4. There is at least some risk pooling. This may include presenting a pooled portfolio of insurance to reinsurers to facilitating a lower reinsurance cost. Risk pooling should reduce the cost of risk, which would lower the cost of the premiums.

Source: Mahul and Stutley 2010.

12 Possible options for coinsurance pools are set out in annex 1.

Box 2.2. Benefits and Limitations of Coinsurance Pool Arrangements

Benefits

Coinsurance pools offer economies of scale through operating as a single unit with shared (pooled) administration and operating functions. Costs savings are due to

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

Pools offer cost advantages: companies save by purchasing common account (pooled) reinsurance protection rather than trying to place their own reinsurance program. Advantages are due to

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

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

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

There are various advantages to coordinating government support to a pool under a PPP: It is much easier for governments under PPP arrangements to coordinate agricultural insurance policy, planning, and specific support functions (e.g., provision of premium subsidies, research and development, education and training, data collection and maintenance) under a single insurance entity (the pool) than it is to try dealing with individual insurers, each of which may have very different priorities for agricultural insurance.

Limitations

A pool may act as the sole agricultural insurer, resulting in lack of competition in the market in terms of the following:

- Range of products and services offered by the monopoly pool underwriter
- Restrictions on the range of perils which are insured
- Restrictions on the regions where agricultural insurance is offered and/or the type of farmer insured
- Lack of competitiveness in premium rates charged by the pool

Source: Mahul and Stutley 2010.

3. Livestock Insurance

At the request of the secretary of the Ministry of Fisheries and Livestock (MOFL) the World Bank Group is exploring opportunities to develop suitable insurance cover for the dairy cattle sector in Bangladesh. This work is being conducted in conjunction with the DLS. This chapter presents a review of the options and challenges for introducing dairy cattle insurance into Bangladesh along with associated fiscal and economic analyses to aid the government of Bangladesh in its decisions.

3.1. Context

Importance of livestock in Bangladesh

Livestock, including dairy cattle, buffalo, goats, and poultry, plays a very important role in Bangladeshi mixed-farming systems as a source of employment, assets, cash income, and improved nutrition, particularly for landless households and female farmers. Overall the livestock and poultry sector contributes about 1.8 percent of GDP and 14.1 percent of agricultural GDP, and it is the third-largest export earner, mainly in the form of hides (DLS 2013–2014 estimates).

A high proportion of the rural population is involved in small-scale livestock and poultry production both for on-farm consumption and for sale of meat, hides, milk, and eggs. According to the 2009 national livestock and poultry survey, 10.4 million households (36 percent of the 28.7 million total rural households) own cattle, for a total of 26.8 million head of cattle and implied average of 2.6 cattle per household owning cattle, and on average 1.5 cows per household. Only 4.06 percent of the cattle herd comprises improved/crossbred cattle (BBS 2010). Goats are owned by 6.4 million households (22 percent of total rural households), for a total of 16.24 million goats[13] and implied average of 2.5 goats per household, followed by much smaller numbers of buffalo, sheep, and swine. Chickens are owned by 15.5 million households (54 percent of rural households), with a 2009 estimated national flock size of 112.4 million birds (BBS 2010).[14]

Causes of Livestock losses

Severe losses are incurred in livestock during major cyclone and flood events. According to BBS data, between 1986 and 2007 a total of 1.1 million head of livestock (cattle, water buffalo, sheep, goats, and poultry) were killed by floods, while a much higher number of animals—3.2 million—were killed by cyclones and associated storm surge. The largest single loss of livestock in Bangladesh was reported under Cyclone Sidr in 2007, with 1.78 million dead animals (International Federation of Red Cross and Red Crescent Societies 2010).[15]

13 The BBS estimate of national goat numbers is much lower than the 2008–2009 DLS-MOFL estimate of 22.40 million head of goats reported in BBS (2013).

14 This compares with DLS-MOFL's estimate of 228.0 million chickens in 2008–2009 (BBS 2013).

15 See also the accompanying situation analysis (World Bank 2015a) for further details of BBS livestock mortality data due to flood and cyclone.

For livestock the value of losses includes not only the market cost to replace the dead animal, but also the consequential loss of production and income from sales of output. In the case of the 2007 floods, the livestock losses included deaths of animals and poultry due to drowning; loss of milk, meat, and egg production; and infrastructural damage to cow sheds, etc. valued at Tk 609 million (1.3 percent of the total losses in the agricultural sector. Under Cyclone Sidr, most of the livestock losses were caused by tidal surge that drowned the animals and poultry. There was also destruction of animal and poultry sheds, fodder, and pasture. The estimated value of damage to the livestock sector was Tk 1.3 billion (US$19.3 million), or 4.4 percent of agricultural sector total losses (GOB 2008).

Flooding not only causes death of livestock due to drowning but is also often associated with increased disease outbreak and mortality, due to contaminated drinking water or grazing. For example, blackleg (or black quarter) disease (*Clostridium chauvoel*) is an acute infectious and highly fatal disease of cattle and other ruminants that is soil-borne and tends to occur during the rainy season; it is spread by ingestion of contaminated grazing/feed and contamination of wounds. Similarly, anthrax disease outbreak in animals is associated with the high humidity and high temperatures experienced in the monsoon season. Flooding also leads to deteriorated fodder and grazing availability, and under-nourished animals become more susceptible to diseases.

In Bangladesh, the major diseases in cattle include anthrax, blackleg, hemorrhagic septicaemia (HS), and foot and mouth disease (FMD). Bangladesh is a member of the OIE: anthrax, HS, and FMD are all notifiable diseases that must be reported to OIE. The OIE website shows that between 2007 and 2013, anthrax and HS were "present but without quantitative data" in Bangladesh. FMD was "present but without quantitative data" from 2007 to June 2011, following which Bangladesh was reported "free of FMD" for 12 months, between July 2012 and June 2013. Since July 2013 no information has been reported to OIE on the status of these notifiable diseases.

Bangladesh does not maintain a national database of livestock mortality arising from natural perils and diseases, and therefore it is difficult to quantify mortality rates in each species of animal. According to a recent Palli Karma-Sahayak Foundation (PKSF) microinsurance market assessment survey,[16] for cattle the mortality rate is 5.43 percent a year in the sample areas (PKSF 2013). However, DLS advises that the mortality rates for managed dairy cattle enterprises are much lower, at no more than 1 percent to 2 percent a year.[17] The Sajida Foundation reports mortality levels of <1 percent in the cattle owned by their members.[18]

The lack of a formal national livestock mortality database for reporting and recording is identified as a constraint for underwriters seeking to design and rate livestock insurance products and programs for different classes of livestock and poultry.

Animal health services and livestock vaccination programs

DLS is active in conducting vaccination programs for the major diseases in cattle, buffalo, sheep, goats, and poultry through its livestock extension services. In 2012 Bangladesh had more than 1,600 public sector veterinarians involved in animal health activities, public health activities, and laboratories, and a further 2,500 independent private veterinarians. In addition, Bangladesh has a large network of field-level veterinary paraprofessionals, including 3,600 involved in animal health activities and 1,000 community animal health workers (DLS 2013). The DLS is involved both in the production of livestock and poultry vaccines and in the provision of free vaccination services to livestock producers. DLS provides routine (preventative) vaccination of animals and treatment in the event of a disease outbreak: in the case of cattle and small ruminants, diseases are treated as opposed to using a stamp-out approach (official culling of animals). For cattle, DLS provides free vaccinations for the four main diseases (anthrax, blackleg, HS, and FMD). Blackleg is almost entirely preventable by vaccination, and this also applies to a greater or lesser extent to anthrax, HS, and FMD. DLS publishes monthly reports on

16 The PKSF microinsurance market assessment survey was conducted in 2011 with a total of 3,490 households drawn from all seven administrative divisions of Bangladesh.

17 DLS personal communication, January 2015.

18 Meeting between World Bank Group and Sajida Foundation, March 2, 2015.

the numbers of cattle (and sheep, goats, and poultry) that are vaccinated though their programs.[19] DLS is not able, however to provide time-series data on the number of disease outbreaks by type of disease and the corresponding number of deaths of each class of animal for each disease outbreak.

Livestock insurance in bangladesh

In 2015 very few farmers in Bangladesh have access to livestock or crop insurance. The micro-insurance market in Bangladesh comprises the products offered by (1) private commercial insurance companies, (2) the two state public insurance companies, and (3) MFIs and NGO's. In 2015 no company is offering crop insurance, and in the case of livestock, only the MFIs are marketing livestock-investment loan insurance. The PKSF national microinsurance market assessment survey, conducted by the Palli Karma-Sahayak Foundation in 2011 with 3,490 microcredit-borrowing urban and rural households predominantly involved in agriculture, showed that no respondents had access to crop insurance, and only 1.4 percent of respondents had access to some form of livestock insurance (PKSF 2013). Since this survey was conducted, PKSF has been active in promoting livestock loan insurance for beef fattening through its affiliated MFIs, but still the overall percentage of livestock owners with livestock mortality insurance protection for their animals remains very low, at no more than about 2–3 percent of livestock owners.

The non-life private and public insurance companies in Bangladesh have been reluctant to invest in developing livestock insurance products and services for the nations' livestock producers. No private commercial insurance company has ever underwritten livestock insurance in Bangladesh. The state-owned non-life insurer SBC launched a pilot cattle insurance program in 1980, which was designed as a voluntary insurance program, but with linkage to cattle loans financed by Bangladesh Krishi Bank and other state commercial banks. The policy insured against mortality due to accidents and named diseases in cattle, but excluded epizootic or Class A epidemic diseases, catastrophes, poisoning and starvation of animals, and theft. The sum insured was based on the value of the loan, and the policy carried a flat premium rate for all insureds that varied over time, from a low of 3.0 percent to a high of 5.0 percent. The SBC cattle insurance program operated for 24 years, but failed to achieve commercial scale-up and was eventually withdrawn by SBC in 2008 (table 3.1).

Conversely, the NGOs and MFIs have taken an active interest in developing livestock insurance programs over the past 35 years. Starting in the early 1990s, several of the large MFIs began offering livestock-credit insurance to their members, including Grameen, Proshika, Pallid Bikes Kendra (PBK), Dust Sashay Kendra (DSK), and Gina Unnayan Kendra (GUK). In 1990, Proshika was the first MFI to introduce a livestock mortality loan protection scheme under its Participatory Livestock Compensation Fund (PLCF). The PLCF was linked on a compulsory basis to Proshika's revolving credit fund for cattle, sheep/goat, and poultry rearing. The PLCF policy compensated against the "sudden death" of insured livestock and poultry during the loan repayment period (usually 12 to 24 months), and it was in effect an all-risk livestock accident and disease policy. Between 1990 and 2009, Proshika achieved both significant coverage under its compulsory livestock-credit insurance program (insuring a total of more than 140,000 cattle and goats) and positive underwriting results. The Grameen Fisheries and Livestock Foundation (Grameen Moshto Pashusampad Foundation, GMPF) introduced a livestock-credit compensation scheme for members of its Community Livestock and Dairy Development Project. Livestock producers who accessed dairy cattle investment loans were protected under a livestock mortality compensation scheme provided by the Livestock Insurance Fund. This program insured against death of the dairy cow where this was "outside the control of the owner," and was also an all-risks livestock mortality policy. The sum insured was equivalent to the amount of loan taken out to purchase the cow, and coverage terminated once the loan had been repaid (usually over a maximum of two years). Between 1999 and 2006, the Grameen Bank livestock insurance program insured a total of slightly more than 7,000 dairy cows, with an average mortality rate of 2.8 percent and insurance loss ratio of 75 percent. (See table 3.1 for further details of the results of these programs).

Since 2010, PKSF has been assisting a group of 40 MFIs distributed throughout Bangladesh to design, rate, and pilot test a range of microinsurance products, including life, health, and

19 For example in its December 2014 report DOL reported the following numbers of cattle vaccinated to date: anthrax, 834,530, blackleg 367,230, HS 346,320, and FMD 273,152.

livestock insurance. PKSF's assistance is being provided through the Developing Inclusive Insurance Sector Project (DIISP) 2010–2014, which is funded by a grant of US$2 million from the Japan Fund for Poverty Reduction and administered by the ADB. The project aims to reduce the vulnerability and improve the welfare of the poor through improved access to reliable and affordable risk mitigation services (microinsurance), building on the existing microinsurance services offered by MFIs.

The DIISP livestock insurance policy is a livestock-credit insurance policy specifically designed for MFIs so they can protect their loans to members under a beef-fattening program. Livestock insurance is compulsory for any borrower. The insurance policy protects against death of the animal due to conventional mortality, natural catastrophes, and epidemic diseases, and the sum insured is based on the value of the loan; in the event of the death of the animal, 100 percent of the loan borrowed from the MFI is waived. The DIISP-designed policy carries a flat premium rate of 0.7 percent for a six-month cover period. The borrower can also purchase life insurance on the livestock loan for a further 0.3 percent premium payment (PKSF 2014). In 2014, 28 out of the 40 selected MFIs offered livestock (cattle) insurance to their members, and 343,508 beef cattle were insured up to October 2014, generating a premium of Tk 52.4 million (about US$0.70 million) against paid claims of Tk 19.4 million, with an implied loss ratio of only 37.1 percent (table 3.1).

Table 3.1. Results of Formal and Informal Livestock (Cattle) Insurance Programs in Bangladesh

Name of Program	Years Operational	No. Insured Policies	No. Insured Cattle	TSI (BDT 000)	Premium (BDT 000)	Premium rate %	Number of Cattle Deaths	% Mortality rate	Paid Claims (BDT 000)	Loss Ratio %
SBC [1]	1981 to 2008	1,026	7,591	162,107	5,734	3.54%	92	1.2%	3,221	56%
Proshika [2]	1990 to 2009	11,739	140,736	597,736	31,393	5.25%	4,855	3.4%	21,300	68%
Grameen [3]	2001 to 2008	n.a.	7,015	n.a.	n.a.	n.a.	194	2.8%	n.a.	n.a.
PKSF [4]	2014 (to Oct)	n.a.	343,508	n.a.	52,393	0.70%	953	0.3%	19,445	37%
Sajida Foundation [4]	2014 (To Dec)	n.a.	566	n.a.	108	0.70%	7	1.2%	174	161%

Source: World Bank Situation Analysis 2015
Notes:
[1] Traditional cattle accident & mortality insurance policy
[2] Livestock-credit insurance policy for cattle and shoats and poultry (cover for up to 2 years)
[3] Livestock-credit insurance policy for dairy cattle (cover for up to 2 years)
[4] Livestock-credit insurance policy for beef cattle fattening (6 months cover)

The former Proshika and Grameen programs as well as the current PKSF-DIISP program demonstrate that there is significant demand by NGO and MFI members for access to credit to purchase livestock (dairy and beef cattle), and that these livestock producers are also willing to pay for compulsory livestock-credit insurance cover as a condition of being granted a livestock investment loan. The major advantages of these livestock-credit insurance programs are that (1) the NGOs and MFIs can offer low-cost veterinary inspection and monitoring services to their members, thereby keeping down the premium rates for their livestock insurance programs; and that (2) because they work very closely with their members, they can minimize antiselection and moral hazard. The main drawbacks of these informal livestock insurance programs are that (1) cover expires on the repayment of the livestock loan; and that (2) none of the programs are reinsured, and they are therefore exposed to catastrophic disease or flood events that could greatly exceed the paid premium and reserves.

Further details of the livestock insurance programs in Bangladesh can be found in the World Bank's recent situation analysis report (World Bank 2015a).

Government Policy for livestock sector

In 2007, the government of Bangladesh–MOFL drew up a National Policy for Livestock Development (NLDP) in Bangladesh with a view to increasing small farmer productivity and production of milk, meat, and eggs in an effort to meet national policy objectives of accelerated poverty reduction and to meet the increased demand for these products by the Bangladesh population (see box 3.1. for further details about the objectives of the NLDP).

Box 3.1. National Livestock Development Policy: 2007 Objectives

The general objective of the National Livestock Development Policy:

To provide the enabling environment, opening up opportunities, and reducing risks and vulnerability for harnessing the full potential of livestock sub-sector to accelerate economic growth for reduction of rural poverty in which the private sector will remain the main actor, while the public sector will play facilitating and supportive role.

The specific objectives of the National Livestock Development Policy:

1. To promote sustainable improvements in productivity of milk, meat and egg production including processing and value addition;
2. To promote sustained improvements in income, nutrition, and employment for the landless, small and marginal farmers; and
3. To facilitate increased private sector participation and investments in livestock production, livestock services, market development and export of livestock products and by-products.

Source: MOFL 2007.

The 2007 NLDP study noted that although Bangladesh has one of the highest cattle densities in the world, its levels of productivity of milk and meat are much lower than in other developing countries with important livestock sectors. Bangladesh has 145 large ruminants/km^2, compared with 90 for India, 30 for Ethiopia, and 20 for Brazil. However, most of the cattle in Bangladesh trace their origin to a poor genetic base; the average weight of local cattle ranges from 125 to 150 kg for cows and from 200 to 250 kg for bulls, or about 25–35 percent lower than the average weight of all-purpose cattle in India. Furthermore, average milk yields are extremely low: 200–250 L during a 10-month lactation period, in contrast to 800 L for Pakistan, 500 L for India, and 700 L for all Asia. Thus the production of milk and meat is inadequate to meet the current demand and would need to be increased 2.5 to 3.0 times by the year 2020 to feed the growing population of Bangladesh (MOFL 2007).

The 2007 NDLP study noted that dairy farming in Bangladesh was affected by numerous constraints in addition to a lack of livestock insurance:

1. Limited knowledge and technical skills of smallholder dairy farmers
2. Scarcity of feeds and fodder
3. Poor quality of feeds
4. Frequent occurrence of diseases
5. Limited coverage of veterinary services, including poor diagnostic facilities
6. Lack of credit support
7. Limited milk collection and processing facilities and low prices at collection points
8. Lack of insurance coverage
9. Absence of market information
10. Lack of appropriate breeds
11. Absence of a regulatory body (MOFL 2007)

The 2007 NLDP identified the following policy framework for future dairy development in Bangladesh:

1. Cooperative dairy development (Milk Vita model) would be expanded in suitable areas of the country.
2. Successful pro-poor models for community-based smallholder dairy development, including appropriate contact farming schemes, would be replicated.
3. Smallholder dairy farming, integrated with crop and fish culture, would be promoted.
4. Supply chain–based production, processing, and marketing of milk and milk products would be promoted.
5. The National Dairy Development Board would be established as a regulatory body to promote dairy development.
6. The National Dairy Research Institute would be established to carry out research in various aspects of dairying (MOFL 2007).

Significant progress has been made since 2007 in promoting private cooperative dairy development, and in 2015 about 20 dairy processors (mainly cooperatives or NGOs) are operating

in Bangladesh. However, to date neither a National Dairy Development Board or a National Dairy Research Institute have been established.

The 2007 NLDP specifically identified the important roles that livestock insurance could play in the development of cattle breeding and dairy industries in Bangladesh. It could (1) protect producers against death of their cattle, thereby protecting their livelihoods and incomes, (2) improve their creditworthiness and thus access to livestock credit, (3) introduce minimum standards of animal husbandry practices, thereby reducing accidents and mortality in the livestock, and (4) encourage development of cattle breeding and dairy industries (MOFL 2007).

Under the NLDP 2007 the following policies were identified for increasing access to livestock insurance:

1. In consultation with insurance companies, CBOs and NGOs and other stakeholders, a strategy for expansion of livestock insurance coverage would be developed.
2. A Livestock Insurance Development Fund would be established in scheduled Bank on consultation with Bangladesh Bank.
3. Self-insurance systems for smallholder farmers through community-based livestock development programs would be promoted.
4. A national database on livestock mortality, disease incidence, and productivity of livestock would be developed and maintained at the DLS.
5. Awareness among smallholders on the benefits of livestock insurance schemes would be raised (MOFL 2007).

Since 2007 progress toward implementing the livestock insurance policy objectives listed above has been slow, but the government of Bangladesh–MOFL has signaled its ongoing commitment by requesting that the World Bank Group develop proposals for dairy cattle insurance in 2014–2015.

Government of Bangladesh's interest in developing dairy cattle insurance

Dairy cattle insurance is seen by DLS as part of a package of measures identified to increase investment in improved cattle breeds and in increasing milk production and incomes for small dairy producers, thereby contributing to the objectives of the NLDP 2007. In Bangladesh, there are about 10.4 million households owning cattle, and of these 3.7 million households (36 percent) have milking cows (BBS 2010). About 10 percent of the national dairy business is managed by commercial diary producers owning between 10 and 50 head of cattle (or in rare cases even larger herds). The bulk of production is, however, in the hands of small-scale emerging dairy cattle producers who typically own between 2 and 5 dairy cows, or resource-poor households, often headed by women, with one or two animals and very little or no land. Dairy cattle insurance provided as part of a package of value-added services could unlock credit to enable small-scale producers to invest in high milk–yielding crossbred cows, could protect the owner against catastrophic natural events and disease outbreaks leading to the death of their animals, and could ensure they remain creditworthy. Such a program would also contribute to the national objectives of (1) increased milk and meat production to meet national demand and (2) accelerated poverty reduction. Annex 1 presents an overview of cattle and buffalo dairy milk production and fresh milk marketing in Bangladesh and can be consulted by readers who require more detail on the dairy sector.

3.2. Proposals for dairy cattle insurance

International experience with livestock insurance and product design options

Livestock insurance has a lengthy history, and it is widely available in both developed countries and in developing countries. A World Bank 2008 survey showed that livestock insurance was available in 85 percent of the 65 surveyed countries with agricultural insurance (Mahul and Stutley 2010). The world's largest livestock insurance markets in terms of numbers of insured livestock and premium volume include China, Japan, and Spain. The international insurance market for livestock is

much smaller than the crop insurance market, accounting for about 7 percent (9 percent with the inclusion of bloodstock insurance) of the total global agricultural insurance premiums written in 2013.[20]

The classes of animal which can be insured under a livestock insurance policy include cattle (both dairy and beef), along with water buffalo, sheep and goats, pigs, horses and donkeys, camels, pets (cats and dogs), and poultry.

The livestock insurance products available internationally can be divided into two main types (box 3.2):

6. Traditional or indemnity-based policies, which insure against physical injury and/or diseases resulting in the death of the animal. Some policies are specifically designed to cover consequential losses or business interruption in livestock. Traditional livestock mortality insurance cover has been available for several centuries.
7. New innovative index-based livestock insurance (IBLI) policies, which include mortality indexes and loss of pasture, and grazing indexes that have been commercially implemented in the past 15 years only.

Box 3.2. Typology of Livestock Insurance Products

A. Traditional Indemnity-based Livestock Insurance Products

Standard mortality cover. The most common form of livestock insurance cover is named-peril animal mortality cover. Mortality cover commonly insures against death or accidental injury requiring slaughter due to suffocation, machinery breakdown, poisoning, pollution, fire, lightning, explosion, flood and windstorm, subsidence and landslide, riot, strike, and malicious damage. Standard mortality cover generally excludes diseases (especially epidemic diseases) and all forms of consequential loss and legal liability.

All-risk mortality cover. In some countries all-risk mortality cover is extended to cover named diseases or epidemic diseases, with an accompanying high deductible and or high rates (e.g., Germany, Czech Republic, Hungary).

Consequential loss/business interruption cover for epidemic diseases. There are specialist policies designed to indemnify both loss of animals following an epidemic and also the reduction or loss of income arising out of the ban on sales of animals or animal products (milk, eggs, etc.) for up to 12 months post-even. (e.g., Germany since 1990 and Mexico since 2005).

Bloodstock insurance. This insurance is for high value-value animals (e.g., race horses, semen bulls, and prize cows). The insured perils commonly include mortality, disability, infertility, medical treatment, and surgery.

B. New Livestock Index-Based Livestock Insurance Products

Livestock mortality index cover. Since 2006 Mongolia has offered livestock breeders a catastrophe winter freeze–index mortality IBLI policy for their livestock. In 2010, Kenya introduced an innovative IBLI product that is based on a predicted livestock mortality index to protect pastoralists against drought-related starvation and death of their livestock.

Livestock pasture-grazing index cover. Several countries, including the United States, Canada, Spain, and Mexico, have developed remote sensing (satellite)–based NDVI (normalized difference vegetative index) pasture-grazing indexes for livestock producers. These are designed to respond to drought-induced degradation of the natural grazing/pasture during the season and to cover the additional costs of purchased feed incurred by the livestock producer. Argentina, Uruguay, and Chile have also designed NDVI pasture drought index insurance programs in recent years, but these programs are not operational yet. Ethiopia has offered NDVI pasture-drought index cover for pastoralists since 2012.

Source: Adapted from Mahul and Stutley 2010.

In the context of Bangladesh, a traditional individual animal livestock mortality cover is identified as being the most appropriate policy type for the needs of the small-scale dairy cattle farmers. Such a cover can be designed to protect small- and medium-scale dairy farmers (with between 1 and 25 dairy cattle) against a broad range of natural perils and named diseases that result in

20 In 2013 the total global agricultural insurance premium volume was about US$23.5 billion, of which multiple peril crop insurance accounted for about 73 percent of total premium, followed by crop hail (15 percent) and then by livestock (7 percent), bloodstock (2 percent), and aquaculture (1 percent). Figures are based on Mahul and Stutley (2010); SwissRe (2013); and authors' best estimates.

the death of the individual animal, and also to enable the dairy producers to replace the dead animal and/or to repay their investment loans to the bank or MFI. For larger commercial dairy farms (with 25 to 50 or more dairy cattle), the owners may elect to purchase herd-based covers (as opposed to individual animal insurance). In the start-up phase of a dairy cattle insurance program in Bangladesh it would not be appropriate to extend cover to any form of consequential loss of milk production, but in future, this option might be offered for large commercial dairy enterprises. IBLI covers are very new and currently restricted to a catastrophe freeze mortality index policy for livestock in Mongolia and to satellite-based pasture drought indexes, which are being implemented in a number of developed and developing countries.[21] These livestock indexes operate at a district or subdistrict level. Neither of these livestock index covers are suited to the insurance needs of individual small-scale dairy cattle producers in Bangladesh, for the following reasons: (1) dairy cattle mortality statistics by cause of loss do not exist at a local level, and these would be needed to construct and rate a mortality index, (2) a district- or even village-level mortality index would be insufficiently accurate to respond to loss at the level of the individual dairy cattle owner with a few head of cattle, and (3) an index can never pick up the range of perils that may lead to the death of a dairy cow, for example, electrocution, suffocation, accidental injury, or birth-related complications. For these reasons, the World Bank Group recommends the development of a traditional individual-animal mortality policy for dairy cattle producers in Bangladesh.

Dairy cattle accident and mortality policy for Bangladesh

Cover design features

This section presents a summary of the design features of a standard dairy cattle livestock insurance cover that could be developed and fine-tuned to the needs of small-scale dairy farmers in Bangladesh. The section draws on the guidance provided by several leading international crop and livestock reinsurers.[22]

The insurance program would be designed to insure dairy cows, but if demand exists could also be extended to include calves/heifers and milch buffalo. Normally such a policy would insure individual adult cows between 18 months or two years of age (or age at first calving) up to about 8 to 10 years of age (to be agreed with DLS). If a demand exists it may also be possible to insure milch buffalo and calves/heifers aged 4 to 6 months up to 2 years old (or the minimum age limit for adult female cows).

In the case of a new start-up dairy cattle program in Bangladesh, it is unlikely that insurers and their reinsurers would grant all risk cover; instead the policy would likely insure against key named perils that cause death of cattle in each location of the country. Thus the policy might insure against death of the cattle due to natural causes such as fire, lightning, flood, tropical cyclone, and tsunami, along with the main named diseases that are routinely vaccinated against and accidental injury that requires the animal to be slaughtered for humane reasons (but only if slaughter is authorized by a qualified veterinarian). Additional coverage can sometimes be purchased for perils such as birth-related complications resulting in the death of the cow, transport cover (animals in transit), etc. (See box 3.3 for summary details of mortality cover.)

Exclusions usually include government slaughter order, all diseases that are not specifically named in the policy and/or vaccinated against, theft, and loss of economic use of the dairy cow (for example, poor milk yield due to mastitis or FMD). Other exclusions include intentional, willful, or negligent acts by the insured or his/her family and employees that result in injury or death of the cows, and insured diseases that occur within the waiting period (usually set at 20 to 30 days following inception of cover). Standard exclusions that international reinsurers require include loss of animals caused by war, atomic or nuclear war, insurrection, rebellion, revolution, riots, civil war, strikes, nuclear reaction or

21 In 2000, Spain became the first country to introduce a pasture-drought NDVI program. Since then, Canada and the United States have developed similar NDVI covers for commercial cattle herds; Mexico has developed NDVI for small-scale vulnerable livestock producers; and in Kenya and Ethiopia, NDVI cover is being piloted for nomadic pastoralists to protect their cattle, camels, sheep, and goats from starvation in severe drought years when forage and grazing are lacking.

22 These include SwissRe, PartnerRe, AllianzRe, and AspenRe.

radiation, or radioactive contamination. In the design of such a cover, the local Bangladeshi insurers and their reinsurers will agree on the exclusions that will apply to the dairy cattle mortality policy.

The sum insured is usually based on the local market value of the animal. It is dependent on the breed, age, and condition of the animal, and usually declines the older the animal. At the time of preinspection, the veterinary officer is usually required by the insurer to confirm the breed and age of the animal and the sum insured. In Bangladesh it may not be practical or economically feasible for the insurer to pay for a veterinarian to confirm each animal's age and insurable value. Instead it may be more cost-effective to devolve this responsibility to the distribution channel/partners responsible for promoting, managing, and implementing the program on the ground (MFIs/NGOs, dairy cooperatives, community-based organizations, etc.). Under no circumstances should the sum insured ever exceed 100 percent of the market value for the animal.

For individual animal cover, deductibles range from no deductible to a coinsurance on the value of the claim of between 10 percent and 30 percent.[23] The objective of the coinsurance on the sum insured (market-based value) of the animal is to reduce the potential for moral hazard by the insured. While some insurance policies state that any salvage value on the animal carcass will accrue to the insurer, in the case of Bangladesh, the costs to the insurer of managing the sale and/or disposal of the carcass would be prohibitively high, and for this reason we recommend that the insured be responsible for carcass disposal. For larger commercial livestock enterprises, the owner may elect to purchase herd cover (as opposed to individual animal cover) and to retain and self-insure their normal expected mortality rates in their herds by agreeing to a deductible of one or two animals before the policy pays out.

Box 3.3. Typical Features of a Dairy Cattle Mortality Insurance Policy

1. **Insured object.** Dairy cows between two years (or age of first calving) and eight years age, free of injury, with health quarantine and vaccination certificates.
2. **Basis of insurance and indemnity.** Individual animal accident and mortality policy.
3. **Insured perils.** Basic cover includes death of the dairy cow due FLEXA (fire, lightning, explosion, aircraft) or collapse of buildings; natural hazards such as flood, hail, tornado, tropical cyclone, sea surge, and tsunami; and named diseases (anthrax, blackleg, hemorrhagic septicemia, FMD), subject to confirmation the animal has been vaccinated against these diseases.

   Additional perils may be included for the payment of an additional premium, such as fractured uterus or perforated hemorrhage due to birth complications; post-partum paralysis or post-partum blood poisoning, despite veterinary intervention; traumatic reticulitis and traumatic pericarditis; transit cover, etc.
4. **Main exclusions.** War, terrorism, etc., freeze, starvation, heat stroke, poisoning, straying, theft; all other diseases not named above; Weakness, senility, sterility, low milk yield, compulsory slaughter; failure to vaccinate animals or to apply timely medical treatment of animal injuries or diseases; lack of management of proper feed regime; Veterinary expenses.
5. **Cover period.** One year. There is usually a waiting period for risk acceptance and in the case of disease cover a 20-day waiting period.
6. **Insured unit.** Each cow is insured separately against death.
7. **Sum insured.** Agreed value basis per animal according to breed, age, and condition as per local market prices for dairy cows.
8. **Basis of indemnity.** Individual animal losses are indemnified at 70–80 percent (or TBA) of the sum insured amount. Any carcass salvage value shall accrue to the insurer.
9. **Policy excess.** 20–30 percent (TBA) *coinsurance* on the sum insured value of the animal.
10. **Loss assessment procedure.** The insured cause of death must be certified by a qualified veterinarian and accompanied by full documentation as applicable.
11. **Other key conditions.** Dead animals may not be disposed of prior to inspection and the consent of the insurer and/or its appointed veterinarian.

23 The alternative to applying a coinsurance to the value of the loss is for underwriters to agree on a sum insured value that is typically no greater than 70 percent of the market value for the animal; in the event of the death of the animal, this is the value that is indemnified in full without any coinsurance being applied. For those insured, the benefit is that they pay premium on only 70 percent sum insured value: where a coinsurance is applied, premium is collected on the higher sum insured value.

Premium Rates for Dairy Cattle Insurance

For individual animal insurance, premium rates charged internationally for small-farmer dairy cattle may range from a minimum of about 2.5 percent to 7.5 percent or higher. Technical premium rates will vary according to the age of the cow (rates are usually higher for heifers and calves), the range of perils that are insured (the inclusion of diseases will significantly increase premium rates), husbandry and management factors, and if known, historical mortality rates in each individual farmer's dairy cattle herd and/or locality (e.g., district). The final commercial premium rate is highly influenced by the administration and operational costs that the insurer has to bear in terms of preinspections by a qualified veterinarian to first verify the individual animal's health status, age, vaccination record, and sum insured, and to then register, photograph, and tag each animal; the costs of loss adjustment in the event of the death of the cow also influence the final commercial premium rate.

In India, the premium rates charged by livestock insurers typically vary from about 2.5 percent to 5 percent depending on whether the cattle are insured under government schemes, through dairy cooperatives, or through other programs. Under the Integrated Rural Development Program (IRDP), which operated between 1983 and 2000, poor farmers were provided subsidized loans to purchase cattle. The IRDP program included a compulsory cattle insurance policy covering death and permanent total disability that was designed to protect the livestock loans. The program was designed by the General Insurance Corporation of India (GIC) and attracted 50 percent premium subsidies. The program carried a flat premium rate of 2.5 percent for the death of the cattle and an additional premium of 0.85 percent for permanent total disability of the animal, and carried no age limit. The cattle insurance premium rates set by GIC were not actuarially determined: while these rates appear extremely low, many insured IRDP beneficiaries did not understand they had livestock insurance and failed to make claims when their animals died. Between 1983 and 2000, a total of 70.4 million cattle were insured under the IRDP program. After 2000 the Indian insurance market was liberalized, and private insurers were encouraged to enter the market and to offer competitive pricing. Today average cattle mortality insurance premium rates offered by four public and six private insurers on nongovernment scheme programs range from about 4 percent for dairy cooperatives and about 5 percent for private individual farmers or programs linked to bank credit. The reason that insurers can offer lower rates to the dairy cooperatives is that they face lower transaction costs and better business opportunities; because the cooperatives employ their own veterinarians and implement their own risk reduction programs, they experience lower livestock mortality rates (Sharma 2011).

In Bangladesh there will initially be challenges for setting dairy cattle insurance premium rates because of the lack of historical mortality statistics at national, regional, local, and individual farmer level, as well as the lack of insurance actuarial or experience data. There is, however, some insurance experience data, which was highlighted in the table 3.1. Under the former SBC cattle insurance program, the average premium rate varied over time from 3 percent to 5 percent, with a long-term average of 3.54 percent against an average mortality rate of only 1.2 percent of the insured cattle and a long-term average loss ratio of 56 percent. Under the Grameen dairy cattle insurance program, the average livestock mortality rate was higher, at 2.8 percent. Finally, under the Proshika livestock insurance program for cattle (and sheep and goats), the average premium rate was 5.25 percent, with a 3.46 percent mortality rate and loss ratio of 68 percent. If in future dairy cattle insurance in Bangladesh is distributed through key institutions, including MFIs/NGOs and dairy cooperatives, it may be possible to obtain livestock mortality data from these organizations that could be used for rating purposes.

Preconditions for Dairy Cattle Insurance

From an insurance viewpoint, various preconditions usually apply in order to implement a large-scale dairy cattle insurance program, including:

1. All insured cattle must be registered according to their breed, sex, and age and individually identified by ear tagging (and in future, possibly by microchip).
2. Before being insured each animal must undergo a preinspection by a qualified veterinarian to certify that it is in sound health and that its vaccination record is fully up to date.
3. Procedures must be put in place for losses (death of an animal) to be immediately declared by the insured to the insurer, and then for the loss to be inspected by a veterinarian appointed by the insurer and the cause of loss verified as being due to insured as opposed to uninsured causes.

4. In some cases, the animals must be raised at a named location (farm) that is located outside a floodplain above the river flood mark (table 3.2).

In Bangladesh there is currently no national system for identifying and tagging individual livestock animals and no national livestock-registration database system, and this will pose a major challenge and cost to insurers in the start-up phase of any dairy cattle livestock insurance program. DLS is making major efforts to establish a national livestock registration system, but to date only 60,767 cattle producers (or about 2 percent of cattle owners) have registered their livestock under this program.[24] Thus records do not exist of the number of animals held by each producer according to their species, genetic breed, sex, age. and vaccination and health record. Furthermore, there is no tradition of individual animal identification, whether through ear tagging, branding, or microchipping, and it may be necessary to consider alternatives such as individual animal photographs.

Insurers face very high costs to (a) conduct preinspections to check the health of each animal and to identify, tag, value-register, and vaccinate each animal; and (b) adjust individual animal losses; this means that it will be necessary to seek the collaboration of DLS, the dairy cooperatives, the MFIs and NGOs, and other community-based organizations to carry out these key operations. International experience with smallholder individual-animal livestock insurance schemes shows that where an insurance company employs its own veterinary officers to conduct these preinspection tasks and to attend and adjust livestock losses, the costs of these inspections is usually prohibitively high, and in turn makes the very high commercial premiums charged to the smallholder livestock producer completely unaffordable. It will therefore be necessary to seek alternative lower-cost options for Bangladesh. For example, DLS could perform an invaluable service by offering subsidized or free preinspection and loss-adjusting services through its national network of veterinary officers. Alternatively, the insurers could enter into agreements with the MFIs, NGOs, and dairy cooperatives to use their managerial and veterinary staff to conduct these key functions. As previously noted, several NGOs maintain their own livestock para-vets specifically to perform preinspections and to conduct vaccinations. Finally, under any community-based initiative, the village-level committees could perform a vital role in conducting preinspection work and in verifying losses. Where third-party or local organizations are involved in individual animal loss assessment, the insurer should always retain the right to attend the assessment and to audit the loss-adjustment exercise.

Table 3.2. Preconditions and Challenges for the Operation of Individual Animal Mortality Insurance for Dairy Cattle in Bangladesh

Key preconditions for traditional indemnity-based livestock mortality insurance	Issues in providing in traditional indemnity-based livestock insurance for dairy cattle in Bangladesh
Animals must be part of commercially managed dairy livestock enterprises.	Many small herds are managed on a purely subsistence basis.
Individual animal identification (tagging) and registration is required.	No national system of individual animal tagging or livestock registration exists for livestock in Bangladesh. Insurers in conjunction with DLS will need to establish a cost-effective system for tagging and registering insured cattle.
Veterinary preinspections to certify animal is in sound health and has been vaccinated against major diseases in cattle are required.	Bangladesh has a well-developed national livestock veterinary service managed by DLS. It will be necessary to develop a cost-effective system for conducting preinspections and vaccinations of animals belonging to insured dairy farmers.
Animals must be contained within farm boundaries, and free-range grazing is not permitted.	Dairy cattle in Bangladesh are fully managed and animals are mainly stall fed on farm, although some managed grazing is practiced.
Loss notification and inspection procedures must be in place and animal pathology services available.	Procedures will need to be developed to permit those insured to report losses of their livestock in a timely fashion (< 24 hours) and to permit a certified veterinarian to travel to the site where the dead animal is located to perform a loss inspection and verification that the animal(s) died as a result of an insured peril.

24 According to DLS, as of December 2014 a total of 68,077 cattle, goat, and sheep farmers have registered their livestock with DLS, and 78,055 poultry farms have also been registered.

Insurance institutional options

In Bangladesh, government may elect to promote dairy cattle insurance both through (1) the public and private insurance companies and (2) the MFIs and NGOs. There are potential advantages and disadvantages to both of these insurance provider routes.

Government of Bangladesh policy is to promote the development of suitable life and non-life microinsurance products for the crop, livestock, poultry, and fisheries sectors, and this is endorsed by the Insurance Act 2010, which obliges all insurers to underwrite a minimum percentage of their business in these sectors. The Bangladesh insurance industry is supervised and regulated by the Insurance Development and Regulatory Authority. There are 41 non-life or general insurance companies in Bangladesh; one, the SBC, is public, and the others are private: to date only SBC has previously underwritten livestock (dairy cattle) insurance. Insurance legislation currently obliges local insurers to place 50 percent of their reinsurance cessions with SBC, and the remaining 50 percent can be placed with international reinsurers. On the basis of the preliminary discussions held with the commercial insurers, there is an interest in underwriting livestock insurance as well as a clear need for technical assistance in product design and rating and in the design of low-cost operating systems and procedures. The main drawbacks are that most private commercial insurers do not have rural distribution networks, and few companies have previous experience with designing microinsurance products and programs that meet the needs of small rural households. It will therefore be very important to identify low-cost distribution systems for dairy cattle insurance in Bangladesh.

In some countries, the commercial agricultural crop and livestock insurance companies operate under PPP coinsurance pool agreements, and Bangladesh may wish to study these institutional arrangements. The most important examples of pool programs include the national PPP pools in Spain (Agroseguro program) and in Turkey (Tarsim): livestock insurance is offered under both these national pool programs, including cover for dairy cattle. Other countries with a pool livestock insurance program include the Philippines and Mongolia (Mahul and Stutley 2010). There are major potential advantages of pool arrangements, including economies of scale by operating as a single entity, reduced administration and operating costs, an ability to retain a higher level of risk, and cost savings in purchasing of reinsurance because of risk pooling and diversification of risk.[25]

Bangladesh also has an important microinsurance sector, and several MFIs and NGOs have previous experience with implementing livestock loan insurance schemes. In Bangladesh microinsurance is not regulated by the IDRA, but rather by a separate entity, the Microcredit Regulatory Authority. Under the terms of the Microcredit Regulatory Authority Act 2006, MFIs have been permitted to offer credit-linked microinsurance products to their members, including life, health, and livestock mortality insurance. The government of Bangladesh is keen to promote microinsurance products for the rural community. The major drawback of these microinsurance programs is that because they are not supervised by or approved by the IDRA, they are not eligible for formal reinsurance and are therefore very exposed to catastrophe losses. Furthermore, the livestock insurance products that have been offered by the MFIs to date are very restricted in their coverage: these products are designed as loan protection policies, which insure only against the value of the livestock loan as opposed to the full market replacement value of the animal, and once the loan is repaid the policy is cancelled. Going forward, solutions will need to be sought to these drawbacks if dairy cattle insurance is to be offered through the MFIs and NGOs.

It is noted that in 2015 PKSF is working with the Microcredit Regulatory Authority to draft new microinsurance legislation, which is designed to strengthen the rules and regulations governing microinsurance provision in Bangladesh.

Distributional and operational options

The major constraint faced by the private commercial insurers is that they lack the rural distributional networks to promote, market, and administer livestock mortality insurance

25 For a wider discussion of the international experience with and benefits of agricultural insurance pools, see Mahul and Stutley (2010).

cost-effectively for small and medium-size dairy cattle producers in Bangladesh. This section reviews the main distribution and operational options for a large-scale PPP dairy cattle insurance program in Bangladesh, including:

1. Government of Bangladesh–sponsored dairy cattle insurance scheme
2. Partner agent model 1: Commercial insurers distribute dairy cattle insurance bundled with livestock investment loans through the MFIs/NGOs and commercial banks
3. Partner agent model 2: Commercial insurers distribute dairy cattle insurance through the major dairy cooperatives/companies
4. Micro dairy cattle insurance policy issued by the MFIs and NGO's linked to livestock microfinance
5. Community-based livestock insurance schemes

Option 1. Government of Bangladesh–sponsored Dairy Cattle Insurance Scheme

The government of Bangladesh's primary goal for the dairy cattle sector is to encourage small- and medium-scale livestock owners to invest in high-value crossbred or hybrid cattle with the explicit objective of increasing productivity/production of milk. The previous section showed that currently Bangladesh's livestock population is dominated (>90 percent) by low-yielding local/native breeds with low productivity (typically less than 2 L of milk per day). The government and the DLS have been working on various programs to improve the cattle population to address the milk needs of the country.

One program that could incentivize farmers to invest in high-yielding crossbred or hybrid cattle capable of yielding 7–10 L or more of milk per day is to offer subsidized livestock insurance linked to public and/or private sector livestock investment loans. Similar programs exist in India, where government since 2005 has encouraged small-scale dairy producers to invest in higher-yielding breeds of cattle and buffalo by providing access to subsidized investment loans backed up by subsidized (50 percent premium subsidy) livestock mortality insurance for a maximum of two animals over three years. Box 3.4 provides further details of the Indian national dairy cattle (and buffalo) insurance scheme. Over a five-year period the government of Bangladesh could possibly look at insuring up to 1 million crossbred and hybrid dairy cattle (and buffalo) under such a scheme. The fiscal costs to government of providing premium subsidies under this option are elaborated under section 3.3. Equally, if the government wishes, it could extend premium subsidies to all five dairy cattle insurance options presented in this section.

Box 3.4. Livestock Insurance Linked to National Project for Cattle and Buffalo Breeding, India

India owns one of the largest livestock populations in the world. According to the 17th Livestock Census conducted in 2003, India—with 185 million cattle and 98 million buffalo—ranks first in cattle and buffalo population in the world. The livestock sector is characterized by low levels of productivity; nearly 80 percent of cattle and 60 percent of buffaloes are low yielding and do not belong to the defined breeds. Average milk yield of Indian cows is only about 3.1 kg/day against a world average of 6.4 kg/day, and average milk production of buffalos (accounting for over half the national milk production) is 4.4 kg/day, against 7.5 kg/day in Pakistan. Less than 20 percent of Indian cattle are crossbred with relatively high milk yields, while a vast proportion are indigenous nondescript cattle with very low milk yields. The overall objective of the Livestock Insurance Linked to National Project for Cattle and Buffalo Breeding (NPCBB) program is to increase the productivity of milk animals by focusing on breed improvement.

The government of India–sponsored livestock insurance scheme, launched on a pilot basis in 2005–2006, is managed and implemented as an integrated service offering as part of the NPCBB program across more than 100 districts nationally. Under the scheme, the crossbred and high- yielding cattle and buffalo are being insured at maximum of their current market price.[a] The premium of the insurance is subsidized to the tune of 50 percent. The entire cost of the subsidy is being borne by the government of India. The benefit of subsidy is being provided to a maximum of two animals per beneficiary for a policy maximum of three years.

The livestock insurance scheme has been formulated with the twin objectives of (1) providing a protection mechanism to the farmers and cattle rearers against any eventual loss of their animals due to death, and (2) demonstrating the benefit of insuring livestock to the people and popularizing it, with the ultimate goal of attaining qualitative improvement in livestock and their products.

In order to get the maximum benefit in terms of competitive premium rates and easier policy issuance and claims settlement, insurance companies are selected through a quality-cum-cost-based tendering process from those public and private general insurance companies having a fairly wide network in the respective states. If any insurance company is offering cover for any type of disability in addition to death of the insured animal, such offer is considered, though no subsidy in the premium for such additional risk coverage isprovided. The entire cost of premium on account of the risk coverage other than death of the animal has to be borne by the beneficiaries. Under no circumstances should the rate of premium exceed 4.5 percent for annual policies or 12 percent for three-year policies. Normally, a single insurance company isentrusted for insurance with the work in a district. However, for the purposes of encouraging competition and popularizing the scheme, more than one insurance company may be allowed to operate in a district, if other terms and conditions remain the same. Default in settlement of claim or any types of deficiency in services on the part of insurance companies can be brought to the notice of the Insurance Regulatory and Development Authority.

The active involvement of the veterinary practitioners at the village level is required for the successful implementation of the scheme. They are associated with the work of identification and examination of the animals to be covered under the scheme, determination of their market price, tagging of the insured animals, and finally issuing veterinary certificates as and when a claim is made. In addition, because they are in touch with the farmers and cattle rearers, they may help in promoting and popularizing the scheme.

a. All those female cattle/buffalo yielding at least 1,500 L of milk per lactation are to be considered high yielding and hence can be insured under the scheme for maximum of their current market value.

It is expected that the Bangladeshi insurer(s) would collaborate closely with the DLS and the lending institutions (public and/or private banks) in implementing this scheme to introduce high-yielding hybrid dairy cattle. Under such a scheme the government of Bangladesh–DLS would (1) establish the eligibility criteria for small dairy farmers who would be the beneficiaries of the dairy cattle investment loans and subsidized livestock insurance scheme; and (2) appoint one or more banks that would be authorized to issue livestock investment loans to the target beneficiaries and that would act on behalf of the insurers in issuing the compulsory livestock insurance policies. It is expected that DLS would play a very important role in ensuring that the crossbred or hybrid dairy cattle purchased under this scheme are properly tagged and registered, have been inspected by a DLS veterinary inspector, vaccinated, and issued a health certificate before a livestock insurance policy is issued. The fiscal costs of identifying, tagging, and registering animals and for carrying out an animal health inspection and vaccinations against insured diseases are reviewed in section 4.3.

Option 2. Partner Agent Model 1: Commercial Insurers distribute dairy cattle insurance Bundled with livestock investment loans through MFIs, NGOs, and commercial banks

There appears to be a major opportunity for the interested commercial non-life insurance companies in Bangladesh to enter into partner agent agreements with NGOs/MFIs and commercial microcredit banks and to provide bundled dairy cattle investment loans linked to dairy cattle insurance. The MFIs/NGOs have a major outreach: in 2010 the Grameen Bank alone had more than 8.4 million members in 2,565 branches distributed throughout the country, and the other 482 NGOs/MFIs licensed by the Microinsurance Regulatory Authority had a further 19.2 million borrowing members (25.3 million members with savings) in more than 17,200 branches. In addition, the 14 public and private commercial banks had cumulative microfinance loans with a further 10.6 million borrowers at end 2010.(SAARC 2013).

Some private commercial insurers in Bangladesh already have considerable experience offering microinsurance products (mainly credit life), but none have previous experience with livestock microinsurance. Delta Life was the earliest insurer to provide microinsurance products, starting in the late 1980s, and roughly 4.5 million Bangladeshis are enrolled in some type of microinsurance scheme through private insurers (Hasan 2007 cited in Khan, Roddick, and Roberts 2013).

Under a partner agent model, the NGO/MFI would agree to act as an agent for the insurer and to market and promote the insurer's dairy cattle insurance policy to its members, either on a voluntary basis or on a mandatory basis linked to livestock investment loans. Under this agreement the NGO/MFI would ideally agree to extend credit to cover the costs of the dairy cattle insurance premiums for each insured member and to pay these over to the insurer. Some MFIs/NGOs in Bangladesh that are involved in provision of livestock-credit insurance recruit their own veterinarians or para-veterinarians (see box 3.5 for the Grameen and Proshika experience). If an NGO/MFI has its

own livestock veterinary officers or para-veterinarians, subject to agreement with the insurer it could also take on the major responsibility for (1) conducting the veterinary preinspections and vaccinations, (2) issuing the livestock health certificates, (3) tagging and registering the insured dairy cows, and (4) inspecting and adjusting livestock losses. The major potential advantages under such an agreement are that (1) the costs of administering and operating the dairy cattle insurance program would be greatly reduced, and (2) the MFIs/NGOs—which are trusted by members and know their members much better than the insurer—are much better placed to ensure insurance discipline and to minimize moral hazard or antiselection. Under a partner agent agreement, the insurer would pay the MFI/NGO an agreed commission for its services. The main operational role of the insurer would be to provide livestock insurance training for the MFI management and for the individual dairy cattle borrowing/insured members.

The dairy livestock insurance policy could be marketed as a bundled product to MFI/NGO members taking out livestock loans and as a voluntary product to other members owning dairy cattle. Although the primary aim of the cover would be to insure cattle during the loan period (usually between one and three years), it would also be important to develop a culture where dairy cattle owners insure all their animals and not just those they have purchased on loan. Flexibility could be provided over whether the sum insured should be restricted to the value of the loan or should be the full replacement cost of the dairy cattle. If the MFI decided to insure only the value of the livestock investment loan for a crossbred cow (for example, between Tk 10, 000 and Tk 15,000) against a full market placement value (for example, between Tk 20,000 and Tk 30,000), then one option would be to allow the dairy producer to purchase additional voluntary top-up cover on the animal.

If private insurers are to enter into successful partner agent agreements with major MFIs/NGOs in Bangladesh, they will need actively to engage with the MFIs and their members and to demonstrate value added—for example, by offering awareness campaigns, education and training programs, and prompt payment of claims. On the basis of feedback provided by various leading MFIs/NGOs to the World Bank Group under this study, it is understood that members of MFIs generally prefer to purchase products from the MFIs because they trust them more than the insurance companies.

Box 3.5. Use of Livestock Para-Veterinarians by NGOs/MFIs under Their Livestock Insurance Programs

A key operational feature of both the Proshika and Grameen micro-level livestock mortality insurance programs was the presence of village-level para-veterinarians who received training in basic animal health, vaccination, and artificial insemination. The para-veterinarians performed a central and low-cost role in facilitating livestock insurance provision: they were contracted to ensure animals were properly registered and ear-tagged, they conducted preinspections to verify each animal was in sound health and its vaccinations were up to date before insurance cover was granted, and in the event of a claim against the policy (accidental injury or death of the insured animal) they inspected the loss and confirmed the cause of death. Thus these MFIs faced much lower costs than the formal private commercial insurance companies for implementing traditional individual animal livestock mortality insurance schemes for smallholder producers.

Option 3. Partner Agent Model 2: Commercial Insurers distribute dairy cattle insurance through the major dairy cooperatives/companies

Any dairy cattle insurance program could also be promoted and implemented through the leading milk cooperatives in Bangladesh, several of which have indicated that they have considerable potential demand from their milk-producing members for such a cover. These dairy cooperatives could potentially enter into partner agent relationships with the formal commercial insurance companies to market dairy cattle insurance to their members, to assist in the preregistration animal health inspection and certification process; and to help collect premiums on behalf of the insurers and then in claims notification. Such a partner agent model would reduce the administration and operating overhead costs for the insurance company to manageable levels.

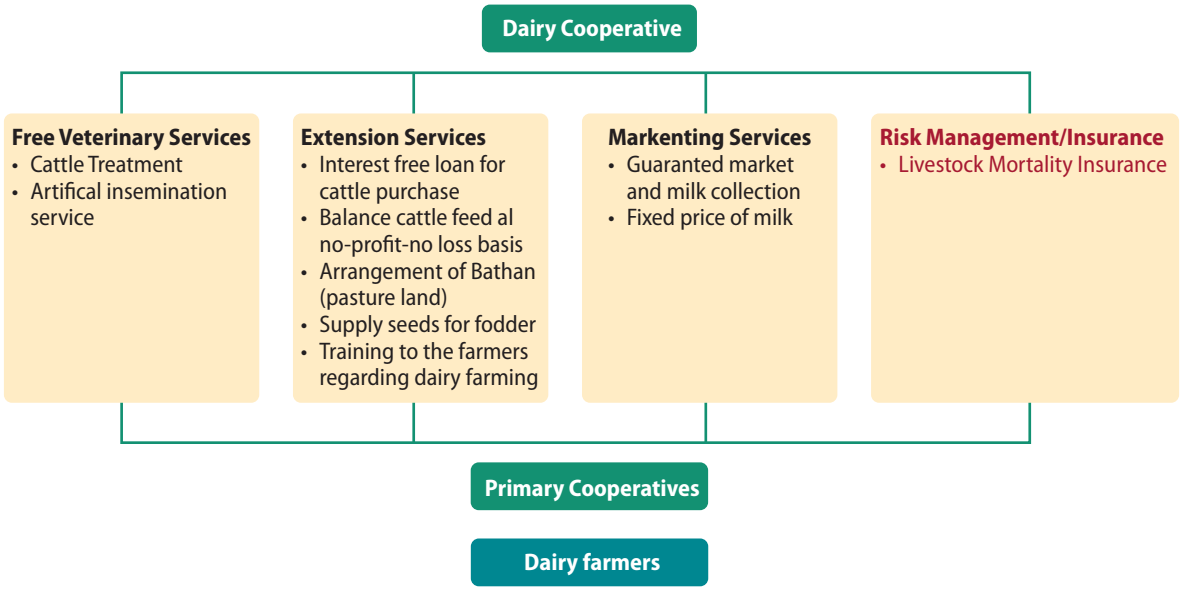
Milk dairy cooperatives may be interested in providing insurance as a value- added service to diary producers and farmers who supply them with fresh milk and as part of their strategy to

retain their market share and suppliers. .As noted above, there are about 20 milk processors/dairy cooperatives in Bangladesh, the major ones being Milk Vita and BRAC-Aarong Dairy. But with competition from other milk processors, established milk processors will likely lose farmers to the new entrants based on price competition—i.e., more money per liter of milk paid by the processor. Milk Vita and others can either compete on price or provide more value-added services such as livestock mortality insurance (see figure 3.1). As a reference, dairy cattle insurance is increasingly popular in India as a way to retain clients (small-scale milk producers) in light of intense competition between various milk processors to attract farmers, and in India the dairy cooperatives also subsidize the costs of livestock insurance premiums to encourage client loyalty.[26]

The dairy cooperatives could play a leading role under a suitable partner agent model in carrying out the following functions (for which they would receive a commission):

1. Insurance awareness creation and dairy cattle insurance education and training
2. Preinspections and vaccinations, and certification of the sound health of the individual cattle
3. Premium collection and payment to the insurer
4. Loss notification and loss adjustment on behalf of the insurer, which would retain the right to audit or verify any loss assessment and lost adjustment submitted by the dairy cooperative..

Figure 3.1. Example of Services Provided by Major Diary Cooperatives with Dairy Cattle Insurance



Option 4. Dairy Cattle MicroInsurance policy issued by the MFIs and NGOs linked to livestock microfinance

Under this option, MFIs/NGOs that are authorised by the Microinsurance Regulatory Authority to offer microinsurance products and services would be encouraged to offer dairy cattle insurance under the proposed large-scale PPP with Government of Bangladesh–MOFL-DLS. Section 4.1 showed that in the past, two leading MFIs have provided livestock (including dairy cattle) investment loan insurance, and that in the past two years, PKSF has actively helped a group of MFIs develop a six-month beef cattle–fattening livestock mortality policy.

The major difference under this option is that the MFIs/NGOs would underwrite their own dairy cattle insurance programs linked to livestock investment loans, and there would be no involvement of the commercial insurers. As noted in both the World Bank Group 2015 situation

26 In India, dairy cooperatives offer livestock insurance whereby the cooperatives subsidize the premium (between one-third to one-half) and the balance (farmers' contribution) is deducted from the milk payments (in easy installments). Note that the value of the cattle is fixed primarily to (1) ensure ease of administration and (2) minimize moral hazard. The farmers can buy top-up insurance cover. Insurance is provided as a group cover covering all farmers to eliminate any adverse selection issues.

analysis report and the current diagnostic report, the major drawback of such a program is that under current insurance legislation, IDRA does not recognize the microinsurance products and services of the MFIs/NGOs, and therefore it would not be possible for the MFI to contract excess of loss insurance on its livestock portfolio from the commercial insurers. Any MFI/NGO underwriting epidemic and/or flood and tropical cyclone in livestock would be very exposed to catastrophe losses if such an event were to occur.

If the priority of Government of Bangladesh–MOFL-DLS is to promote cattle (dairy and beef) insurance through the MFIs/NGOs, then the World Bank Group could help these entities and the Microinsurance Regulatory Authority develop legally acceptable risk financing and risk transfer (reinsurance) solutions to protect the insured interests of the individual MFIs. The Microinsurance Regulatory Authority is currently drafting new microinsurance legislation and regulations and is working with IDRA to identify ways of aligning microinsurance more closely with commercial insurance rules and regulations. If the legal hurdles can be overcome, then it would be relatively easy to help an umbrella organization such as PKSF to develop a formal layered risk financing and risk transfer (involving reinsurance) program for the network of MFIs offering livestock (dairy cattle and beef cattle) insurance in order to protect them against catastrophe natural or disease events in livestock.

Option 5. Community-based Livestock Insurance

The community-based livestock insurance model is a form of mutual insurance program where the policyholders (the insured dairy farmers) are both the owners and managers of the scheme. In India there is major experience with community-based dairy cattle insurance in Andhra Pradesh state that dates back to 2005. This program is targeted at women dairy farmers and is designed to protect loans they take out to invest in dairy cattle and buffalo. The program started as a self-help mutual insurance scheme operated by community development organizations, initially with no excess of loss insurance protection, but since 2006–2007 it has attracted major support from TATA AIG Insurance Company. The program has achieved major scale-up over time. Further details of the dairy livestock insurance cover, premium rates, and overall experience are attached as annex 2.

In Bangladesh further research is required to explore whether the community-based insurance model could be an option that offers potential for scale and sustainability. There may be opportunities in Bangladesh to work with the NGOs to explore whether there is significant demand to develop mutual livestock insurance. However, this is likely to take secondary importance compared to opportunities to develop partner agent models with the MFIs/NGOs and dairy cooperatives.

Reinsurance considerations

The development of a commercial dairy cattle insurance market in Bangladesh will be very dependent on the technical and financial support from the local reinsurer, SBC, and international specialist livestock reinsurers. Most insurance companies in Bangladesh have a low capacity to retain risk, and if a large-scale livestock insurance market is to be developed, the active participation of SBC and international reinsurers will be very important. Current insurance legislation obliges local non-life insurers to place 50 percent of their reinsurance cessions with SBC, while the remaining 50 percent can be placed with international reinsurers. International reinsurers have major experience with insuring dairy cattle insurance programs and can potentially provide major technical support and guidance to the commercial insurers under this large-scale PPP initiative for dairy cattle insurance. If a livestock coinsurance pool were to be established by the private commercial insurers, it would be relatively easy for them to develop, in conjunction with SBC, a single (common account) layered reinsurance program to protect the large-scale dairy cattle insurance program.

Role of government support to dairy cattle insurance

This chapter has provided a review of institutional issues and options for large-scale agricultural insurance programs for Bangladesh, including the roles that the private and public sectors might play under these PPPs. This subsection applies the principles discussed above 3 to identify some specific roles that Government of Bangladesh–MOFL-DLS might wish to play in promoting the development of dairy cattle insurance in Bangladesh. These include the following:

1. **Technical assistance.** This includes training and capacity building of para-veterinarians and artificial insemination (AI) service providers (as barefoot agents and claims administrators of livestock insurance), as well as financial literacy/awareness building concerning livestock insurance for small and medium-size dairy cattle producers. Through its livestock extension officers, MOFL-DLS could initially receive "training for trainers" courses in dairy cattle insurance to enable the livestock extension officers to take a lead role in training for the distribution agents and their dairy cattle members.
2. **Financial support to start-up and operating costs of dairy cattle insurance program.** Through MOFL-DLS, the government of Bangladesh could provide financial assistance toward the costs of deploying DLS veterinarians to (a) carry out livestock preinspections, vaccinations, and health certification of the insured cattle, (b) confirm the breed, age, and sum insured of each insured animal, and (c) ensure the animal is properly tagged and identified and that its unique details are entered into a national electronic database registration system for cattle. The aim would be to assist each delivery channel (MFIs/NGOs and dairy cooperatives/milk processors to establish a standard and transparent system of animal health inspection, certification, vaccination, identification, and registration throughout Bangladesh. This system would be invaluable for national planning purposes as well as for insurance purposes.
3. **Premium subsidy support.** International experience shows that premium subsidies are the most popular form of financial support by governments in agricultural crop and livestock PPPs (Mahul and Stutley 2010). In Bangladesh, Government of Bangladesh–MOFL-DLS should consider carefully the role of premium subsidy provision as a way of promoting the adoption of high-yielding hybrid or crossbred cattle under program options 1 to 5 identified above. A major drawback of premium subsidies is that once introduced, they are very difficult for a government to withdraw; and where an agricultural crop or livestock insurance program is expanding, the costs to government of premium subsidies also increase. The alternative to premium subsidies is for the government to subsidize administration and operating costs (as per option 2), which would have the effect of reducing the costs of premiums for small and marginal dairy livestock producers.
4. **Reinsurance support.** This could be worth exploring, particularly during the formative years (first three to five years) when it might be difficult to convince global reinsurers to take on significant risk. Also, international reinsurers might add significant uncertainty loadings (to mitigate the lack of mortality data and moral hazard/adverse selection risks). Offering some sort of local reinsurance capacity (along the lines of the IBLI program in Mongolia) could encourage local insurers to underwrite livestock insurance.

3.3. Fiscal costing

The objective of this section is to provide Government of Bangladesh–MOFL-DLS with guidelines on the indicative fiscal cost to government of introducing a large- scale PPP for dairy cattle insurance in Bangladesh. It is stressed that these are preliminary fiscal estimates that have not yet been presented to or discussed with the government, and as such these figures will require further work and refinement in due course. It is hoped, however, that these cost estimates are useful for policy makers in gauging the possible scale and costs of such a large-scale PPP insurance initiative for the dairy cattle sector. The fiscal cost assumptions over a five-year period are summarized in tables 4.4 and 4.5 in US dollars (at a current exchange rate of Tk 75 = US$1. 00).

There are approximately 11 million dairy cattle in Bangladesh in 2015, and under the fiscal assumptions it is supposed that by year 5 between 5 percent (table 3.3) and 10 percent (table 3.4) of these dairy cattle (between 550,000 and 1,100,000 animals) might be insured under the dairy livestock insurance scheme. These assumptions will need to be reviewed and agreed by MOFL-DLS and the major potential delivery channels, including the government of Bangladesh (option 1), the MFIs/NGOs (option 2 partner agent model), and dairy cooperatives (option 3 partner agent model).

Concerning dairy cattle valuation, we have not yet obtained detailed local figures for crossbred animals. Various studies suggest local indigenous-breed cows' market value is in the order of Tk 15,000

to Tk 16,000 (US$190 to US$200), but in the case of crossbred cows, which can yield as much as three times more milk per day, indicative values are between Tk 20,000 and Tk 30,000 (US$300 to US$350). For hybrid cows, which will yield as much as 10 L/day or more, indicative value is Tk 30,000 to Tk 40,000. For valuation purposes we have used two estimates: (1) US$200 per cow, to approximate the value of credit provided by banks or MFIs to producers wishing to purchase improved breed of dairy cows; and (2) a higher estimate of US$350 per animal, to reflect the full market replacement value of a crossbred cow. These values should be confirmed by DLS.

For the medium uptake assumptions and sum insured based on an average loan value of US$200 per cow, in year 1 the total sum insured for 55,000 insured dairy cattle would be in the order of US$11 million, rising in year 5 to 825,000 insured cattle and total sum insured of US$165 million (table 3.3). This is a very significant capacity requirement, which will require active support from local insurers, SBC, and international reinsurers.

The indicative or target premium annual rates used in this fiscal analysis are based on international experience for dairy insurance schemes, ut will need to be analyzed further and confirmed by local insurers and their international reinsurers. Using a median target premium rate of 5.0 percent, the year 1 indicative premium would be in the order of US$0.55 million, rising to US$8.25 million by year 5 (table 3.3).

If the government of Bangladesh elects to provide 50 percent premium subsidies (or level to be agreed) under any of the options as part of the national strategy to increase milk production, then the annual fiscal cost to government of these subsidies would be in the order of US$0.275 million (year 1), rising to US$4.125 million by year 5 (table 3.3).

The costs of livestock identification (tagging) vary considerably (table 3.5). The cheapest technology is to use metal or plastic ear tags, which in India cost Rs 4–6 per tag. The drawback with metal ear tags is that they can easily be lost or removed. In many societies, branding or tattooing the cow's hide with the owner's identification mark is not culturally acceptable or not practiced, as this reduces the sale value of the hide. Radio-frequency identification (RFID) tagging is increasingly being used to identify cattle in developed and developing countries, either as an internal microchip which is injected beneath the skin of the animal, or as an external ear tag. RFID tags can store a large amount of electronic information on the individual cow, but their drawbacks include cost and the need to use a hand scanner to read the tag. For the purposes of this fiscal costing exercise, we recommend the use of RFID electronic tags, and a value of US$1.50 has been used per registered and insured cow (tables 3.3 and 3.4).

For the purposes of this preliminary analysis, the costs of veterinary preinspections have been estimated at US$1.50 per cow, and the costs of insurance education and training for the distributors and dairy cattle producers have been estimated at US$0.50 per insured cow.

Under the above assumptions, if the government of Bangladesh elected to subsidize 100 percent of the tagging, veterinary preinspections, and insurance education and training programs, the costs to government in year 1 would be about US$0.19 million, rising to US$2.9 million by year 5 (table 3.3)

Under the maximum uptake of 10 percent of the national dairy herd by year 5 and average market-based valuation for a crossbred dairy cow of US$350/cow, the financial costs of the dairy livestock insurance program become very much more expensive. By year 5, a total of 1.1 million cattle would be insured under the program, with total sum insured of US$385 million and annual premium of between US$9.6 million (lowest premium rate assumptions) and US$28.9 million (highest premium rate assumptions). The corresponding fiscal costs of government subsidies would also be very much higher by year 5, with the 50 percent premium subsidy costing between US$4.8 million (low rates) and US$14.5 million (highest rates) per year. The administration and operating (A&O) expenses subsidy costs by year 5 would also have increased to US$4.85 million on account of the high number of insured cattle (table 3.4). Further details of the livestock fiscal costing scenarios are presented in annex 3.

Table 3.3. Bangladesh Dairy Cattle Insurance Fiscal Costs over Next Five Years: Medium Uptake Scenario and Investment Loan Valuation per Cow (US$)

Bangladesh Livestock Insurance Fiscal costs in US Dollars[1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
MEDIUM INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	0.5%	1.0%	2.5%	5.0%	7.5%	
No Insured Dairy Cattle	11 million dairy cattle	55,000	110,000	275,000	550,000	825,000	1,815,000
LOW SUM INSURED based on value of dairy cattle investment loan (US$)	US$ 200 (BDT 15,000) per adult cross-bred cow [3]	11,000,000	22,000,000	55,000,000	110,000,000	165,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	275,000	550,000	1,375,000	2,750,000	4,125,000	
Premium US$ Median Rate	5.00%	550,000	1,100,000	2,750,000	5,500,000	8,250,000	
Premium US$ High Rate	7.50%	825,000	1,650,000	4,125,000	8,250,000	12,375,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	137,500	275,000	687,500	1,375,000	2,062,500	4,537,500
A.2. Medium Premium rate	50%	275,000	550,000	1,375,000	2,750,000	4,125,000	9,075,000
A.3. High Premium Rate	50%	412,500	825,000	2,062,500	4,125,000	6,187,500	13,612,500
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	27,500	55,000	137,500	275,000	412,500	907,500
B. 4. Total Subsidies on Operating Costs		192,500	385,000	962,500	1,925,000	2,887,500	6,352,500
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		233,750	467,500	1,072,500	2,337,500	3,987,500	8,098,750
A.2. Medium Premium rate + B.4.		371,250	742,500	1,760,000	3,712,500	6,050,000	12,636,250
A.3. High Premium Rate +B.4.		508,750	1,017,500	2,447,500	5,087,500	8,112,500	17,173,750

Assumptions:
[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis
[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL
[3] Average Sum Insured for a cross breed adult dairy cow based on livestock investment loan of BDT 15,000 (US$ 200) per cow
[4] Premium rates based on international experience and will need confirmation for Bangladesh
[5] Costs of Tagging and Registration per cow will need to be confimed by SDL
[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians
[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents
Source: World Bank Group Fiscal Analysis.

Table 3.4. Bangladesh Dairy Cattle Insurance Fiscal Costs over Next 5 Years: High Uptake Scenario and Market Price Purchase Valuation per Cow (US$)

Bangladesh Livestock Insurance Fiscal costs in US Dollars (Exchange rate BDT 78 = US$ 1.00)

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
HIGH INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	1.0%	2.5%	5.0%	7.5%	10.0%	
No Insured Dairy Cattle	11 million dairy cattle	110,000	275,000	550,000	825,000	1,100,000	2,860,000
HIGH SUM INSURED based on market value of cross-bred dairy cow (US$)	US$ 350 (BDT 26,250) per adult cross-bred cow [3]	38,500,000	96,250,000	192,500,000	288,750,000	385,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	962,500	2,406,250	4,812,500	7,218,750	9,625,000	
Premium US$ Median Rate	5.00%	1,925,000	4,812,500	9,625,000	14,437,500	19,250,000	
Premium US$ High Rate	7.50%	2,887,500	7,218,750	14,437,500	21,656,250	28,875,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	481,250	1,203,125	2,406,250	3,609,375	4,812,500	12,512,500
A.2. Medium Premium rate	50%	962,500	2,406,250	4,812,500	7,218,750	9,625,000	25,025,000
A.3. High Premium Rate	50%	1,443,750	3,609,375	7,218,750	10,828,125	14,437,500	37,537,500
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	55,000	137,500	275,000	412,500	550,000	1,430,000
B. 4. Total Subsidies on Operating Costs		385,000	962,500	1,925,000	2,887,500	3,850,000	10,010,000
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		577,500	1,395,625	2,791,250	4,571,875	6,737,500	16,073,750
A.2. Medium Premium rate + B.4.		1,058,750	2,598,750	5,197,500	8,181,250	11,550,000	28,586,250
A.3. High Premium Rate +B.4.		1,540,000	3,801,875	7,603,750	11,790,625	16,362,500	41,098,750

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured based on market value for a cross breed adult dairy cow valued at BDT 26,250 (US$ 350) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7]Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

v*Source:* World Bank Group fiscal analysis.

Table 3.5. India: Comparison of Costs of Different Techniques for Tagging and Identifying Cattle

Type	Read distance	Ease of Reading	Retention	Ease of Application	Cost
Metal tag	Inches	Varies	Low	Easy	Rs. 4-6
Brand	Feet	Good (Until fades)	Fades over time	Difficult	Cheap
Tatoo	Few metres	Low	Fades over time	Difficult	Cheap
Ear Notch	1-3 feet	Difficult	Long	Difficult	Cheap
Colour pattern	Meters	Difficult	Long	N/A	Price of colour
Bar-code	Inches	Varies	Good to moderate	Easy	Cheap
RFID (Implant)	Inches to feet	Easy	Good to moderate	Slightly tough	Rs. 40 to 200 (depends on volume)
RFID (External)	Inches to feet	Easy	Good to moderate	Easy	Rs. 40 to 200 (depends on volume)
DNA testing	N/A	Lab testing	Lifetime	Test takes time	Expensive
Retinal imaging	Inches to feet	Easy	Lifetime	Equipment set-up	Not used extensively
Muzzle identification	Inches	Requires expertise	Good to moderate	Precautions to take muzzle imprint	Still in experimental stage

Source: Sharma 2011.
Note: N/A = not applicable.

3.4. Welfare impacts

This section looks at welfare impacts of dairy cattle insurance for smallholders in Bangladesh.

Dairy cattle production is an important source of assets, nutrition, and income, especially among the dominant smallholder producers that make up 37 percent of rural population and 88 percent of all cattle producers. According to HIES (2010)[27], total dairy cattle–raising households[28] occupy 42 percent of total rural households (table 3.6). The 88 percent dominant smallholders producers (with agricultural land of less than 2.5 acres) account for 82 percent of dairy cattle production in the country, have between 0 and 1.8 acres of land, and own an average of 2.2 cattle, 2.4 goats/sheep, and 9.8 poultry (relative to 4.3 cattle, 1.2 goats/sheep, and 15.3 poultry owned by large-scale producers). The smallholder producers are largely poor, with average income of US$1,536 per household per year and 30 percent poverty head count. An average of 88 percent of smallholder producers report consuming out of their cattle production (mainly milk), which occupies between 10 percent and 14 percent of their total income. Cattle also serve as the main productive asset, occupying an average of 55 percent of nonland assets of smallholder producers. With its significance for smallholders' livelihoods, improvement in livestock production thus has strong potential to crowd in economic growth, better nutrition, and poverty reduction for these dominant smallholders (BIDS 2014b).

Low smallholder productivity has been identified as one of the key barriers to the development of livestock production, especially dairy cattle. Despite the fact that livestock production displayed impressive growth among smallholder farmers over the past 10 years, investment in dairy cattle production among smallholders has been very low. It has also been dominated by a traditional subsistent production system, with only 4 percent of high-value (crossbred or hybrid) breeds invested and less than US$10 median livestock input costs reported in the data. The result is low average milk-production yield of 501 L per lactating cow per year (compared to a 760 L yield with 23 percent of high-value breeds for large-scale producers). Empirical evidence from Uddin et al. (2011) combined with BIDS (2014b) and Saadullah (2001) imply large yield gaps and so large differences in rates of return between

27 Household Income Expenditure Survey 2010
28 Dairy cattle–raising household is defined as a household that owns cattle in the HIES data. Smallholder producers include cattle-raising households with less than 2.5 acres of land, and thus include marginal, small, and medium-size farmers, according to the definition in the Bangladesh Integrated Household Survey (IFPRI 2011).

the currently adopted traditional subsistent system with traditional breed and low input (with 350–600 L milk yield per cow per year and averaged benefit-cost ratio of 1.55) and the extensive or intensive livestock production with high-value breed and improved inputs (with 600–1,200 L milk yield per cow per year and averaged benefit-cost ratio of 2.44). The existing evidence thus implies that on average, the currently low investment comes to an averaged untapped gross margin of US$363 per cow (115 percent improvement from the gross margin for traditional subsistent system).[29]

Constrained access to credit has been one of the key hurdles that prevent smallholder producers from productive investment in livestock production in Bangladesh. Access to credit is important for the development of livestock farming and is a key prerequisite for smallholders seeking to expand beyond subsistent level, though the current use of credit among smallholder producers is limiting. Forty percent of smallholder cattle-raising households have some access to credit, with small averaged loan size of US$129 per household—too small for subsistent producers to afford to expand toward more a productive system.

Table 3.6. Summary Statistics of Livestock-Producing Households

Dairy cattle raising household	Marginal	Small	Medium	Large	Overall
Socioeconomics					
Share in total rural households	23%	10%	4%	5%	42%
Share in total livestock	46%	25%	11%	18%	100%
Agricultural land range (Acres)	< 0.5	0.5-1.5	1.5-2.5	>2.5	
Median agricultural land (Acres)	0.00	0.90	1.80	3.93	0.33
Income and poverty					
Total economic income ($/year/hh)	$1,279	$1,982	$2,039	$3,349	$1,745
% livestock income in total income	14%	10%	10%	19%	13%
% consuming from livestock production	91%	86%	88%	81%	89%
Consumption expenditure ($/year/hh)	$1,391	$1,763	$1,997	$2,796	$1,694
Poverty headcount (upper poverty line)	36%	0%	15%	8%	27%
Livestock asset					
Cattle	2.0	2.5	2.7	4.3	2.4
Goat and sheep	3.2	0.8	1.0	1.2	2.2
Poultry	9.6	10.0	10.6	15.3	10.4
% livestock in total non-land asset	58%	54%	49%	37%	52%
Cattle production					
% high-value breed or hybrid	0%	7%	14%	23%	6%
Median livestock feed expenses	$5	$9	$10	$14	$8
Milk production (per lactating season/cattle)	512	465	453	760	503
Access to credit					
% with credit	45%	33%	30%	42%	41%
Avg Loan size/hh	$110.00	$170.00	$140.00	$160.00	$132.00

Note: Categorization of livestock farmers follows IFPRI's BIHS (2011) and is a modified version of HIES (2010). Smallholders include marginal, small and medium farmers with less than 2.5 Acres of land.

The presence of uninsured risk in livestock production can explain most of the key impediments for improving smallholder productivity in Bangladesh. Disease, floods, and cyclones could directly cause catastrophic herd losses, which could depress asset accumulation and future income

29 This estimate is based on (1) average yield of 475 L per cow per year of traditional system and 900 L per cow per year of improved extensive or intensive system; and (2) averaged price of milk of US$1/L. We note that the key caveat of this estimate is our reliance on relatively older evidence of net benefit-cost ratio from a 2001 study. Our estimated yield gap should thus be taken with caution.

generation. With limited access to credit, restocking could be difficult. Smallholders in turn rely heavily on limited saving, social risk sharing within communities, and public disaster assistance, which appear to be largely inadequate and potentially ineffective in managing highly covariate shocks, e.g., floods or cyclones. The presence of uninsured risk could also reduce risk-averse smallholder producers' incentive to invest in high-value breeds at the first place. The presence of uninsured risk could signal high expected default rates on loans and thus could further impede access to the credit necessary for livestock investment among smallholder producers.

Dairy cattle insurance packaged with improved cattle breeds and value-added input loans targeted to small-scale producers could potentially unlock credit access and so crowd in sustainable improvement in smallholders' productivity and reduction in rural poverty. When insurance can unlock credit and induce smallholder producers to switch from the existing low-yielding traditional subsistent system to an extensive or intensive system with high-value or hybrid breeds and improved inputs, this could possibly allow smallholder producers to realize more than doubled productivity, with an averaged untapped net margin gap of 215 percent relative to existing traditional system per cow. This could potentially translate into an averaged improvement in income of smallholder producers with one lactating cow of US$363, or 23 percent of total income. More importantly, as dairy cattle insurance could help smallholder producers stabilize their herd and herd accumulation over time, it would gradually move these smallholder producers out of poverty.

4. Aquaculture Insurance Opportunities

The Ministry of Fisheries and Livestock and Department of Fisheries (DOF) have identified a need to develop suitable aquaculture insurance products for the fish-farming sector. DOF is keen to introduce aquaculture insurance both for the 300,000 shrimp and prawn producers located in the southern coastal regions and also for the 4 million or more smallholder freshwater pond finfish producers of carp, tilapia, and catfish, who are distributed throughout the country. On the basis of the discussions between DOF and the World Bank Group, it has been agreed that shrimp insurance potentially offers an easier entry point than finfish insurance to developing aquaculture insurance in Bangladesh in a first phase. A further option that might be considered in future is cover for the 60,000 artisanal in-shore fishermen who are registered with DOF.

Under this diagnostic phase, work has focused on a preliminary assessment of the issues and challenges and on the options for developing suitable aquaculture insurance cover for the shrimp (and prawn) sector. This section presents a review of shrimp and prawn production systems in Bangladesh and the main risk exposures. It then offers an assessment of shrimp insurance opportunities in Bangladesh drawing on international experience; possible cover design options are presented and key issues and challenges are identified. A preliminary analysis of the economic benefits of shrimp insurance is included towards the end of the section.

To date it has not been possible for the WBG to visit the main shrimp- and prawn-farming locations in Bangladesh to conduct a formal risk assessment and insurance demand and contract design study. It is therefore stressed that if, in due course, the government of Bangladesh and DOF wish to proceed with the development of shrimp and prawn insurance in Bangladesh, further field-level research will be required to assess the issues, challenges, and viable shrimp insurance policy design options that would be acceptable to international reinsurers.

4.1. Context

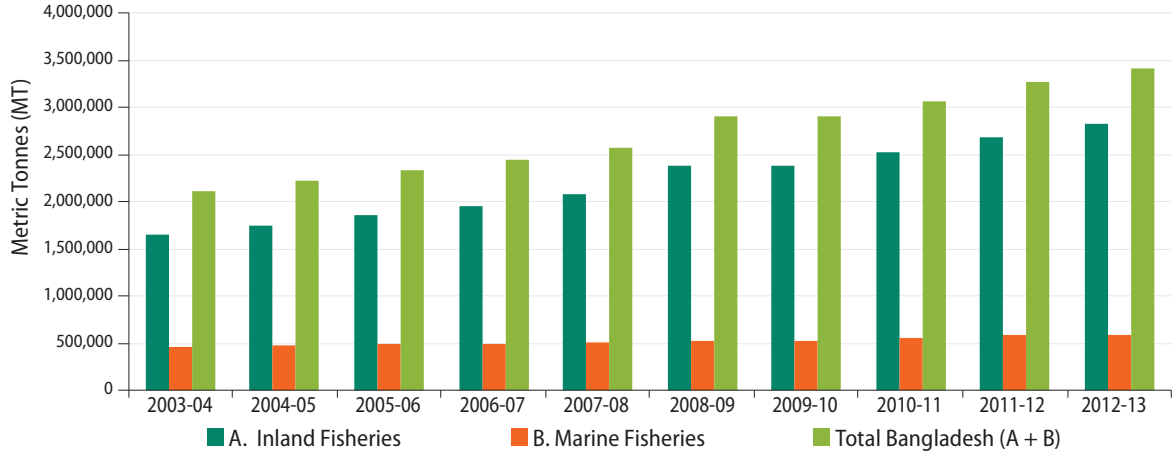
Importance of aquaculture and fisheries production in Bangladesh

The fisheries sector plays a very important role in the economy of Bangladesh, contributing about 4.4 percent of GDP and 22.8 percent of agricultural GDP in 2012–2013. Fish provide about 60 percent of all protein consumed in Bangladesh, and about 10 percent of the population (15 million people) depend directly or indirectly on fisheries for their livelihoods (DOF 2014). Bangladesh is among the top 10 exporters of shrimp, which is the second-largest foreign currency earner after the garment industry, with 2009–2010 exports valued at US$412 million (Belton et al 2011).

The fisheries sector is very diversified and includes (1) a marine capture fishing industry, which is dominated by about 60,000 small-scale artisanal in-shore fishermen; (2) inland open-water capture in rivers and estuaries; and (3) a very large aquaculture or fish-farming sector, including both freshwater pond production of finfish (carp, tilapia, catfish and other species) and coastal shrimp and prawn farming. More than 4.25 million households are involved in homestead fishpond production, and a further 300,000 households are involved in shrimp and prawn production (DOF 2014).

Over the past decade, the fisheries sector has experienced growth rates in production of between 4.8 percent and 7.3 percent per year. In 2012–2013, the country produced 3.41 million metric tons (MMT) of fish, of which 2.82 MMT (83 percent of total) came from inland fisheries and the remaining 0.59 MMT (17 percent) came from marine capture (DOF 2014) (figure 4.1).

Figure 4.1. Contribution of Inland and Marine Fisheries to Total Fish Production (metric tons)



Source: DOF 2014.

In 2012–2013, the inland aquaculture or fish-farming sector accounted for 1.86 million MT of fish production, or 55 percent of total fish production in Bangladesh. Fish farming has grown rapidly over the past 10 years, from 0.91 MMT (44 percent of total annual fish production) in 2003–2004 to 1.86 MMT (55 percent of total) in 2012–2013. The bulk of the farmed fish is finfish; it accounts for 1.65 MMT, or 89 percent of 2012–2013 aquaculture production, while shrimp and prawn production accounted for 0.20 MMT, or 11 percent of farmed fish production.

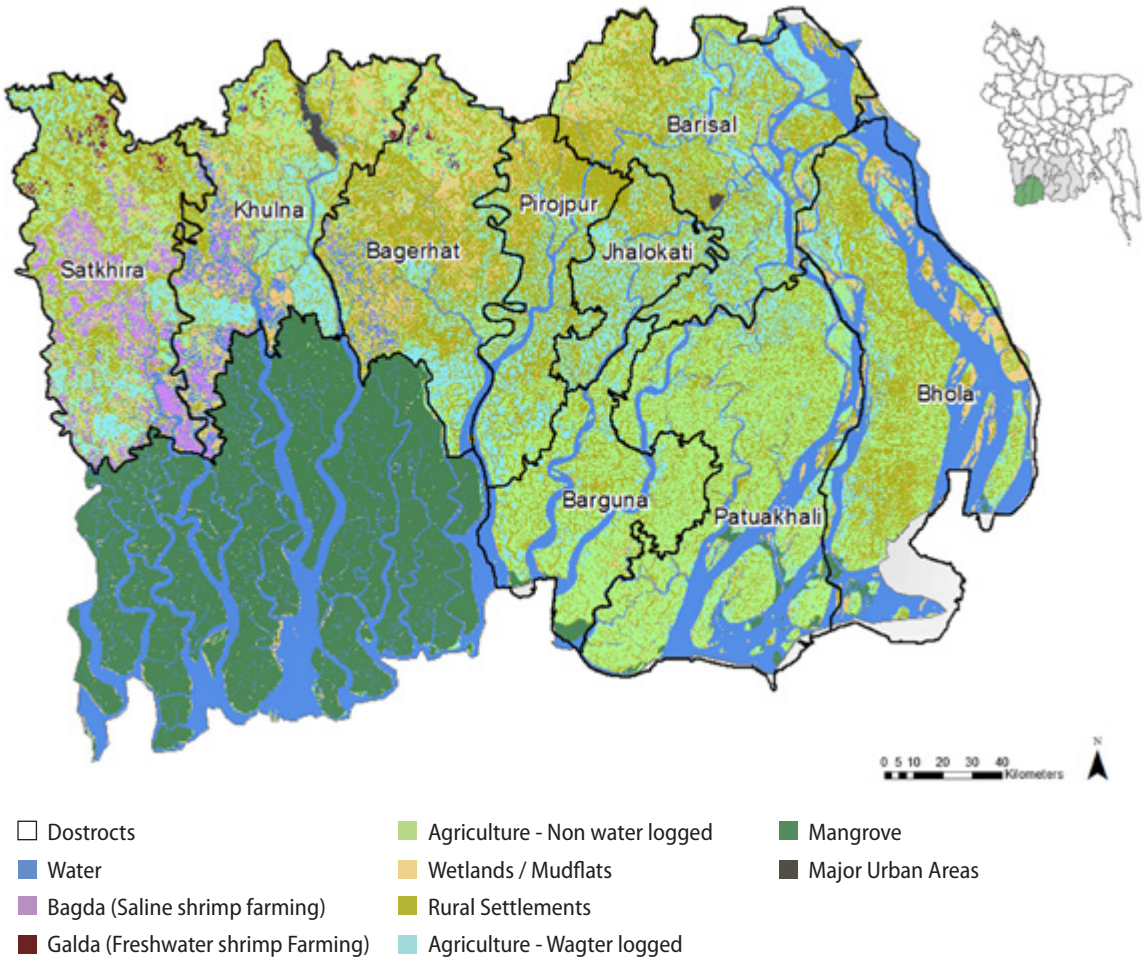
Shrimp and prawn production in Bangladesh

location and scale

Shrimp and prawn production in Bangladesh started in the 1970s, and this sector has expanded more rapidly than any other agro-export commodity in Bangladesh. The area of shrimp and prawn farms has increased from 137,996 ha in 1994 to 244,295 ha in 2010, and over the past 10 years, shrimp and prawn production has increased from 114,600 metric tons (2003–2004) to 206,235 metric tons (2012–2013), or an average annual increase in production of 8.0 percent. There are currently about 300,000 shrimp and prawn producers in Bangladesh (Belton et al. 2011; DOF 2014).

Saltwater shrimp (locally known as bagda) farming and freshwater prawn (known as golda) farming is concentrated in the southwestern coastal region of Khulna, and there is a further smaller concentration of shrimp farming in Cox's Bazar. Nearly three-quarters (74 percent) of the total area of shrimp and prawn farms is located in the districts of Khulna, Satkhira, and Bagerhat; 19 percent of the total farmed area is located in Cox's Bazar (restricted to saltwater shrimp production and hatcheries); and about 5 percent of total farmed shrimp and prawn area is located in other coastal districts of Jessore and Narail. The map in figure 4.2 shows that the saltwater shrimp farms tend to be located in the coastal tidal areas, which are protected by large-scale polders and mangrove swamps, while the freshwater prawn farming is located further inland, where there is less exposure to tidal saltwater incursion. Shrimp and prawns are also produced in the same areas in brackish water.

Figure 4.2. Location of Shrimp (bagda)– and Prawn (golda)–Producing Areas of Bangladesh



Source: Johnson et al 2016.

In Bangladesh, production of giant saltwater shrimp (Penaeus monodon) and giant freshwater prawn (Macrobrachium rosenbergii) takes place mainly in converted rice fields known as ghers In 2010 shrimp production accounted for 188,046 ha, or about 75 percent of total farmed area, and there were 89,448 registered shrimp *ghers* or farms, with an average size of 2.10 ha. There are more freshwater prawn farms (97,845 *ghers*) than shrimp farms in Bangladesh, but the average size of prawn farm is much smaller, at 0.57 ha (table 4.1).

Table 4.1. Number and Area of Shrimp and Prawn Gher, by District, May 2010

	Tiger Shrimp			Freshwater Prawn			Total (Shrimp & Prawn)			
District	No. ghers	Area (Ha)	Average size (Ha/gher)	No. ghers	Area (Ha)	Average size (Ha/gher)	No. ghers	Area (Ha)	Average size (Ha/gher)	% of total area
Khulna	20,616	35,850	1.74	29,515	13,006	0.44	50,131	48,856	0.97	20.0%
Satkhira	33,285	58,680	1.76	7,753	7,203	0.93	41,038	65,883	1.61	27.0%
Bagerhat	30,047	46,923	1.56	37,855	18,023	0.48	67,902	64,946	0.96	26.6%
Jessore	954	825	0.86	14,070	14,479	1.03	15,024	15,304	1.02	6.3%
Narail	0	0		5,158	2,198	0.43	5,158	2,198	0.43	0.9%
Gopalgonj	0	0		3,494	1,340	0.38	3,494	1,340	0.38	0.5%
Cox's Bazar	4,546	45,768	10.07	0	0		4,546	45,768	10.07	18.7%
Total	89,448	188,046	2.10	97,845	56,249	0.57	187,293	244,295	1.30	100.0%

Source: Belton et al. 2011, based on unpublished DOF 2010 data.

Production Systems and Yields

Most shrimp production is carried out in low-lying ghers protected from the sea by polders and connected by sluice gates to the estuaries and canals to permit the ghers to be flooded by seawater. Traditionally the *ghers* were cultivated with aman rice in the monsoon season (August to November/December) but then left fallow from January to July due to lack of irrigation water and high soil salinity. Since the introduction of shrimp farming in the 1970s, much of the *gher* land is used for shrimp farming between January and July; it has been converted by building up the field bunds and then flooding the *ghers* with seawater at high tide to a depth of about 1.0 to 1.5 m. In many parts of Khulna Region, farming communities have leased out their *gher* lands to contractors who exclusively produce shrimp throughout the year: with a 120-day growth cycle to maturity, up to three shrimp crops can be sown per year. Traditionally farmers trapped wild seed (shrimp post-larvae, or PL) that were washed into the *gher* at high tide, but increasingly this practice has been replaced by artificial stocking of the *ghers* with PL, either collected from the wild or produced in commercial shrimp hatcheries. Freshwater prawn production is carried out in rice fields in low-lying agricultural land, and often the prawns are grown along with carp and rice in the *ghers*: prawns mature much more slowly than shrimps and they have a six- to eight-month cycle to maturity and harvest (Belton et al. 2011).

Shrimp farming is classified into three main categories according to the level of intensity (and technology and husbandry), namely

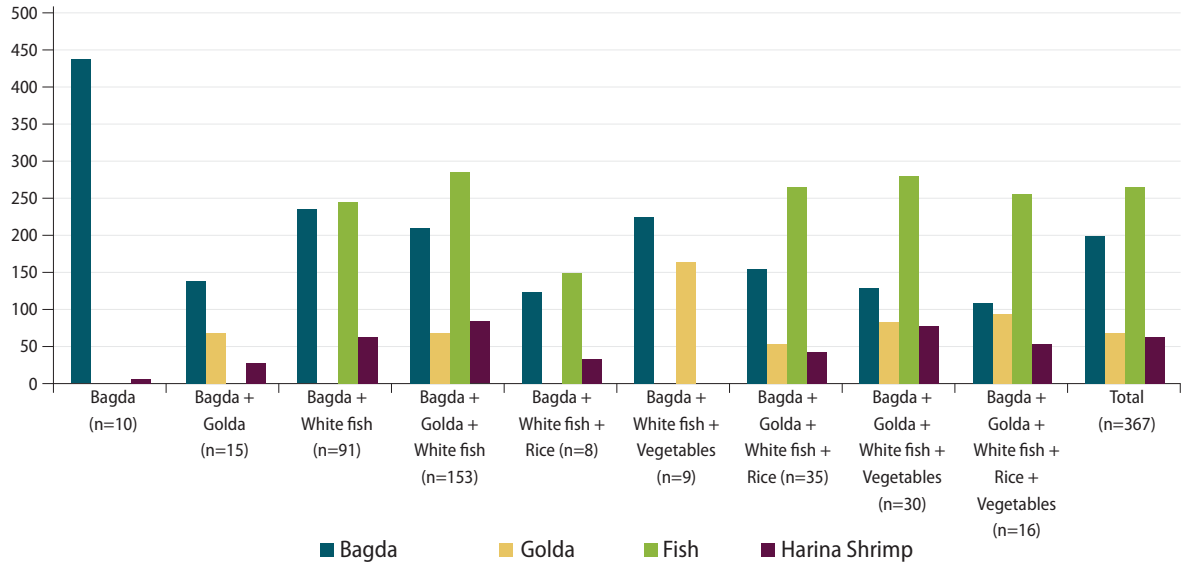
1. Extensive cultivation system. In Bangladesh, the majority (>90 percent) of shrimp farmers adopt extensive practices under which the stocking density is very low, with a range from 0.2 to 1.5 PL/m^2, the shrimp depend on naturally produced organisms for their nutrition, and there is little or no management in respect of drying, ploughing, and liming or cleaning of the *gher* bottom after each cycle, nor of fertilization and artificial feeding. Under this low-input-use, low-production-cost system, the annual yields of shrimps are very low, in the order of 160 to 230 kg/ha.
2. Improved extensive or semi-intensive cultivation. Some shrimp farmers adopt improved extensive or semi-intensive production systems using certified shrimp PL, and they adopt a higher stocking density of 1.0 to 2.5 PL/m^2. The PL are fed both on natural food and fertilizer and sometimes supplementary feeds are given to enhance growth rates. Under this system, average yields are about 350 to 500 kg/ha per year.
3. Intensive cultivation system. According to DOF, there are currently only a handful of intensive commercial shrimp farmers in Bangladesh who adopt intense management practices, including high stocking densities of 5 to 10 PL/m^2, artificial feeding, and installation of water aeration systems, and who adjust the pH of the water, drain the water between cycles, and clean the *ghers*. Under this high-input, high-cost system, annual yields range from 500 to 5,000 kg/ha, with an average of 2,000 kg/ha (Belton et al. 2011).

Economics of Shrimp Production

Information on the returns to shrimp (and prawn) farming comes from two main sources: (1) a 2010 baseline survey of 369 *gher*-farming households in the main shrimp-producing districts of Bagerhat, Khulna, and Satkira and reported by Belton et al. (2011); and (2) a larger sample of 570 shrimp farmers in 2011 and reported by USAID (2013).

Under the 2010 survey a total of nine different shrimp-, fish-, rice- and vegetable-farming systems were identified, including the most common type of farm which produced *bagda*, *golda*, and white fish (42 percent of respondents) or *bagda* and white fish (25 percent of respondents), followed by farmers who produced shrimp/fish plusrice and/or vegetables, accounting for 27 percent of the surveyed farmers. Finally, 25 farmers, or 7 percent of the total, produced only shrimp or shrimp and prawns. The average size of *ghers* was 1.0 ha per household (ranging from 0.51 ha to 1.2 ha), and the annual average yields of *bagda* and *golda* were 202 kg/ha and 69 kg/ha, respectively. The highest average yields—437 kg/ha—were obtained by the 10 farmers who cultivated only giant shrimp (*bagda*). The low average yields suggest most respondents adopted extensive shrimp cultivation systems (figure 4.3).

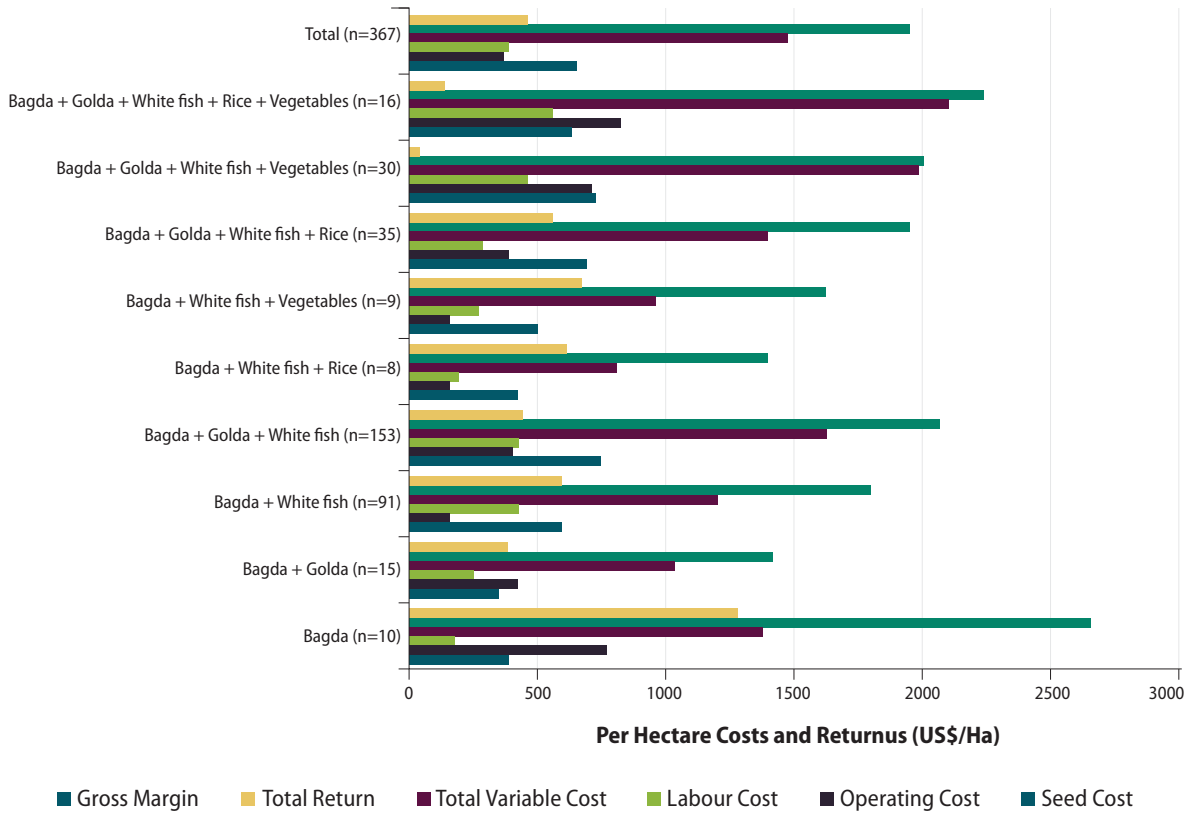
Figure 4.3. Average Yields of Shrimp (Bagda), Prawn (Golda), and other Farmed Fish Species (kg/ha/year)



Source: Belton et al. 2011, based on baseline survey of Greater Harvest and Economic Returns from Shrimp Project, funded by USAID under its PRICE Program.

The gross margin returns to shrimp farming in Bangladesh are potentially high. The 2010 USAID-PRICE program baseline survey (cited in Belton et al. 2011) showed that for all 9 shrimp-farming systems, the average production cost, total return, and gross margin per hectare were US$1,482/ha, US$1,955/ha, and US$472/ha, respectively. The highest gross margin returns of US$1,278/ha were obtained by the group of farmers who cultivated only shrimp (*bagda*); however, because of the very small sample size, this finding is not statistically significant (figure 4.4).

Figure 4.4. Costs of Production, Gross and Net Returns to Shrimp Farming (US$/ha)



Source: Belton et al. 2011, based on baseline Greater Harvest and Economic Returns Survey from Shrimp Project, funded by USAID under its PRICE Program.

A separate study with 570 shrimp farmers in Khulna Region also showed that the returns to shrimp farming are potentially very high. Under the USAID FtF Aquaculture Project, a survey was conducted in 2011 with 991 household fish farmers, 401 commercial fish farmers, and 570 shrimp farmers in Khulna Region. Shrimp farmers cultivated an average of 2.6 *ghers* per household, with an average area of 195 decimals/household (0.79 ha/household). Shrimp farmers had the highest average incomes—Tk 109,255 (about US$1,450)—and incurred average costs for cultivating shrimp of Tk 54,340/ha (US$725/ha), with an average return (gross value of production) of Tk 99,460/ha (US$1,325/ha). The result was an average gross margin of Tk 45,120/ha (US$600/ha) and a very high benefit-cost ratio of 1.83 (table 4.2).

Table 4.2. Gross Margin Costs and Returns to Shrimp Production (BDT/ha)

Item	BDT/Ha	% of total costs
Fixed costs	17290	32%
Hired labour	14079	26%
Pond Preparation	4446	8%
Seeding	1976	4%
Inputs for stock management	11856	22%
Water management	1482	3%
Harvesting	1235	2%
Selling	1976	4%
Total Costs of Production	**54340**	**100%**
Yield per hectare (KGs)	230	
Total Return	**99460**	
Gross Margin	**45120**	
Benefit Cost Ratio	**1.83**	

Source: USAID 2013.

SHRIMP Value Chain System

The shrimp and prawn sector supports the livelihoods of more than 600,000 people, including farmers and services providers such as traders and processors (Belton et al. 2011). There is a well-developed production and marketing chain system for shrimp in Bangladesh (USAID 2013). A large variety and number of intermediaries are involved in the production and supply of PL to farms. Upon harvest, shrimp and prawns are sold on through a range of other intermediaries who distribute them to processors and exporters.[30] (See value chain in figure 4.5).

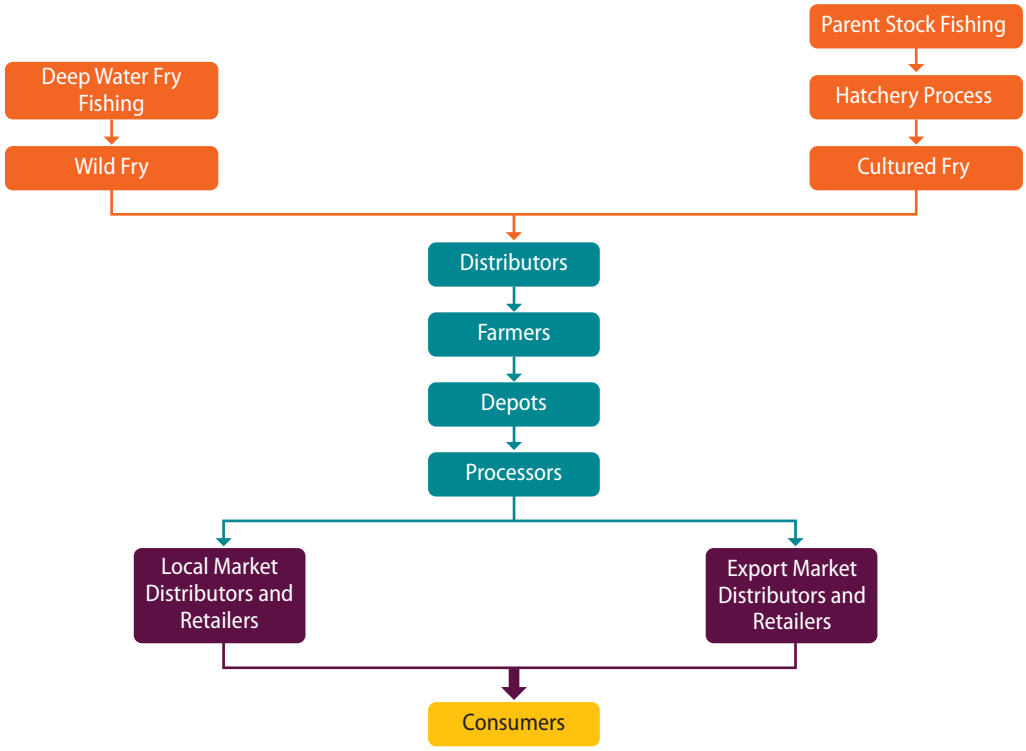
Shrimp and prawn are farmed using both wild and hatchery-produced PL, but since 2000, in order to protect biodiversity and prevent the spread of diseases, the government has imposed a ban on natural PL collection by amending the Protection and Conservation of Fish Act. Today most shrimp (*bagda* and *golda*) cultivation is based on hatchery-bred PL. The USAID (2013) study of 570 shrimp producers reported that *bagda* PL were mainly sourced from hatcheries, but about 20 percent were collected from natural sources; around 90 percent of *golda* were hatchery produced.

DOL has actively promoted bagda and golda breeding technology, and in 2012–2013 there were about 60 bagda hatcheries and 21 golda hatcheries in Bangladesh supplying 92,392 lakh[31] *bagda* PL and 331 lakh *golda* PL (DOF 2014). The commercial shrimp hatcheries are all located in Cox's Bazaar in the southeastern part of the country. The shrimp hatcheries at Cox's Bazaar mainly obtain female broodstock from deepwater trawler suppliers: the fertilized eggs are hatched into shrimp seedling.

30 DOF (2014) reports that in 2012–2013, there was a total of 634 registered depots, 82 fish-processing plants, and 31 fish-packing centers in the fish export value chain in Bangladesh. In addition there were 2,627 registered fish feed companies in the country, including 371 in Khulna, 71 in Sylhet, 90 in Barisal, and 71 in Rangpur.

31 One Lakh is equivalent to 100,000

Figure 4.5. Shrimp Value Chain



Source: *Gaillard and Quader (undated)*

The shrimp value chain is a buyer-driven one, and the predominantly small producers have little ability to influence the price they receive for their product. In Bangladesh suppliers such as PL catchers and small shrimp farmers tend to be dependent on larger dominant buyers or are locked into contracts where they are obliged to sell to particular buyers at prices that are lower than they could freely obtain in spot markets. Furthermore, barriers to entry, poor infrastructure, inadequate communications, and significant transaction and transport costs limit the markets where producers and traders sell (Belton et al. 2011).

Risk exposures to aquaculture and marine fisheries

In Bangladesh the major risks that affect shrimp-farming operations and profitability are the occurrence of tropical cyclones, floods, and diseases of shrimps. These can negatively affect the health and physical well-being of the fish farmers themselves, working conditions, farm production assets, and the production of fish and other aquatic organisms (World Bank 2010).

Bangladesh is a cyclone-prone country, and cyclones and their associated storm surge can cause major damage to the shrimp farms located in the southern coastal regions. Shrimp production areas in Bangladesh are located in the tropical cyclone corridor. An average of one to three severe to moderate cyclonic storms hit Bangladesh each year. The major tropical cyclones of 1970, 1991, and Sidr in 2007 caused severe economic damage to the shrimp industry. Tropical cyclone damage to shrimp farming is mainly caused by storm surge, which washes away the shrimp biomass and destroys the pond infrastructure. Storm surges in Bangladesh can be up to 13 m higher than normal sea levels and can reach as far as 200 km inland in extreme cases (Milliman et al. 1989). Sidr in 2007 caused severe damage to the fisheries' infrastructure, including *dighis* (large ponds) and *ghers*; to private fishing equipment, such as boats and nets; and to public infrastructure, such as boundary walls, roofs, and electric lines in fisheries. Damage and losses in the fisheries subsector, in the 10 most affected districts, was estimated at Tk 463 million (US$6.7 million) (Goverment of Bangladesh 2008).

Shrimp-producing regions of Bangladesh face different tropical cyclone risk exposure (table 4.3.) Khulna Region coastal shrimp-producing areas face a higher cyclone risk than the coastal areas of Cox's Bazar's: Khulna shows a higher frequency of cyclone landfalls (0.28 landfalls per year) than Cox's Bazar (0.16 landfalls per year) (Islam 2006). In addition, Khulna Region coastal areas show higher

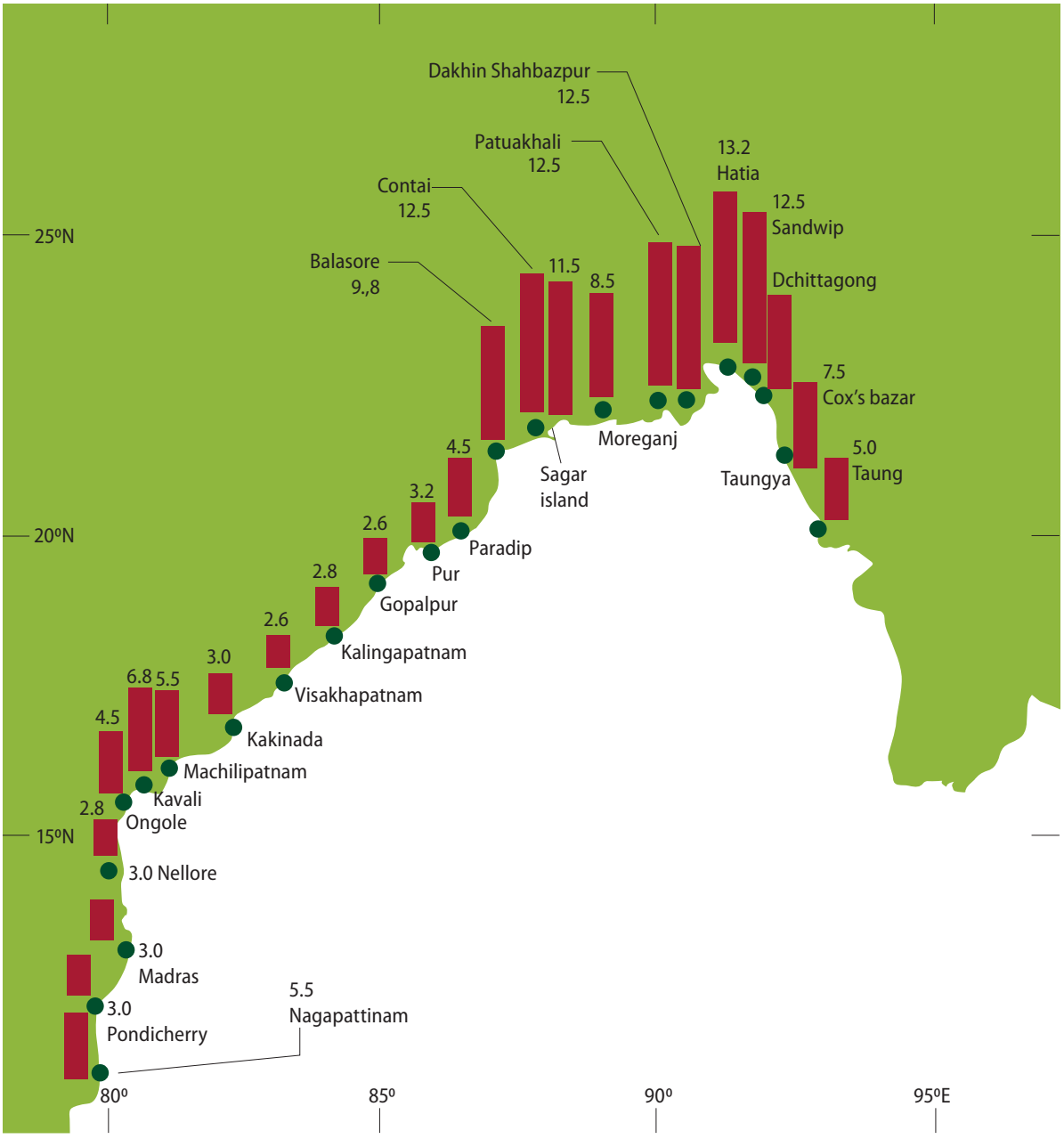
vulnerability to the storm surges caused by tropical cyclone than the Cox's Bazar coastal area. According to Mandal (1991), Khulna's coastline has a probable maximum storm surge of 12.5 m above sea level, while at Cox's Bazar the probable maximum storm surge is only 5.0–7.5 m above sea level (figure 4.6).

Table 4.3. Frequency of Tropical Cyclone in Bangladesh Coastal Areas

Location	Frequency (Landfall/year)
Khulna	0.28
Barisal	0.24
Noakhali	0.07
Chitagong	0.17
Cox's Bazar	0.16

Source: Islam 2006.

Figure 4.6. Maximum Storm Surge along the Coastline of India and Bangladesh



Bangladesh is also a flood-prone country, and flooding can cause major damage to low-lying shrimp farms. Floods lead to the washing away of shrimp biomass and damage to the ponds, *dighis*, and *ghers*. Approximately 37 percent, 43 percent, 52 percent, and 60 percent of the national territory is flooded by events with return periods of 10, 20, 50, and 100 years, respectively. Under the severe flooding in 2007, the fisheries sector losses were estimated at Tk 1,965 million (4.3 percent of total losses), which included losses from fish fingerlings, fish, shrimp, and fisheries infrastructures.

Shrimp diseases are a serious problem in all major shrimp-producing countries, and in Bangladesh, white spot syndrome virus (WSSV) has caused major losses in the past. WSSV was first observed in East Asia in 1992–1993, and between 1993 and 1994 it spread to China, Thailand, Japan, Taiwan, Indonesia, India, and Bangladesh, causing severe mortality levels in penaeid shrimp, including *Penaeus monodon*. From Asia, WSSV spread rapidly to the United States, causing mass mortality in farmed shrimp in Texas and South Carolina in 1995–1997; it then spread to Central America (Honduras, Mexico) and South America (Ecuador) (Durand and Lightner 2002; Sangamaheswaran and Jeyaseelan 2001; Baumgartner et al. 2009). WSSV is one of at least 13 viral diseases of cultured penaeid shrimps, some of which cause relatively low levels of disease and mortality, while others are highly pathogenic and can result in 100 percent mortality levels in the affected shrimp: in the case of *Penaeus monodon*, the disease causes acute infection and high mortality levels within two weeks (Sangamaheswaran and Jeyaseelan 2001). In Bangladesh, WSSV was detected in the 1990s, and in 2001 an outbreak caused huge losses to the shrimp sector (World Bank 2010).

There are several reasons for the perpetuation of WSSV in Bangladesh. Firstly, the wild shrimp population is infected with it, and this acts as a source of transmission from infected broodstock to the eggs in hatcheries and causes high levels of infection in nurtured PL. Moreover, until recently there was no quality assurance system to ensure that farmers were receiving WSSV-free PL from the hatcheries. Another factor is the difficulty of controlling seawater flows in the coastal shrimp-producing locations: once the shrimp in one farm have been infected by WSSV, it is extremely difficult to isolate and quarantine this farm, and the virus is transferred from one farm to another. There is a wide range of hosts (carriers), which also makes controlling WSSV difficult and leads to its spread in shrimp, crabs and other crustaceans.

In Bangladesh, DOF is actively involved in a program to introduce screening of hatchery-produced shrimp PL and certification that the PL are free of WSSV. DOF is investing in PCR (polymerase chain reaction) laboratories to conduct DNA testing for WSSV presence in shrimps. Currently DOF is screening about 5 percent of the hatchery-produced PL in Bangladesh for WSSV, and there is thus a long way to go before all shrimp PL can be certified as free of this disease. WorldFish is also supporting DOF with PCR testing.

Some countries (including India since 2009) have switched from black tiger (Penaeus monodon) shrimp production to Pacific white shrimp (Penaeus vannamei), which grow more quickly and are more WSSV-resistant than black tiger shrimp; these countries have imported specific pathogen-free (SPF) vannamei broodstock from the United States for cultivation (Wright 2015).

Early mortality syndrome (EMS) is also an emerging problem for the shrimp industry in Southeast Asia and in the past few years has resulted in more that 30 percent reductions in shrimp production in the region (Wright 2015). Since EMS was first reported in China in 2009, it has spread to Vietnam, Malaysia, and Thailand, and now causes annual losses of more than US$1 billion. EMS outbreaks typically occur within the first 30 days after stocking a newly prepared shrimp pond, and mortality can exceed 70 percent (Global Aquaculture Alliance 2013). To date neither India nor Bangladesh has been affected by EMS, and each has increased its share of global shrimp exports.

4.2. Proposal for fisheries/aquaculture insurance

This subsection presents a review of the past experience in Bangladesh with shrimp insurance, then looks at international experience with shrimp insurance, and finally offers a preliminary assessment of the options for shrimp insurance in Bangladesh.

History of aquaculture (shrimp) insurance in Bangladesh

In the 1990s, Sadharan Bima Corporation introduced a shrimp insurance policy that provided named-peril cover restricted to floods, cyclones, and tidal surges: 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 applied to the sum insured, which was based on the value of input costs (stock, feed, etc.) for each 120-day shrimp production cycle. The policy did not carry a deductible: instead, in the event of a loss, a coinsurance of 20 percent was applied to the value of the claim (see table 4.4. for further details of SBC shrimp policy cover). The program never achieved the required sales levels; the fixed premium rate of 0.99 percent was far below the actuarially correct premium rate(s) in each zone, and in the absence of a conventional deductible the product was very exposed to first loss. On account of the poor underwriting results, SBC withdrew this cover in 2004 (World Bank 2015a; World Bank 2010).

Going forward, if Bangladesh is to develop a large-scale shrimp insurance PPP program, it will be important to learn from SBC's experience and to work closely with the company in the planning and design of any new initiative.

Table 4.4. Summary Details of SBC Technology-Based (Shrimp Farm) Insurance Policy

Features	Details
Type of Policy	Individual farm insurance for SHRIMP FARMING
Insured perils	Flood, tidal Bore, cyclone, sudden surcharge of water (diseases were not covered)
Type of assets	• Prawn/Shrimp stock in pond • Prawn/ Shrimp juvenile / Fry • Dykes/Embankments • Prawn/shrimp feed and fertilizers on stock at project site • Buildings and go down
Policy Holder	Individual Farmers
Voluntary or compulsory	Voluntary.
Period	120 days from the time of the release of the shrimp larvae into the stocking pond. However the policy provisioned an extension of 30 days applicable in case of the existence of delays caused by erratic behaviour of the sea
Sum Insured	Input cost. Determined on an agreed basis based on the market value of the larvae and shrimp feed and price list of feed and other inputs supplied by the concerned company
Premium Rates	For every culture period 0.99% of the sum insured. This rate was applicable for three consecutive culture periods.
Loss Assessment and claim settlement	Any liability subject to the terms and conditions of this policy was assessed by a representative of SBC, a representative of the insured, and a representative of the prawn culture project/ association and a representative of the concerned prawn culture committee. Claim if accepted was settled on the basis of the assessed loss as follows **Stage of production) Sum insured** 1. First stage. Value of released larvae + value of 1 month's feed 2. Second stage Value of larvae plus value of two months' feed. 3. Third stage. Value of larvae plus value of three months' feed 4. Fourth stage Value of larvae plus value of four months' feed
Deductible	20% of the value of the claim borne as a coinsurance by the Insured
Underwriting	Centralized underwriting form SBC's Headquarters
Government subsidy	None
Reinsurance	None
Results	The volume of sales of the shrimp policy were low and the program never achieved a critical mass and spread of risk. Since 2004 SBC has stopped underwriting shrimp insurance due to the poor performance of this program.

Source: Zengykoren REgional Conference on Insurance and Credit for Sustainable Fisheries in Asia, 1996

Shrimp insurance international experience

There is a specialist global aquaculture insurance market that insures both onshore freshwater aquaculture and offshore marine aquaculture and that covers a wide range of finfish, crustaceans, and shellfish species. This market is dominated by a small group of reinsurers, including the large general reinsurers such as SwissRe, MunichRe, AllianzRe, SCOR, HannoverRe, and PartnerRe, and it also includes specialist aquaculture reinsurers such as Sunderland Marine and GAIC (the Global Aquaculture Insurance Consortium, which is a Lloyd's of London facility established to underwrite fish and shellfish). According to a World Bank 2008 survey, aquaculture insurance was available in about a third of all counties surveyed; the largest markets, including Norway, Canada, and Chile, have large marine salmon insurance programs, and the highest concentration of aquaculture insurance is in Europe, where nearly one in two countries has this class of insurance (Mahul and Stutley 2010). Conversely, with the exceptions of China and Japan, aquaculture insurance is relatively poorly developed or not available in most of Asia, including in Bangladesh.

The international aquaculture insurance industry offers two main types of mortality cover for fish stock: (1) named-peril cover and (2) all-risks cover. Named-peril cover is typically restricted to natural perils such as storm, tidal wave, and flooding resulting in the death of the fish stock and usually excludes all diseases. All-risks mortality cover typically includes diseases of the fish stock, pollution, algae bloom, theft, machinery breakdown, etc. Cover may also extend to loss or damage to the aquaculture installations (fishponds, fish cages, buildings), and the machinery and equipment (pumps, oxygenators-aerators, feeding equipment, and feed stocks). All-risk cover can be offered only with high premium 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 or values at risk at the time of the loss, and premium rates typically vary from about 2.5 percent to 10 percent according to the location, management, and technology levels of the insured risk and species of insured fish (World Bank 2010).

The market for shrimp insurance is very much more restricted than for finfish species and is mainly restricted to large intensive commercial shrimp farms. The major issues for shrimp insurance are the following: (1) 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 they are very exposed to moral hazard; (2) 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 (3) 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 (World Bank 2010).

The main traditional aquaculture insurance markets for shrimp include Mexico, Brazil, and China. Mexico is the largest shrimp producer in Latin America and a top-10 global producer and has operated shrimp insurance for several decades. The Mexican shrimp policy provides comprehensive protection against loss of the stock due to climatic risks, biological risks (diseases), and environmental contamination/chemical pollution–related risks. Specific exclusions include theft, 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 coinsurance of 10 percent of the value 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 a coinsurance on the value of the claim (World Bank 2010).

Although Asia dominates the global production of shrimp,[32] the provision of shrimp insurance is very restricted: China has the longest history of shrimp insurance, and India and Vietnam

32 Seven of the world's 10 largest shrimp producers in 2003 were Asian countries. These seven producers—China, India, Indonesia, Thailand, Vietnam, Malaysia, and the Philippines—had a combined output of 6.96 billion pounds, which represented two-thirds of world production of shrimp.

have also piloted shrimp insurance. In China the People's Insurance Company of China (PICC) underwrote a small aquaculture insurance program including fish and shrimp between 1982 and 1995 with very poor underwriting results. Over this period, PICC's aquaculture insurance premium income was US$1.12 million against paid claims of US$2.2 million, resulting in a loss ratio of 197 percent. However, from 1989 to 1995, PICC's average loss ratio of fish culture insurance was 172 percent, while that of shrimp culture insurance reached 1,440 percent (FAO 2006). Other Chinese insurers also experienced very poor underwriting results from shrimp insurance in the mid-1990s. In the early 2000s, the Chinese insurers offered named-peril insurance policies for shrimp that insured losses due to tropical cyclones and devastating tides, tsunamis, collapse of ponds, atrocious weather conditions causing an anoxic situation inside the fishpond, and losses due to pollution; diseases were generally excluded (FAO 2006). Since 2007, the Chinese government has provided massive premium subsidy support to the agricultural crop, livestock, and aquaculture insurance industry and has actively encouraged entry by foreign reinsurers. Thus it is understood that some Chinese insurers are now offering specific disease cover for shrimp against named diseases such as Taura Syndrome virus and WSSV.

In India, the national insurer, GIC, introduced a brackish water shrimp insurance scheme in the 1990s. The shrimp policy was a total loss policy; losses to shrimp stock had to exceed 80 percent due to one or more named perils for the policy to compensate a claim. The policy offered two cover options Section 1 basic cover covered pollution from external source only; poisoning; riot and strike; malicious acts of third parties; earthquake; explosion/implosion; storm, tempest, cyclone, typhoon, hurricane, tornado, flood, inundation, volcanic eruption, and or other convulsions of nature; aircraft and other aerial devices or articles dropped from them; impact with any road vehicle; and terrorism. Section I comprehensive cover covered all perils as listed in section I of basic cover, along with mortality due to WSSV only.[33] According to FAO (2006), the shrimp policy sold only a handful of policies in 2005.

In Vietnam, a pilot aquaculture insurance program was first introduced in 2001. In 2001 the government licensed a French mutual insurance company, Groupama, to develop crop, livestock, and aquaculture insurance in Vietnam, but these programs did not pass beyond a pilot scale with very low policy sales. In 2011 the government launched an ambitious subsidized agricultural crop, livestock, and aquaculture (shrimp, prawn, and finfish) PPP insurance program. The aquaculture program was intended to cover storm, flood, and diseases of fish and shrimp (FAO 2011).

Shrimp insurance policy design options for Bangladesh

The sections below present cover options for two main shrimp insurance covers that might be developed in Bangladesh:

1. Named-peril cover for commercial shrimp producers located in Khulna Region of Bangladesh
2. All-risks cover for shrimp hatcheries located in Cox's Bazar

Named-peril policy for commercial shrimp production

The rationale for designing a named-peril shrimp mortality insurance policy for the large number of predominantly small-scale extensive shrimp producers in Bangladesh is that this would enable them to intensify their shrimp cultivation systems through modest investments in higher levels of inputs and improved technology and husbandry practices, resulting in significant productivity gains and increased incomes. The preceding sections have shown that the vast majority of shrimp producers in Bangladesh adopt a low-risk, low-investment cost strategy for shrimp production and that average shrimp production and yields are very low, at about 250 kg/ha per year. Most shrimp producers are unwilling to invest in their shrimp production because of the high risks of losses due to tropical cyclones, storm surges, flooding, and diseases. With modest investments and a shift to a semi-intensive cultivation system, however, shrimp producers could double their shrimp yields, resulting in significant income gains. The purpose of this insurance cover is to reduce the risks of catastrophe losses due to natural perils, which will hopefully stimulate the transformation of the shrimp sector to a semi-intensive cultivation system.

33 A copy of the Indian shrimp policy wording is available at http://nfdb.gov.in/pdf/Assistance%20of%20Crop%20Insurance%20for%20Shrimp%20%20Prawn.pdf.

In the start-up phase of any shrimp insurance program in Bangladesh, it is likely that cover for small-scale commercial shrimp producers will need to be restricted to named natural perils, and it is very unlikely that international reinsurers will agree to insure viral diseases of shrimps (e.g., WSSV). This belief is based on a series of factors: (1) under the extensive culture system that nearly all shrimp farmers adopt, disease prevention and control practices are very rudimentary and probably would not meet the minimum requirements of international reinsurers; (2) there is no formal monitoring and recording of disease outbreaks, and historical disease mortality data does not exist for the shrimp sector, making it extremely difficult to quantify the disease exposure for risk assessment and premium rating purposes; and (3) the underwriting experience of shrimp insurance programs has generally been very poor, and premium rates and deductibles would be very high if diseases were included. Over time, once the Bangladeshi insurance sector has gained experience with underwriting named-peril shrimp insurance and in putting in place monitoring and control systems, it might be possible to consider the conditions under which disease cover could be offered to certain shrimp farmers who use only certified disease-free shrimp PL and who practice high levels of disease prevention and sanitary husbandry practices in their shrimp farms.

In the design of a named-peril shrimp policy for commercial shrimp farmers in Bangladesh, the following options and considerations will need to be take into account:

- **Insured goods.** Some shrimp insurance policies cover only mortality or loss of the shrimp stock, while other policies insure both the shrimp stock and loss or damage to the shrimp ponds (*ghers*), buildings and machinery, and equipment and shrimp feeds.
- **Unit of insurance.** The insured unit is likely to be an individual *gher* or pond of known area and pre-agreed sum insured for the shrimp stock in that *gher*.
- **Insured perils.** Named-peril policies typically insure death or loss of the shrimp due to tropical storm and associated storm surge, tsunami, tidal waves, tornados, flooding, and lightning.
- **Exclusions.** It is likely that all diseases will be excluded along with malicious acts by the insured or its employees, pollution of the seawater, poisoning by contaminated feed, theft, and predators, along with standard reinsurance exclusions such as strikes, riots and civil commotion, war, terrorism, and nuclear incidents (nuclear clause).
- **Cover period.** The policy would be designed to cover the growth cycle of each batch of shrimp from the time the PL are released into the *gher* up to the time the shrimp are harvested, which is normally about 120 days. The policy would need to be adapted to cover situations where the shrimp farmers cultivate two or even three shrimp crops in any one year.
- **Basis of valuation and sum insured.** The sum insured would be a pre-agreed value that could be based on the costs of production of shrimp farming, or a revenue-based valuation taking into account the average yield of shrimp and sale value. For a smallholder shrimp insurance scheme it would be easier to establish an "average production costs per hectare" valuation according to whether the farmer adopts an extensive culture system or an improved extensive or semi-intensive system. On the basis of the survey data presented in this report, average annual production costs for shrimps in Bangladesh vary from about US$725/ha to about US$1,500 per ha. In the design of a shrimp insurance program it will be necessary to work closely with DOF in the selected shrimp-producing districts to establish current average costs of production for each shrimp production system. Under a revenue-based valuation system, it would be more difficult to establish farmers' actual average yields of shrimps, and the policy might be more open to moral hazard and antiselection, whereby farmers elect to overdeclare their yields in order to obtain a high sum insured in the hope of claiming on their policy.
- **Basis of indemnity.** There is a major challenge for any shrimp insurance policy of how to assess losses to the shrimp stock contained in each *gher*. Unless there is accurate information on the number of PL that were added to the *gher* at the start of the production cycle, it is not sufficient to sample-count the actual stocking density at the time of the insured event and calculate the percentage loss of shrimp stock; this is not an accurate or reliable procedure for quantifying the loss and for indemnifying the claim. Therefore the measurement of partial losses may be difficult and costly to implement on very small shrimp farms with an average of about 1 ha or less. In Bangladesh, the former SBC policy measured and indemnified partial losses, while in India the brackish water shrimp policy is a total loss policy which triggers a payout only when the estimated mortality/loss of shrimp exceeds 80 percent. A further consideration is whether to indemnify losses according to the costs

incurred up to the time of loss and/or size of the shrimp (as per the former SBC cover, which carried increasing monthly indemnity payouts over the 120-day production cycle; see table 4.4) or offer a fixed payout by applying the estimated percentage damage or loss to the pre-agreed sum insured. The basis of indemnity and loss-assessment procedures will need to be carefully designed to ensure that costs can be maintained at reasonable levels.

- **Deductibles.** If the shrimp policy is designed to indemnify partial losses (as opposed to being a total loss policy) then it will be extremely important to have a per-event damage deductible set at a sufficiently high level to eliminate frictional losses that are not of economic consequence to the insured but that will result in very high premium rates being required. Deductibles on aquaculture policies are typically between 10 percent and 20 percent of the sum insured per event. In any design stage it will be important to check whether DOF's fisheries officers in each district maintain registers of the percentage losses experienced by shrimp farmers due to natural perils such as tropical cyclone, flooding, etc., which could be used to set the deductible level(s).
- **Premium rate and payment.** Such a policy should not be cancellable save for the nonpayment of premium by the insured and/or failure to comply with the terms and conditions of the policy. Normally premium should be paid before cover incepts. In Bangladesh there will be major challenges for insurers to establish technically based premium rating because of the lack of detailed mortality records in the shrimp sector. Furthermore, there will be a need to address the affordability of shrimp insurance and how to collect premiums from large numbers of small shrimp farmers (discussed further in the section on issues and challenges)
- **Other terms and conditions.** A shrimp policy will typically cover the insurer's obligations, especially with respect to loss assessment and claims settlement, and the insured's obligations with respect to providing full disclosure of all material facts relating to their risk (shrimp farm), managing their risk, and claims notification, etc. The policy should also include procedures for dispute resolution.

It is stressed that in order to design a named-peril insurance policy for Bangladesh it will be very important actively to involve the insurance companies, shrimp farmers, and DOF in the design process.

(b) All-risks cover for shrimp hatcheries

The commercial shrimp hatcheries located in Cox's Bazar involve a very substantial investment in hatchery infrastructure and machinery and equipment as well as in the broodstock. According to DOF a single female brood *bagda* black tiger shrimp may be worth several hundred U.S. dollars. These hatcheries are very exposed not only to natural and climatic disasters, but also to disease outbreaks, which could either kill their broodstock or result in the closure of the hatchery, leading to high consequential or business interruption losses.

Currently at a global level there are very few specialist shrimp hatchery aquaculture insurance policies. However, if a demand is identified by the hatchery industry in Cox's Bazar, it may be feasible in a second phase of this World Bank Group technical assistance program to bring in a specialist aquaculture reinsurance expert to conduct a feasibility study for the design of a tailor-made shrimp hatcheries all-risk cover including named viral diseases such as WSSV.

A precondition of a shrimp hatcheries all-risk cover that includes named viral diseases is that the hatcheries would have to invest in PCR virus-screening technology to ensure that none of their broodstock entering the hatcheries is infected and that PL leaving the hatcheries are also free of viral diseases. According to WorldFish[34], the hatcheries sector in Bangladesh produces about 10 billion PL each year. Currently only about 5 percent of the PL are screened for viruses and marketed with a certification that the shrimp seed have been tested for and are free of viruses. DOF is actively encouraging virus screening and certification, but many hatcheries are reluctant to introduce screening, as this would add about 2 percent to the costs of the shrimp PL, which are already high; traders and intermediaries are also resistant to any changes that would add to the costs of the PL.

34 Personal communication, World Bank Mission November 2014

Key issues and challenges for introducing shrimp insurance

There are major issues and challenges for the design and implementation of shrimp insurance in Bangladesh that will need to be addressed in any phase II preparation stage. These challenges are briefly listed below:

1. **Lack of aquaculture underwriting expertise.** Although SBC experimented with shrimp insurance in the 1990s, currently there is no expertise in the private commercial insurance companies to underwrite shrimp insurance and to adjust losses. Furthermore, the interest of the private insurers in investing in shrimp or other forms of aquaculture insurance has yet to be confirmed. Any PPP initiative will need to include medium-term provision for training and education programs for the insurers on the design, rating, and implementation of shrimp insurance.
2. **Lack of shrimp mortality data and statistics for risk assessment and rating purposes.** There is no centralized database for losses in the shrimp industry in Bangladesh, and this applies specifically to mortality data. Losses are reported and recorded only under catastrophe events (e.g., the floods of 2007 or Tropical Cyclone Sidr in 2007) for the purposes of identifying affected families and for distributing disaster relief. The lack of time-series mortality data by cause of loss will pose a major challenge for the rating of (a) a named-peril shrimp mortality cover for producers and (b) an all-risks cover including diseases for the shrimp hatcheries.
3. **Unknown demand for shrimp insurance cover by Bangladeshi shrimp farmers.** To date no insurance demand surveys or studies have been conducted with shrimp farmers in the coastal districts to identify their main risk exposures, losses, risk management practices, and potential interest in participating in a voluntary or bundled named-peril shrimp mortality insurance program. Nor is anything known about their willingness to pay premiums. Such a study will need to be conducted as part of any phase II preparation work.
4. **Distributing and administering a shrimp insurance cover cost-effectively.** The insurance companies lack any rural infrastructure to promote, market, and underwrite voluntary individual shrimp insurance policies to small shrimp farmers in Khulna Region. Any demand study should also interview key organizations involved in the shrimp value chain to elicit their potential interest in promoting and administering such a program. Potential distribution channels might include (a) input dealers and traders providing shrimp seed (PL) and/or shrimp feed suppliers, who often provide inputs on credit terms, repayable at harvest and sale of the shrimps; (b) banks lending to shrimp producers (although it is understood that banks mainly lend to larger commercial shrimp enterprises and not to small shrimp farmers), shrimp processors, and packers.
5. **Development of accurate, cost-effective individual farmer shrimp loss-assessment systems and procedures.** As noted above, it is extremely difficult to adjust losses objectively and accurately in individual shrimp ponds (*ghers*) and at the same time keep loss-assessment costs to a manageable level that can be included in the commercial premium charged to the insured. In the next phase it will be necessary to draw on international experience with loss adjusting to design sampling procedures for determining shrimp losses in individual *ghers*. At the same time, options should be explored under the PPP that would allow DOF to deputize its local fisheries officers in each district to help the insurers adjust shrimp losses in-field.
6. **Defining the roles of the commercial insurers and government of Bangladesh–DOL.** Under the PPP initiative, there are several important roles that DOF could play in supporting the implementation of the shrimp insurance program: (a) hatcheries inspections and screening /certification of shrimp stock to ensure the stock are free of major viruses, (b) shrimp farmer registration for insurance purposes (DOF currently maintains a register of over 200,000 shrimp farmers); (c) funding of shrimp farmer insurance awareness, education, and training programs, (d) participation in loss assessment, and (e) provision of premium subsidies.

4.3. Fiscal costing

It has not been possible to date to prepare any fiscal costings for shrimp insurance. It is not possible at this early stage of research into aquaculture insurance options for the shrimp sector to provide any estimates of possible demand and uptake rates of insurance or to assess insurance premium costs and operational expenses, which could provide the basis for indicative fiscal costings for

the government of Bangladesh to consider. If, however, the government of Bangladesh elects in future to conduct further, more detailed research into shrimp insurance, such costings would be prepared at that stage.

4.4. Welfare impacts

Shrimp production is an important source of income and employment among the dominant poor smallholder shrimp farming households that make up 0.5 percent of the rural population. According to HIES (2010) and reported in table 4.5, 85 percent of shrimp- producing households are smallholder producers (owning less than 2.5 acres of agricultural land) and contributing 87 percent of total shrimp production in the country. On average, these smallholder shrimp producers own 0–1.8 acres of land while operating in an average of 2.42 acres, consisting of one to two *ghers*. These smallholder producers are largely poor, with 30 percent poverty head count and average income of US$1,535 per household per year, 24–32 percent of which is from shrimp production. With its significance to the country's economy and smallholder's livelihoods, shrimp production is thus expected to continue to play an important role in ensuring food security and poverty alleviation for these dominant smallholders (BIDS 2014a, USAID 2013).

Low smallholder productivity resulting from low productive investment has been identified as one of the key barriers in the development of shrimp production. Despite the growing trend in shrimp production over the past 10 years, production still largely relies on extensive cultivation systems with low input use; slightly above 5 percent of smallholder producers reported purchasing fertilizer and feed. This results in low average shrimp yields of 44 kg/acre per crop among smallholders (HIES 2010), compared to an average of 79 kg/acre per crop realized by large-scale producers with relatively higher input cost. USAID (2013) provides further empirical evidence of potentially improving yield with relatively more input investment among 570 shrimp-farming households in Khulna Region (table 4.5), implying an average yield of 93 kg/acre per crop and average benefit-cost ratio of 1.83, with US$293 investment cost per acre. Belton et al. (2011) suggests a potential yield improvement by more than double when subsistent smallholder producers can afford improved extensive or semi-intensive cultivation.

The presence of uninsured risk in shrimp production has been one of the key impediments to productive investment in and improvement of smallholder productivity in Bangladesh. By nature, tropical cyclones, storm surges, flooding, and diseases can easily cause catastrophic losses to shrimp production. With limited access to credit, restocking could be difficult. Smallholders in turn rely heavily on limited saving, social risk sharing within communities, and public disaster assistance, which appear to be largely inadequate and potentially ineffective in managing highly covariate shocks. The presence of uninsured risk could thus reduce risk-averse smallholder producers' incentive to invest in high-yielding and high-input-cost cultivation systems in the first place. The presence of uninsured risk could also signal high expected default rates on loans, and this has been one of the key impediments for access to credit necessary for productive investment among smallholder producers. According to the HIES (2010) study, 41 percent of smallholder shrimp-farming households have some access to credit, but with a small average loan size of US$148 per household—too small for subsistence producers to afford to expand toward more productive cultivation systems.

A named-peril shrimp mortality insurance policy for the large number of predominantly small-scale extensive shrimp producers could potentially enable them to intensify their shrimp cultivation systems through modest investments in higher levels of inputs and improved technology, resulting in significant productivity gains, increased incomes, and reduction in rural poverty.

Existing studies already provide indicative evidence that shrimp producers could potentially double their shrimp yields, resulting in significant income gains with modest investments and a shift to a semi-intensive cultivation system. When insurance can reduce the risks of catastrophe losses due to natural perils, this could potentially increase incentives of smallholders to increase investment. Insurance could further reduce expected loan default rates and so unlock access to necessary

credit. Overall, insurance has good potential to stimulate the transformation of Bangladesh's shrimp sector to a semi-intensive cultivation system, with a potentially large contribution to food security and poverty reduction among rural populations.

Table 4.5. Summary Statistics of Shrimp-Farming Households

Shrimp farming household	Marginal	Small	Medium	Large	Overall
Socioeconomics					
Share of fishery households in rural households	11%	4%	2%	3%	20%
Share of shrimp farming households alone	0.3%	0.1%	0.1%	0.1%	0.6%
Share in total shrimp production	56%	19%	12%	13%	100%
Agricultural land owned (Acres)	< 0.5	0.5-1.5	1.5-2.5	>2.5	
Median agricultural land owned (Acres)	0.00	0.82	1.85	3.96	0.37
Median operating land (Acres)	2.23	2.59	3.13	4.68	2.76
Number of ghers	1.33	1.66	2.07	2.78	1.69
Income and poverty					
Total economic income ($/year/hh)	$1,458	$1,895	$2,072	$3,993	$1,987
% fishery income in total income	32%	26%	24%	19%	28%
Consumption expenditure ($/year/hh)	$1,579	$1,851	$2,001	$3,252	$1,892
Poverty headcount (upper poverty line)	35%	23%	12%	6%	27%
Livestock asset					
Cattle	1.1	1.7	2.2	4.8	1.8
Goat and sheep	0.0	0.7	1.2	1.2	0.8
Poultry	9.4	10.5	11.2	16.7	10.8
Shrimp production					
% purchase fertilizer and feed	4%	7%	7%	11%	6%
Median shrimp yield (kg/acre)	42	51	44	79	50
Access to credit					
% with credit	45%	35%	33%	38%	39%
Avg Loan size/hh	$135.29	$149.35	$160.18	$192.56	$144.70

Note: Categorization of livestock farmers follows IFPRI (2011) and is a modified version of HIES (2010). Smallholders include marginal, small and medium farmers with less than 2.5 Acres of land.

5. Crop Index Insurance Linked to Credit

5.1. Context

In Bangladesh, crop production is a key source of food and income, especially for rural Bangladeshi households. The recent Household Income and Expenditure Survey report (HIES 2010) shows that 36 percent of the country's population rely mainly on agriculture. Share of agriculture, especially crop production, in household's total economic income was 20.4 percent nationwide and 29.7 percent in the rural areas in 2010. Over the past three decades, Bangladesh has achieved self-sufficiency in rice production for its 160 million people. The country has achieved tripled rice yield as a consequence of steady advances in irrigation systems, adoption of high-yielding rice variety, and other agricultural innovations. With growing population but land and other resource (including climatic) constraints, the country's ability to ensure food security and continuous decline in poverty would thus rely on the capacity to continue to enhance agricultural productivity.

Crop production in Bangladesh is largely exposed to catastrophic shocks, which can result in significant welfare loss and increasing poverty and vulnerability. World Bank (2010) estimates that 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. An extreme, 1-in-100-year disaster event could lead to 23 percent loss of national paddy and wheat production. As shown in section 5.4, net crop income available for consumption for average households can drop by up 50 percent at a frequency of once in five years in parts of Bangladesh, which can push small- and medium-scale farmers into poverty. The impact of larger shocks (e.g., a 1-in-10-year shock) can push almost all farmers (except the large high-yielding producers) below the food poverty line. The frequency and severity of these shocks is likely to increase even further as a consequence of climate change.

While low-income smallholder households have employed a wide range of strategies to manage shocks (e.g., community risk-sharing arrangements, savings, crop and labor diversification) these strategies tend to be ineffective with extreme shocks that potentially create widespread losses affecting the whole community at the same time. Some strategies could also place high cost to long-term development, e.g., when households forgo the opportunity to concentrate investment in a higher-return, higher-risk production strategy by diversifying crops. Lacking effective risk management tools, low-income smallholder households may be forced to reduce food consumption, take their children out of school, and sell productive assets. These destructive coping measures could further deplete productive assets and drive poorer households into chronic poverty (Barnett, Barrett, and Skees 2008). Using longitudinal household survey data, Quisumbing and Baulch (2013) and Quisumbing (2007)

show that covariate shocks could create significant consumption and asset losses among rural Bangladeshi households. Dasgupta (2007) further shows that catastrophic floods have been one of the major causes of persistent poverty in the country. And according to HIES (2010), disaster-prone districts appear to be among the poorest regions with the worst development outcomes.

Catastrophic shocks can create impediments in the development of the rural agricultural credit market necessary for smallholders' productive investments. Catastrophic shocks can seriously affect farmers' ability to repay loan, reduce performance of agricultural loan portfolios of lending institutions, and hence reduce the supply of agricultural credit. Overall, while most farmers can access credit, they usually have to borrow from informal lenders at high rates of interest, with average annual interest rates from 19 percent to 30 percent. The presence of uninsured shocks can also discourage smallholders from productive investment and so reduce demand for credit. World Bank (2007)[35] shows that a high proportion of farmers with small and medium-size farms—the so called "missing middle"—do not have access to formal credit through the banks and MFIs and are forced to take on expensive loans from other informal sources. It also shows that by reducing exposure to crop failure and farmers' inability to repay their loans, effective risk management tools for agricultural households could play an important role in encouraging the banking sector to lend to these farmers.

While the government of Bangladesh already has disaster relief programs to support disaster-affected farmers in time of catastrophic shocks, such post-shock response programs can be slow, unreliable, and inadequate in bad years to effectively save the livelihood of affected populations. World Bank (2010) reports that the government of Bangladesh currently relies heavily on external assistance to finance post-disaster losses (implemented by the Ministry of Food, Ministry of Disaster Management and Relief, Ministry of Agriculture, and Ministry of Fisheries and Livestock). The main forms of disaster relief offered include vulnerable group feeding (VGF) and gratuitous relief, both of which disburse 10–20 kg of grain monthly to each affected households for up to six months (total of Tk 1,439–Tk 2,878 per household) to help poor farmers cope during times of natural disasters. The Ministry of Agriculture and MOFL are also responsible under their own budgets for providing affected farmers, fisherman, and livestock owners with post-disaster supports following a declared disaster event. The supports may be in kind, in the form of seeds, insecticides, or livestock, or they be cash payments. Emergency loan provisioning of Tk 1,000–Tk 4,000 per household at a subsidized rate is also available through PKSF's partner institutions. Despite large spending in the aftermath of disasters by the government of Bangladesh and external donors, Air Worldwide (2014) reports large funding gaps, especially in the bad years. World Bank (2013) also provides evidence that post-shock assistance could be slow, unreliable, and appear with leakages. Late-arriving (and potentially inadequate) assistance often fails to protect the livelihoods of affected populations, who often must deplete their productive asset stocks or engage in other destructive coping in response to shocks, e.g., removing children from schools or reducing consumption, which could in turn have a long-term development cost and make them more vulnerable to future shocks.

Crop insurance is not currently offered in Bangladesh,[36] but two weather index–based and donor-supported initiatives are under preparation. One of these initiatives is a micro-level individual farmer rainfall index for rice, triggered by ground-based automated weather stations, which is led by the government-owned insurance company Sadharan Bima Corporation and supported by the Asian Development Bank. The other is led by private sector company Green Delta and supported by the World Bank Group and includes the development of a gridded rainfall database. One of the key constraints to the supply of agricultural insurance indicated by insurers is their lack of knowledge and technical expertise in the design, rating, and implementation of crop insurance products (World Bank 2015a, 2010).

Several decades ago, the public insurer SBC piloted a multiple peril crop insurance (MPCI) program, but it was terminated following poor underwriting results. From 1977 to 1995, SBC offered MPCI for a variety of crops including rice (aman, boro, and aus), wheat, sugar cane, and jute. However,

35 World Bank, 2007, Increasing access to rural finance in Bangladesh : the forgotten missing middle

36 According to a 2011 national microinsurance market assessment survey conducted by the Palli Karma-Sahayak Foundation with 3,490 microcredit-borrowing urban and rural households predominantly involved in agriculture, no respondents had access to crop insurance.

this program did not achieve scale and experienced very poor underwriting results, with a long-term average loss ratio of 499 percent (see details in World Bank 2015a).

By securing agriculture lending, crop insurance could help unlock access to cheaper credit for farmers in Bangladesh. While farmers in Bangladesh can generally access credit,[37] they often face high annual interest rates—ranging from 19 percent to 30 percent, depending on their landholding—because they rely on informal sources of credit. In particular, while the annual interest rate on agriculture credit supplied by banks is capped at 13 percent, interest rates charged by moneylenders are above 70 percent for marginal farmers.[38] Exposure to production risks is a key constraint to the expansion of credit to farmers. In particular, a recent report on the Rural Credit Survey in Bangladesh states that "the government should introduce agricultural insurance for the borrowers . . . It will help to protect the borrowers from financial risks, including damage of crops for different natural calamities" (BBS 2015). By transferring out production risks, crop insurance could help small- and medium-scale farmers access cheaper sources of credit.

The following section aims to identify options for a comprehensive crop-credit insurance program in Bangladesh, as well as providing an illustrative fiscal costing and an economic impact analysis of these options.

5.2. Proposal for index insurance

Design

There are two main types of crop insurance products: traditional indemnity products and indexed products. Traditional individual farmer indemnity-based crop insurance products include named-peril crop insurance and multiple peril crop Insurance; they require a loss-adjustment process in each farm to evaluate individual damages arising respectively from one type of peril (for named-peril crop insurance) or various perils (for MPCI). Conversely, crop index insurance policies are products based on an underlying index using objective variables such as average yields (for area yield index insurance) or weather variables (for weather index insurance, WII); they do not depend on establishing an insured crop yield for each farmer nor on in-field loss assessment on a farm-by-farm basis (see details in figure 5.1)

Given that the average farm size in Bangladesh is about 1 acre, the costs associated with individual loss adjustments would be prohibitive for the majority of farmers, and it is recommended that crop insurance be designed on an indexed basis. Most (81 percent) farmers in Bangladesh are marginal or small farmers owning less than 1.5 acres of land. In addition, the lack of historical data on average yields at the individual level would make it hard for insurers to price such products.

AYII is based on an indexed approach and could be considered in Bangladesh for important cereal crops such as paddy rice, wheat, and maize. The key feature of AYII is that it does not indemnify crop yield losses at the individual field or grower level. Rather, an AYII product makes indemnity payments to growers according to yield loss or shortfall against an average area yield (the index) in a defined geographical area. An area yield index policy establishes an "insured yield" that is expressed as a percentage (or "coverage level") of the historical average yield for selected crops in the defined geographical area that forms the insured unit. If the threshold yield is lower than the insured yield, all insured farmers in the insured unit are eligible for the same rate of indemnity payout (see figure 5.2).

37 According to the Rural Credit Survey 2014 (BBS 2015), 48.7 percent of rural households in Bangladesh (12 million households) received rural credit in 2013.

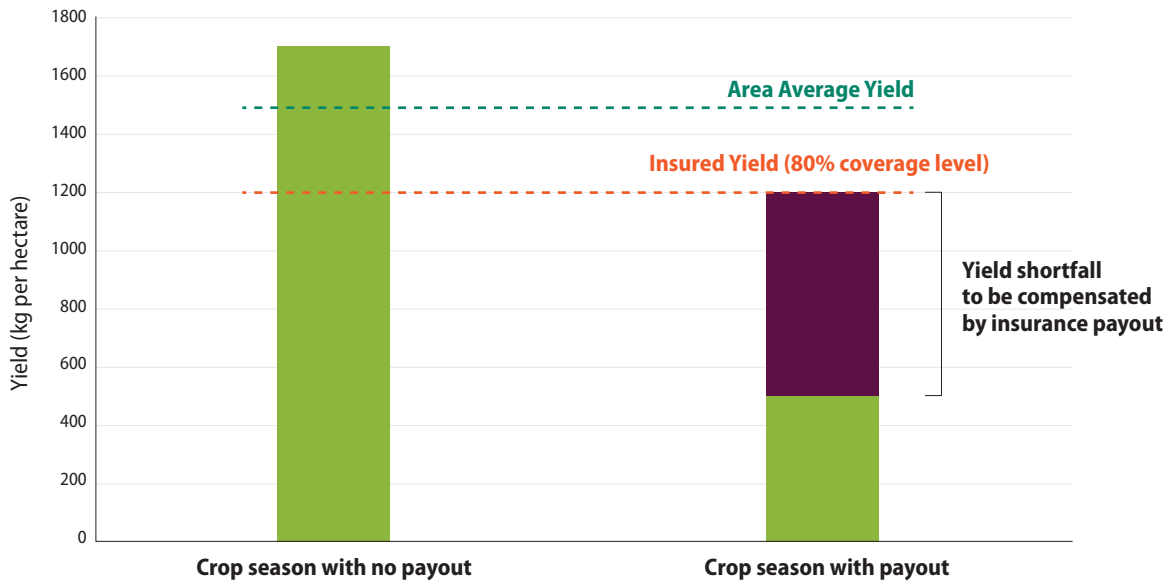
38 Moneylenders account for 15 percent of credit supplied to medium-size farmers, 11 percent for small farmers, and 13 percent for marginal farmers, according to the International Food Policy Research Institute (IFPRI).

Figure 5.1. Types of Agricultural Insurance Products

1. What are the various types of insurance products for agriculture

	What is it?	Transaction costs	Moral Hazard and adverse selection	"Mismatch Risk"	Claims Settlement time
Traditional indemnity insurance — Farm	• Payouts are determined through a farm-level loss assessment process. • Protection can be offered for multiple perils or for a named peril.	High	High	Low	Medium
Area-yield index insurance — Village	• Area-yield index insurance is based on average losses at the village level, rather than farm level. • It is often based on crop cutting experiments.	Medium	Low	Medium	Medium
Weather index insurance — Village	• Weather index insurance is based on weather parameters (such as rainfall, temperature, or soil momisture) correlated with farm-level yields or revenue outcomes.	Low	Low	High	Low

Figure 5.2. Coverage Level and Insurance Payouts In AYII



The key advantages of the area yield approach are that it provides wide peril coverage against all climatic, natural, and biological sources of crop yield loss while minimizing moral hazard, adverse selection, and administrative costs. As the policy responds to yield loss at a defined area level, and not at the level of the individual farmer, if the insured unit is large enough, no farmer can influence the yield indemnity payments; thus adverse selection and moral hazard are minimized. Administration costs are also greatly reduced because there is no need for prein-spections on individual farms, and loss assessment is not conducted on an individual farmer and field-by-field basis, but rather according to a pre-agreed random sampling of crop yields on plots within the insured unit.

The main drawback of AYII is the potential difference between the insured area yield outcome and the actual yields achieved by individual insured farmers within the insured area. Such risk arises where an individual grower may incur severe crop yield losses due to a localized peril (e.g., hail or flooding by a nearby river), but because these localized losses do not impact the area-level average yield, the farmer who has incurred severe crop damage does not receive an indemnity. In addition, such

mismatch risk may arise where individual farmers' crop production and yields are highly heterogeneous (different) within the same department, which will invalidate using an area-based approach.

WII is an interesting innovation that might also be feasible and is being piloted in Bangladesh. While not affected by moral hazard and adverse selection, WII usually covers a limited number of weather perils (e.g., rainfall deficit or excess rainfall, high or low temperatures), and this product is often very exposed to potential mismatch between individual losses and index payouts.

Were the government of Bangladesh to proceed to develop indexed insurance products, a partnership between public and private sector stakeholders would be needed to ensure that high-quality data are collected and audited. High-quality data are necessary to ensure that insurance products reliably trigger payouts when needed, but also in order to minimize pricing. Indeed, reinsurance companies—which help off-load some covariate risk outside the country—have high standards for the data they are willing to use to develop and price insurance products, and will charge significantly higher premiums if they have concerns about how the data are audited. Therefore, it is important that agriculture data be audited through a transparent process. Both AYII and WII require long series of reliable historical data for product design and rating. This is an area in which financial and logistical support of the government can help the private sector to overcome the challenges related to providing insurance in the inception phase.

An AYII product could be readily designed, given Bangladesh's highly developed system of seasonal crop production and yield reporting based on sample crop-cutting; however, further investments in data collection and auditing would be required to use such data for insurance purposes. The data for AYII are usually collected through CCEs, in which samples of crops are harvested, dried, and weighed, and grain yields calculated. In Bangladesh, crop yield data have been systematically collected and recorded by the Bangladesh Bureau of Statistics and the Department of Agricultural Extension for major crops such as paddy and wheat.[39] AYII products could build on the existing 25 years of historical yield data for seven major crops collected at *upazila* (subdistrict) level. However, data requirements for AYII go beyond the needs of agricultural statistics, and in order for AYII products to be reinsured, CCEs would need to be audited. In addition, in order for payouts to be distributed quickly after shocks, further development of the technology to transfer yield data in real time (currently piloted by BBS) might be necessary. Such activities could be carried out by the public or private sector (see chapter 2 on the institutional framework).

A WII product could be developed based on the 30-year weather gridded database currently being developed with World Bank Group support, although the density of weather stations is relatively low, which creates a significant risk of mismatch between individual losses and payouts. There are 35 synoptic weather stations managed by the Bangladesh Meteorological Department, which means an average radius of 100–150 km for each weather station. Similarly, satellite data resolutions are relatively low and cannot be used for prediction of daily rainfall. In addition, data accuracy and gaps in data are major problems. The World Bank Group is currently working with the Bangladesh Meteorological Department to develop a synthetic gridded data set[40] for the entire country based on the 30-year historical data from current synoptic weather stations. The gridded data set is of higher resolution— typically 25 km x 25 km—but this resolution will still result in significant errors if the weather index insurance contracts are designed and priced for individual farmers.

In designing and implementing a crop insurance program in Bangladesh, it will be important to take into account lessons learned from international experience and opportunities provided by the latest developments in technology. For instance, elements piloted in India—such as real-time data transfer through mobile phone connections, digital video recording, remote sensing performance indicators, GIS mapping, GPS georeferencing, etc.—will increase the possibilities of assessing production losses in an efficient, effective, and transparent way.

39 Such data are not, however, available for cash crops, horticulture, and minor crops.
40 The data set would have information on daily rainfall and minimum and maximum temperature.

Distribution

There are three key issues for the distribution of crop insurance in Bangladesh: types of channels, compulsion, and subsidies. The first issue concerns choice of distribution channels—i.e., whether crop insurance could be sold as a stand-alone product by insurance brokers, or sold as part of a package with credit by financial institutions, or sold with inputs by input suppliers. The second issue concerns a potential policy decision to make the purchase of crop insurance mandatory with credit. The third concerns potential support by the government through subsidies.

International experience suggests that agricultural insurance is typically distributed alongside agricultural credit, and this also seems to be an attractive option in Bangladesh. In most agricultural insurance programs that have reached scale, insurance is sold as part of a broader package, for instance with credit (as is the case in India and Mexico) or together with agriculture inputs (as is the case in Kenya and Rwanda).

Bundling crop insurance and credit would increase the cost of agricultural credit for some farmers, but decrease the cost for other farmers and provide liquidity in bad years. In spite of government's efforts, in Bangladesh exposure to shocks creates constraints to the supply of agriculture credit representing 3 percent of total lending, while agriculture contributes about 16 percent to GDP. By putting an objective price on risk, agriculture insurance may help provide better access to credit for farmers currently credit-rationed out of the market, while increasing the cost of credit for the farmers most exposed to risks. While bundling insurance and credit may increase the overall cost of the package of credit and insurance, insurance payouts will provide liquidity to farmers in bad years, therefore helping them to maintain their creditworthiness and potentially giving them access to new loans to cope with the financial impact of disasters.

Agriculture insurance can help unlock access to credit but cannot deliver impact in isolation. While production risks have been identified by several financial institutions as a key constraint on agriculture credit supply, other constraints include the lack of agriculture expertise of financial institutions, the costs associated with small transactions, the lack of (and difficulty in enforcing) farm collateral, and the exposure to nonproduction risks (such as health or price risks[41]). Moreover, a World Bank (2008a) report has suggested that reforming the publicly sponsored financial sector and facilitating the participation of private financial institutions and MFIs would also be needed to increase access to finance in rural Bangladesh.

Some ministries or central banks have made agriculture insurance mandatory for government-supported agriculture credit in order to secure agriculture lending and allow for the rapid scale-up of insurance. This is the case in Mexico, where bundling of credit with insurance is mandatory for credit institutions that receive public support, and where 300,000 farmers are covered. This is also the case in India, where 33 million farmers are covered (or 20 percent of farming households). A World Bank survey of 65 countries conducted in 2008 showed that agricultural insurance is compulsory for crop and livestock borrowers in 11 percent of surveyed countries (Mahul and Stutley 2010).

These policy decisions are not mutually exclusive, as compulsory basic catastrophic coverage could possibly be complemented by voluntary products. Indeed, the government might decide to make agriculture insurance mandatory for government-supported agriculture credit for low-frequency and high-severity events, while supporting the development of voluntary agriculture insurance for more frequent events.

41 The 2014 Rural Credit Survey (BBS 2015) indicated that in 2013, low crop prices accounted for 12 percent of nonrepayment of agriculture loans, while unexpected medical expenditures accounted for 9 percent of nonrepayment of agriculture loans.

Table 5.1. Pros and Cons of Legal Requirements to Bundle Insurance with Credit

	Mandatory	Voluntary
Scale-up in coverage	Compulsion may allow rapid scale-up of insurance which • Increases overall impact as more farmers are covered, and financial institutions are more likely to increase lending and offer more favorable lending terms ✓ • Allows insurance companies to operate sustainably, as scale allows them to reduce transaction costs and to diversify risks ✓ However, compulsion is not always associated with rapid scale-up. India's experience shows that borrowers might switch to alternative sources of credit when financial institutions set up mandatory bundles of insurance and credit to avoid a perceived "tax on credit." !	Pure voluntary schemes may not reach a critical mass to make them sustainable or impactful: • Voluntary take-up of agricultural insurance is usually low
Cost of access to credit and insurance	In the short term, compulsion may increase the cost of access to credit. For farmers who already have access to formal credit, mandatory bundles would increase the cost of access to credit. !	A voluntary scheme might not generate required economies of scale to reduce the costs of insurance. !
Flexibility in product design	Financial institutions might have limited ability and incentives to adapt products to customer needs e.g., threshold yield, sum insured, etc.). !	Financial institutions and farmers can tailor products to needs, based on feedback loop from customers. ✓
Consumer protection	Compulsion may create consumer protection risks if customers are purchasing a product that • They are not aware of • They do not fully understand. potentially giving them a false sense of security !	Campaigns to raise awareness about insurance can be conducted as part of the distnbution process to ensure consumer protection. ✓

Premium subsidies are widely used by governments to support agricultural insurance markets, but are not always the best way to structure financial support to agricultural insurance. A review of agricultural insurance programs in 65 advanced and emerging countries finds that almost two-thirds of the surveyed countries, including low-, middle- and high-income countries, provide substantial agricultural insurance premium subsidies (Mahul and Stutley 2010). Premium subsidies can reduce the cost of insurance to the farmer, and thereby increase utilization of insurance, particularly for more vulnerable farmers and herders, and they can support insurance companies in developing a minimum sustainable market size. However, if not used carefully, subsidies can distort price signals and provide inappropriate incentives to farmers (e.g., have an adverse effect of encouraging them to take more risks or continue engaging in risky activities).

Any subsidies to agricultural insurance should be designed with a clearly stated and well-documented policy objective, and should be designed to address a market failure or equity concern. Subsidies to agricultural insurance premiums should be carefully considered and targeted. Policy makers should carefully identify their objectives, such as which beneficiaries and regions to target, and whether the subsidies will be provided for a limited period or in perpetuity. This ensures that the subsidies are "smart"—i.e., they minimize distortions in the market and mis-targeting of clients, while also crowding in private insurance. Potentially, different subsidy levels could be applied to different market segments, with higher levels of support for subsistence farmers.

5.3. Illustrative example of fiscal costing for AYII

The objective of this section is to provide an indication of the potential fiscal costs of developing an AYII insurance program for rice producers (aman and boro high-yielding varieties, HYV) in Bangladesh. It is stressed that these are preliminary fiscal estimates that have not yet been presented to or discussed with the government of Bangladesh, and as such these figures will require further work and refinement in due course. It is hoped, however, that these cost estimates are useful for policy makers in

gauging the possible scale and costs of such a PPP insurance initiative for aman and boro. In order to develop such projections, estimations of commercial premiums for aman and boro have been developed (see tables 5.2 and 5.3, respectively), based on which fiscal costs to the government have been inferred (see table 5.4). The assumptions that have been made for these estimations are described below.

This illustrative costing makes use of take-up assumptions and loan amounts that are based on Bangladesh specificities as well as international experience. Assumptions on sum insured are based on a take-up rate that increases from 1 percent of cultivated area of aman and boro paddy at the beginning of the program in 2016, to 10 percent in 2020. These projections are in line with large-scale agriculture insurance programs, where insurance penetration after several years is usually below 20 percent of farm households.[42] Based on current landholding and costs of inputs in Bangladesh, it is assumed that farmers would cover a loan amount equal to US$100 for aman HYV[43] and US$150 for boro HYV, [44] for an average of 2.5 acres for each crop. Under these assumptions, the overall sum insured—or total lending for aman and boro production—would amount to US$250 million after five years, which amounts to 10 percent of current agriculture lending offered by the main agriculture banks BKB and RAKUB. This result is in line with the fact that BKB and RAKUB lend for a variety of crops and a variety of purposes (including agriculture production, trade, and marketing).

The commercial premium rate includes several key components, such as the cost of risk (or "pure risk premium"), and other charges such as catastrophic loading cost, reinsurance fees, administration costs, tax, and profits. A preliminary assessment of the pure risk rates, technical rates, and commercial premium rates for both aman and boro paddy was carried out in 2010 in survey districts of Bogra, Pabna and Dinajpur (World Bank 2010). This assessment suggested that affordable commercial premium rates—which could be achieved by setting insured yield coverage levels accordingly—would range between 5 percent and 7.5 percent for aman HYV (for insured yield coverage levels of 60 percent to 70 percent) and 3 percent to 5 percent for boro HYV (for coverage levels of 70 percent to 80 percent), depending on the *upazila* and district. These commercial premium rates are purely indicative, and the responsibility to perform appropriate actuarial analyses for underwriting purposes lies with the Bangladeshi insurance industry and their reinsurers.

Table 5.2. Commercial Premiums Projections for AYII for Aman HYV from 2016 to 2020, with Sum Insured at US$100 per Acre

	2016-17	2017-18	2018-19	2019-20	2020-21	Total
Percent uptake area	1%	2.00%	5%	7.50%	10%	
Area (Acres)	100,000	200,000	500,000	750,000	1,000,000	
No. benefiting farmers	40,000	80,000	200,000	300,000	400,000	1,020,000
Sum Insured (US$)	10,000,000	20,000,000	50,000,000	75,000,000	100,000,000	
Premium/Acre - Low case (US$)	5.0	5.0	5.0	5.0	5.0	
Premium/Acre - High case (US$)	7.5	7.5	7.5	7.5	7.5	
Total Premium Aman Low (US$)	500,000	1,000,000	2,500,000	3,750,000	5,000,000	
Total Premium Aman High (US$)	750,000	1,500,000	3,750,000	5,625,000	7,500,000	

This fiscal costing exercise is based on the assumption that the government will provide financial support to the AYII scheme through premium subsidies, investment in data market infrastructure, and support to awareness raising activities .[45] In this illustrative example, it is assumed that the government will cover a 50 percent share of premium subsidies, invest in strengthening and auditing of current crop-cutting experiments at a cost amounting to 7.5 percent of low premium estimate, and support insurance awareness-raising activities at US$1 per beneficiary.

42 In India, where the government has made agriculture insurance mandatory for government-supported rural loans, 20 percent of farming households are covered.

43 This is the input cost for seeds and fertilizers.

44 This is the input cost for seeds and fertilizers plus US$50 for irrigation charges.

45 See section 3 for a more detailed argumentation on the need for public support.

Table 5.3. Commercial Premiums Projections for AYII for Boro HYV from 2016 to 2020, with Sum Insured at US$150 per Acre

	2016-17	2017-18	2018-19	2019-20	2020-21	Total
Percent uptake area	1%	2.00%	5%	7.50%	10%	
Area (Acres)	100,000	200,000	500,000	750,000	1,000,000	
No. benefiting farmers	40,000	80,000	200,000	300,000	400,000	1,020,000
Sum Insured (US$)	15,000,000	30,000,000	75,000,000	112,500,000	150,000,000	
Premium/Acre - Low case (US$)	4.5	4.5	4.5	4.5	4.5	
Premium/Acre - High case (US$)	7.5	7.5	7.5	7.5	7.5	
Total Premium Boro Low (US$)	450,000	900,000	2,250,000	3,375,000	4,500,000	
Total Premium Boro High (US$)	750,000	1,500,000	3,750,000	5,625,000	7,500,000	

Under these assumptions, the annual fiscal costs to be borne by the government for supporting the development of a national AYII program for aman and boro paddy would range between US$6 million and US$9 million in 2020, when it is assumed that the program will have reached significant scale (see table 5.4). As a reference, this amounts to about 0.05 percent of the government of Bangladesh's 2014 budget, and 1 percent of the Ministry of Agriculture's budget.[46]

Table 5.4. Government Fiscal Costing Projections for AYII for Aman and Boro HYV from 2016 to 2020 (US$)

	2016-17	2017-18	2018-19	2019-20	2020-21	Total
1. Premium Subsidies at 50%						
Aman + Boro (Low case)	475,000	950,000	2,375,000	3,562,500	4,750,000	12,112,500
Aman + Boro (High case)	750,000	1,500,000	3,750,000	5,625,000	7,500,000	19,125,000
2. Support to strenghtened data collection and management	71,250	142,500	356,250	534,375	712,500	1,816,875
3. Promotion and awareness creation axctivities	80,000	160,000	400,000	600,000	800,000	2,040,000
Total Costs (Low case)	626,250	1,252,500	3,131,250	4,696,875	6,262,500	15,969,375
Cost/beneficiary	8	8	8	8	8	8
Total Costs (High case)	901,250	1,802,500	4,506,250	6,759,375	9,012,500	22,981,875
Cost/beneficiary	11	11	11	11	11	11

This costing exercise does not differentiate subsidy levels by market segment, although different supporting schemes could be envisioned. In particular, higher levels of support could, for instance, be provided to subsistence farmers, while specific limits to the amount of subsidized insurance could be introduced for more commercially oriented production.

5.4. Welfare impacts of area yield insurance for boro HYV and aman HYV in Bangladesh

This section develops a simple household model fitted to longitudinal agricultural production and micro-level socioeconomic data to illustrate the potential welfare impacts of AYII and government supports to AYII in delivering timely and reliable post-disaster support to farmers as an alternative to existing post-disaster relief programs. As Bangladesh's agricultural system is complex and varies significantly by geographical and climatic condition, the analysis considers rice (the country's key cereal, occupying 78 percent of total cropped land nationwide) and thus AYII contracts for boro HYV, aman HYV, and boro hybrid (as an alternative high-yielding crop with expensive input

46 Government of Bangladesh's 2014 budget is about US$32 billion, and the Ministry of Agriculture's budget is about US$1.5 billion.

requirement). We classify rice production areas based on statistics from the Bangladesh Agricultural Research Council and focus the study on two key rice production zones, occupying 79 percent of the country's total rice-growing areas. The high-potential zone occupies about 31 percent of the country's rice-growing areas and includes high-potential agricultural districts in Khulna, Rajshahi, and Dhaka, where good irrigation and relatively low flood risk results in high rice yields and lower yield variability (coefficient of variation [CV] = 0.22 (boro HYV) and 0.31 (aman HYV). The medium-potential zone occupies 48 percent of the total rice-growing areas and includes more flood-prone districts in Dhaka and northern Barisal and more drought-prone districts in Rangpur; the higher flood and drought risk along with less reliable irrigation result in lower boro rice yield and more yield variability (CV = 0.29 [boro HYV] and 0.39 [aman HYV]).[47] In each production zone, the economic model considers and simulates an average household from each of the four farm-size groups (marginal, small, medium, and large) that owns a median-size farm, produces with the zone-specific production system; there is an individual-specific cost of production credit and crop yields, with some correlations with subdistrict yields and faced with both price and yield risks. The model considers the case when these average households grow two crops per year, and also distinguishes two types of farmers: (1) high-yielding growers initially growing aman HYV and boro HYV, and (2) low-yielding growers initially growing aman local and boro HYV. Boro hybrid is also considered as one potential alternative that high-yielding crop households can adopt in Rabi season when they can afford more expensive input cost through cheaper and more credit. These average households are resource constrained and so need to take an input loan at the beginning of the cropping year to purchase required minimum inputs at the average interest rates observed empirically for different farm-size groups. The loan is repaid using crop income obtained after the harvest (see Annex 4 for detail on modelling and simulations). The model is then calibrated using a combination of 30 years of subdistrict and district yield data from BBS and the farm-level rural household survey data in the 2011–2012 Bangladesh Integrated Household Survey.

The four farm-size groups of farmers vary in operating land, credit access, and economic income, implying that the potential welfare impacts of AYII might vary across these groups. Overall, 36 percent of rural farmers are marginal (operating less than 0.5 acre of land), 45 percent are small farmers (operating 0.5–1.49 acres of land), 12 percent are medium farmers (operating 1.50–2.49 acres of land), and only 7 percent are large farmers (operating 2.5 acres or more).[48] Table A4.1 provides summary statistics of these farm groups based on Bangladesh Integrated Household Survey data. Average annual consumption expenditure per rural household is averaged at US$2,302, slightly above the US$1.25 international poverty line,[49] with an overall poverty head count (US$1.25 international poverty line) of 43 percent. The majority of marginal farmers are poor; and small farmers are very vulnerable to falling into poverty. The share of crop income in total economic income increases by farm size, ranging from 12 percent for marginal farmers—who, with small farm size, operate highly diversified livelihoods while still relying on cropping for food—to 33 percent, 53 percent, and 60 percent for small, medium, and large farmers respectively. This variation underlies the variations in the role of crop income in welfare across groups. Adoption of agricultural technology by Bangladeshi farmers is relatively high for rice, with most farmers in the key suitable production zones already adopting boro HYV. The share of farmers growing aman HYV is 83–92 percent, with larger adoption among large farmers. The share of farmers growing boro hybrid is 6–16 percent; it is more common among larger farmers due to its requirement of high-cost inputs. Seventy-one percent of farmers already have access to credit, but mostly from informal institutions. Bank loans are accessible only to large farmers, while NGO loans target marginal and small farmers. Many groups, especially the medium farmers, have to rely on expensive loans from moneylenders and other sources to afford input costs. Overall, while farmers can access credit, they encounter significantly high costs, with average annual interest rates from 19 percent to 30 percent.

47 High-potential rice production zone is classified as districts with more than 60 percent of areas defined by the Bangladesh Agricultural Research as very suitable for aman and boro rice production. The medium zone is classified as districts with 30–60 percent of areas very suitable for aman and boro rice and more than 50 percent of area defined as suitable for aman and boro production.

48 The four farm-size groups match the categorization in the 2012 Bangladesh Integrated Household Survey report (IFPRI 20112012) and match the cut-off points of the six categories presented in the 2010 HIES report of the Bangladesh Bureau of Statistics (BBS 2011) by aggregating the smallest two HIES farm-size groups under the marginal farmer category and the largest two groups under the large farm category.

49 With average household size of five and using purchasing power parity conversion, poverty lines per household per year are estimated at US$2,281.25 (US$1.25 international poverty line), US$1,266.86 (national upper poverty line), and US$1,077.86 (national lower or food poverty line) in 2011 respectively.

The net crop income available for consumption (used as awelfare indicator) of the average household appears with large variability; its mean and variability also varies greatly across farm-size groups and production zones. The black lines in figures 5.3 and 5.4 reflect annual crop income after netting out input loan repayment of average households in the high- and medium-potential rice zones. In each zone, households are segmented into four farm-size groups and two initial production systems, either the high-yielding system with aman HYV and boro HYV (81 percent of the zone farmers) or the low-yielding system with aman local and boro HYV (13 percent of the zone farmers).[50] The expected net crop incomes (realized in one-in-two year frequency) are very low—lower than the lower poverty line (equivalent to the national food poverty line), especially for the marginal and small farmers (that is, the majority of rice farmers) in both production zones due to small operating land.[51] Net crop incomes are also very low for medium farmers producing aman local in both zones due to relatively lower productivity. In general, farmers in the medium-potential zone have slightly larger expected net crop incomes but significantly larger yield variability relative to the high-potential zone.

Net crop incomes available for consumption for average households could drop by up to 40 percent in the high zone and by up to 50 percent in the medium zone at a frequency of once in five years. And this could easily push medium farmers (in both zones) below the lower poverty line, and could push small and marginal farmers deeper into poverty. A 1-in-10-year production shock could further drop net crop incomes available for consumption in these zones by up to 68 percent, and could easily push crop income of almost all farmers (except the large high-yielding producers) below the food poverty line. These large shortfalls in crop income could have significant welfare consequences, especially for small, medium, and large farmers, whose economic income largely depends on crop income. The overall welfare impact of crop income shortfalls would be smaller for the marginal households, which rely on crop income for only 12 percent of total economic income. And because the net crop incomes available for consumption of average households already reflect the average values across households in each production area, they thus reflect the crop income available for consumption that exists after risk-sharing mechanisms within the communities have already been employed to buffer some income shortfalls. The observed large variability of crop incomes of these averaged households thus implies that production risk is still largely uninsured by social insurance.

AYII could stabilize consumption in the bad years of extreme shocks that affect the entire community. We first explore the potential of high-coverage AYII contracts for existing high-yielding crops—i.e., aman HYV and boro HYV—each with a pay-out based on a subdistrict yield index at a coverage level specific to each zone, and each with insurance coverage that is possible within a 7.5 percent maximum commercial premium rate (the modest variability of observed subdistrict yield data results in insurance coverage of 85–90 percent in the high-potential zone and 80–85 percent in the medium-potential zone). The model considers the situation when average households currently producing aman HYV or boro HYV purchase available AYII for their high-yielding crops in both seasons. Those that currently produce aman local or boro HYV could purchase AYII only for their high-yielding crop in Rabi season. Net income available for consumption for average households that purchase available commercial AYII for their high-yielding crops in both seasons is then plotted in solid orange (figures 5.3 and 5.4). In general, AYII would reduce net income in good years, as the household needs to pay for the commercial insurance premium that is loaded at a multiple of 1.5. AYII payouts could then buffer some 6–11 percent of net crop income shortfalls, especially in bad (e.g., 1-in-10) years. Overall, the risk reduction benefit of AYII is more for the high-potential zone with a relatively lower risk, where farmers can enjoy larger insurance coverage within the 7.5 percent premium rate.[52]

AYII could potentially increase the ability of farmers to pay back input loans in the bad years and so increase expected loan repayment rates of the rural lenders' loan portfolios. In reality, a household might also not use all crop income to pay back the loan. To look at a more realistic scenario, table A4.3 further computes expected loan repayment rates of institutions lending to households in these two zones in two assumed scenarios: (1) an optimistic case assuming that a household will try

50 The two groups do not add up to 100 percent as the analysis excludes about 6 percent of the zone farmers who currently grow boro local.

51 Because crop income could occupy a very small share in total economic income, especially among the marginal farmers, our model does not permit direct calculation of poverty rates.

52 See annex for detailed summary and assumptions on AYII's payout function, pricing, household's insurance choices, and related summary statistics of AYII commercial premium rates and coverage levels used in our simulations.

to pay back a loan to the extent possible after meeting the necessary subsistent consumption of 50 percent of the food poverty line; and (2) a less optimistic case with subsistent consumption set at 80 percent of the food poverty line.[53] Overall, commercial AYII could stabilize expected loan repayment rates of lending institutions in bad (1-in-10) years, and so increase expected loan repayment by as much as 20 percent in the optimistic case and 6 percent in the less optimistic case relative to the case without AYII. These results mean an increase in the overall averaged loan repayment rate of up to 5 percent.

As we can see from the simulations, even with high coverage, AYII still might provide only partial protection against income shocks in bad years. This could be due to several factors: (1) commercial AYII is quite expensive, (2) there are still basis risks associated with AYII, which provides protection only with respect to subdistrict yield risk, not individual yield risk, and (3) there could be other background risk due to uninsured variations in prices.

If insurance could further unlock farmers' access to cheaper and/or larger agricultural credit (e.g., from formal financial institutions) for investment in expensive but more productive inputs and also enhance farmers' investment incentives, even the commercial AYII could potentially crowd in a sustainable increase in productivity. Various studies have documented positive effects of de-risking agricultural production on households' incentive to increase productive investment and on credit demand; see e.g. Cai et al. (2012) on China; Galarza and Carter (2010) on Peru. With the increase in expected loan repayment rates associated with AYII, rural banks in many countries started to expand lending to farmers using insurance as a prerequisite for credit and/or bundling insurance with credit directly. World Bank (2007) also outlines this potential in the Bangladesh rural agricultural credit market. We explore potential impacts of these possibilities by considering these scenarios: (1) average households who already grow aman HYV and boro HYV can borrow at the cheaper bank rate (12 percent per year) with insurance as compared to their higher rates (19–30 percent) without insurance; (2) households initially growing aman local can get more and cheaper credit to afford to adopt aman HYV, which requires a US$28.85 (21 percent) larger input cost but results in expected yield improvement of US$520 (85 percent) and US$569 (94 percent) per acre in the high and medium zones respectively; and (3) households can get more and cheaper credit to afford to adopt a higher-yielding variety, e.g., boro hybrid, which requires US$82 (31 percent) larger input costs but could result in up to a US$525 (32 percent) and US$484 (31 percent) yield improvement in the high and medium zones respectively.

Commercial AYII might be expensive and have limitations as stand-alone insurance in this setting, but if AYII could unlock more access to cheaper credit, it could potentially crowd in both increased and more stabilized crop income for farmers in these two key rice production zones of the country. The solid green in the right panel and solid blue in the left panel of figures 5.3 and 5.4 illustrate these potential effects. In all cases, if AYII could crowd in only cheaper credit for existing production technology, the interest saving could provide partial or total compensation for the cost of commercial AYII, allowing farmers to benefit from more stabilized crop income as a consequence of AYII without having to sacrifice large expected income for insurance premium. And the impact is larger especially for the marginal, small, and medium farmers with relatively higher costs of credit. The potential impacts could be larger relative to the above case, and so AYII could stabilize and further increase crop income if it could further crowd in farmers' adoption of more productive technology. The solid blue and red in the right panel and red in the left panel of figures 5.3 and 5.4 further illustrate this.

If AYII could crowd in credit and so adoption of aman HYV among the households initially growing aman local or boro HYV (13 percent of the farmers in the two zones), this could increase expected crop income by 27–33 percent and insurance protection by up to 44 percent against income shortfalls in bad (1-in-10) years. The potential effect on income improvement is larger in the medium-potential zone (due to larger yield gap), while the potential effect on income variability is smaller (due to higher risk). This potential benefit, however, could be achieved by the minority of

53 These two scenarios could better reflect the real situation given that households would need to first meet their required consumption. But because the crop income is only part of their total economic income, they could possibly use other sources of income to finance some of the required consumption (the rest of the percentage of the food poverty line). Since the gross crop income of marginal households is already well below even 30 percent of the food poverty line (as crop income makes up only 12 percent of total economic income), we assume for simplicity that for this group, the subsistent consumption is set at 30 percent and 50 percent of their expected net crop income.

rice farmers who still do not produce with high-yielding technology. Similar benefit could also be achieved by the majority of farmers, who already produce aman HYV and boro HYV, assuming that AYII could crowd in adoption of other better technologies. The potential of this scenario is illustrated in this analysis using boro hybrid. If AYII can crowd in credit and adoption of boro hybrid, this could further increase expected crop income by 6–19 percent and insurance production by up to 30 percent against income shortfalls in bad years. Overall, if AYII could crowd in technology in both crop seasons, this could increase protection against income shortfall by up to 65 percent and increase expected crop income among small and medium farmers by up to 41 percent. The improved productivity and reduced variability impacts are larger in the high-potential zone, with its larger boro hybrid yield gap with smaller variability. Table A4.2 further summarizes these simulated results.

If AYII could unlock more access to cheaper credit, it could further increase the ability of farmers to pay back input loans in the bad years and so increase expected loan repayment rates by up to 35 percent. Overall, commercial AYII could stabilize expected loan repayment rates of lending institutions in bad (1-in-10) years and so increase expected loan repayment by 16–35 percent relative to the case without AYII. This results in an increased overall average loan repayment rate of 8–12 percent—and further suggests AYII's crowding-in effects.

By subsidizing AYII and using AYII to crowd in cheaper productive input loans and/or adoption of better production technology, government could further ensure more stability and significant increases in rice farmers' productivity and crop income, relative to government's existing post-disaster relief program for farmers. The government of Bangladesh already has a disaster relief program for farmers, which provides varying assistance levels in kind (e.g., through input supports) or in cash following declared disasters. Taking current empirical evidence of existing relief programs for farmers, we model the government's relief program (see annex 4 for more detail) such that (1) post-disaster relief includes food aid (similar to VGF or gratuitous relief), which could possibly consist of up to 20 kg of grain monthly for up to six months (total of up to US$76.30 per household with two beneficiaries) in bad years; and input supports could possibly be provided for up to 25 percent of input costs (including seeds, insecticides, and irrigation) in bad years, capped at up to two acres of operating lands; (2) the relief is triggered in any crop season when subdistrict yields fall below 80 percent of their long-term means in each production zone (i.e., similar to AYII with coverage of 80 percent); and (3) the relief provides support proportional to the subdistrict income shortfalls until it reaches its maximum limit when subdistrict yields fall below 30 percent of the long-term average, at which point the maximum amount of relief is disbursed. Overall, the modelled post-disaster relief program results in the maximum compensation of 44 percent, 17.7 percent, and 8.8 percent of crop income in bad years for marginal farmers, small and medium farmers, and large farmers respectively, with expected costs of 3.8–6.3 percent, 1.4–2.3 percent, and 0.7–1.1 percent of gross crop income for the three groups respectively. The key features of the current relief program for farmers captured in our modelled disaster relief include (1) that the amount of assistance is still very limited (to the maximum modelled relief), especially in bad years when more compensation is needed for large income shortfalls, and (2) that this considered relief program is focused on farmers, and thus while the amount of compensation as a percentage of gross crop income is larger for smaller farmers, the amount in dollar terms is proportional on operating farm lands and capped at two acres. Thus while in reality the poorer smallholder farmers would be qualified for larger relief compensation, for analytical purposes the current modelled program only considers compensation specific to farmers.[54] The modelled relief program is rather optimistic, as it does not take into account the current empirical issues of delay and unreliability in the existing program (World Bank 2013a), which could make the program even less effective in buffering income losses. The dashed black lines in figures 5.3 and 5.4 illustrate the potential impacts of this modelled post-disaster relief program to farmers. While post-disaster relief could provide some buffer to farmers' crop income shortfalls, the amount of compensation is rather limiting, especially in bad years.

In all cases, government subsidizing of AYII and use of AYII to crowd in productive credit and adoption of better technology outperforms the existing disaster relief program in ensuring both higher and more stabilized crop income for farmers. Government supports to AYII through premium subsidy are modelled such that the level of subsidy considered can result in the same total

54 Chapter 6 on social protection considers relief programs as part of social protection programs more broadly and so will include these cases.

expected cost as that of the existing post-disaster relief program.[55] This results in averaged subsidy rates for AYII on input loans of 100 percent for marginal farmers, 54 percent for small and medium farmers, and 27 percent for large farmers. The dashed orange, green, blue, and red lines in figures 5.3 and 5.4 illustrate the potential impacts of subsidized AYII. If shifting the current relief budget to subsidizing AYII can promote uptake of AYII by farmers, this could result in up to 13 percent more protection against crop income shortfalls in bad years relative to the existing post-disaster program. If government can further use subsidized AYII to crowd in cheap credit and adoption of aman HYV among the currently low-yielding farmers, subsidized AYII could not only provide up to 43 percent more protection of crop income shortfalls in bad years, but also provide up to 52 percent higher expected crop income relative to the current disaster relief. And the subsidized AYII performance relative to relief could possibly be larger if the subsidized AYII could further crowd in adoption of boro hybrid in the high-potential zone, since this would result in up to a 30 percent larger expected crop income and 21 percent more income protection in bad years relative to the relief program. Overall, if subsidized AYII could crowd in technology in both crop seasons, this could result in up to a 60 percent increase in protection against income shortfall (up to 54 percent larger than disaster relief) and up to a 65 percent increase in expected crop income, especially among small and medium farmers. And these results hold despite the fact that our modelled disaster relief program is already very optimistic.

These relative performances of subsidized AYII and relief also vary across farmer groups and especially production zones. For example, while subsidized AYII crowding in boro hybrid alone could result in larger expected crop income, this scenario rarely outperforms optimistically modelled disaster relief in bad years in the medium-potential zone, given that boro hybrid production is significantly risky in this zone. The top panel of table A4.4 summarizes these simulation results. Government supports to AYII that could further crowd in adoption of better production technology could further result in a 32–39 percent increase in the expected loan repayment rate for lending institutions in bad (1-in-10) years, a lot larger than the effect from disaster relief itself. This results in an 8–22 percent increase in the overall expected loan repayment rate.

We now answer which farmer groups and production zones benefit the most from the government of Bangladesh's subsidized AYII as an alternative to existing post-disaster relief. With the same amount of budget, government supports to AYII and use of subsidized AYII to enhance post-disaster relief provision would be more cost- effective if targeted to relatively larger farmers, i.e., small, medium, and large. The bottom panel of table A4.4 further compares increase in expected income in dollars in a normal year and reduction in income shortfalls in dollars in a bad (1-in-10) year across groups and zones, holding dollar cost of relief/subsidy constant. If AYII could induce private uptake of AYII and potentially further crowd in cheaper production credit and adoption of better technology, the potential impacts (which are already larger than the disaster relief program in all cases) would be greater among small, medium, and large farmers, whose welfare relies more extensively on crop income; this scenario could directly enhance crop income and offer more protection through subsidized AYII. The potential impacts on overall economic income of subsidized AYII would be significantly lower for marginal households, which have only a 12 percent crop income share in total economic income.[56]

Overall, the welfare impacts of AYII could also vary across production zones with different degrees of risk exposures and across different insurable indexes and coverage levels. Table A4.4 shows that changing from a district yield index to a subdistrict yield index, with potentially smaller correlations with the yield of the representative farmer, could achieve smaller reductions in net income variability. The performance of AYII in reducing income variability also declines as one moves from the high coverage, with a 15 percent maximum premium rate, to the lower coverage level affordable within the 10 percent commercial premium.

55 We note that the model thus allows us to compare the relative performance of the relief program with government's support through subsidizing AYII using similar expected budget cost within each farmer group and zone. But because the amounts of relief budget costs are different across farmer groups and zones, the model does not permit direct comparison of disaster relief or subsidized AYII performance separately across groups and zones.

56 This poorest group of farmers could be more qualified for the insurance-linked social protection program analyzed in the next chapter.

Figure 5.3. Potential Impacts of AYII on Net Crop Income Available for Consumption in High-Potential Aman-Boro Production Zone (24 percent of the country's rice-growing area)

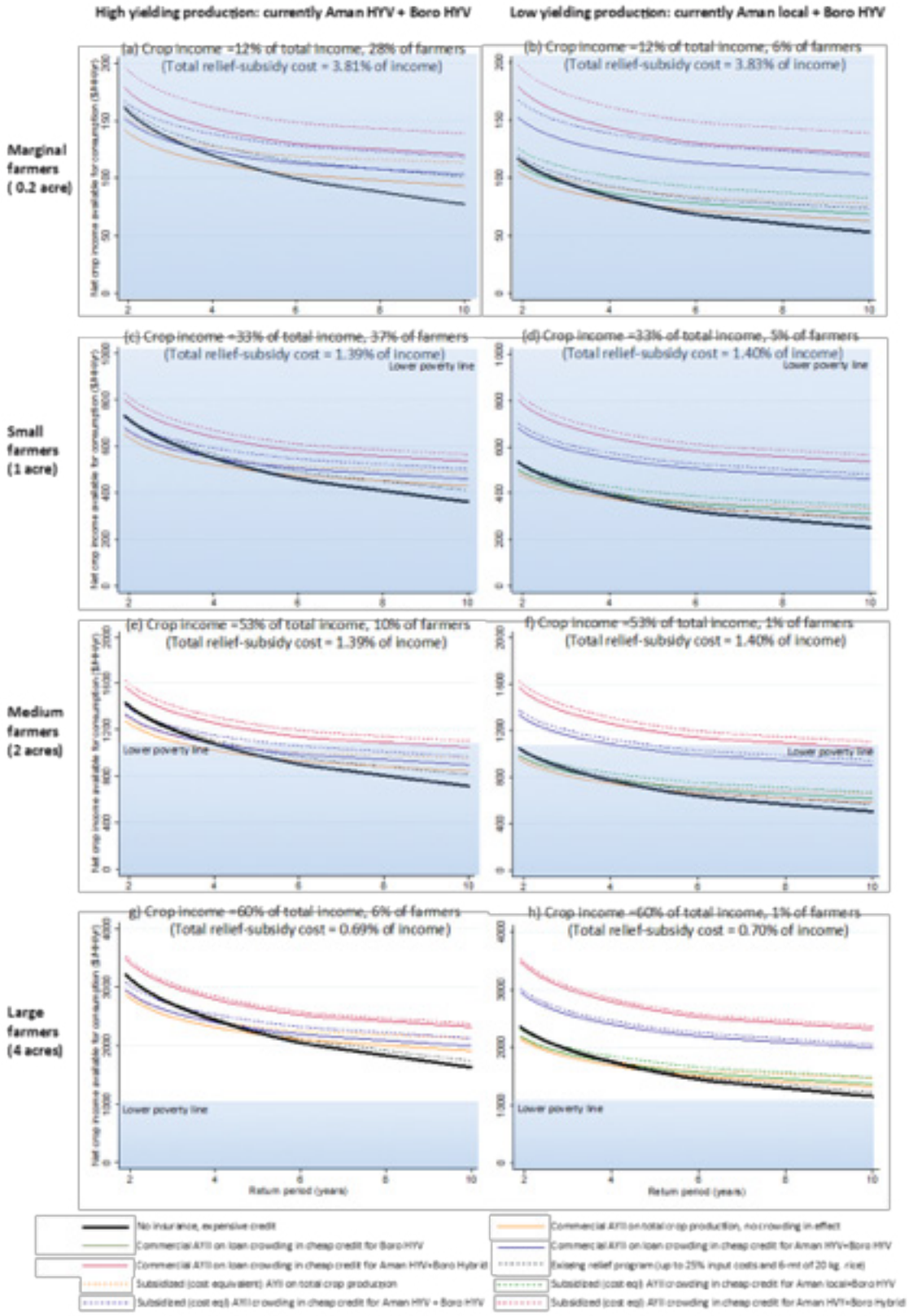
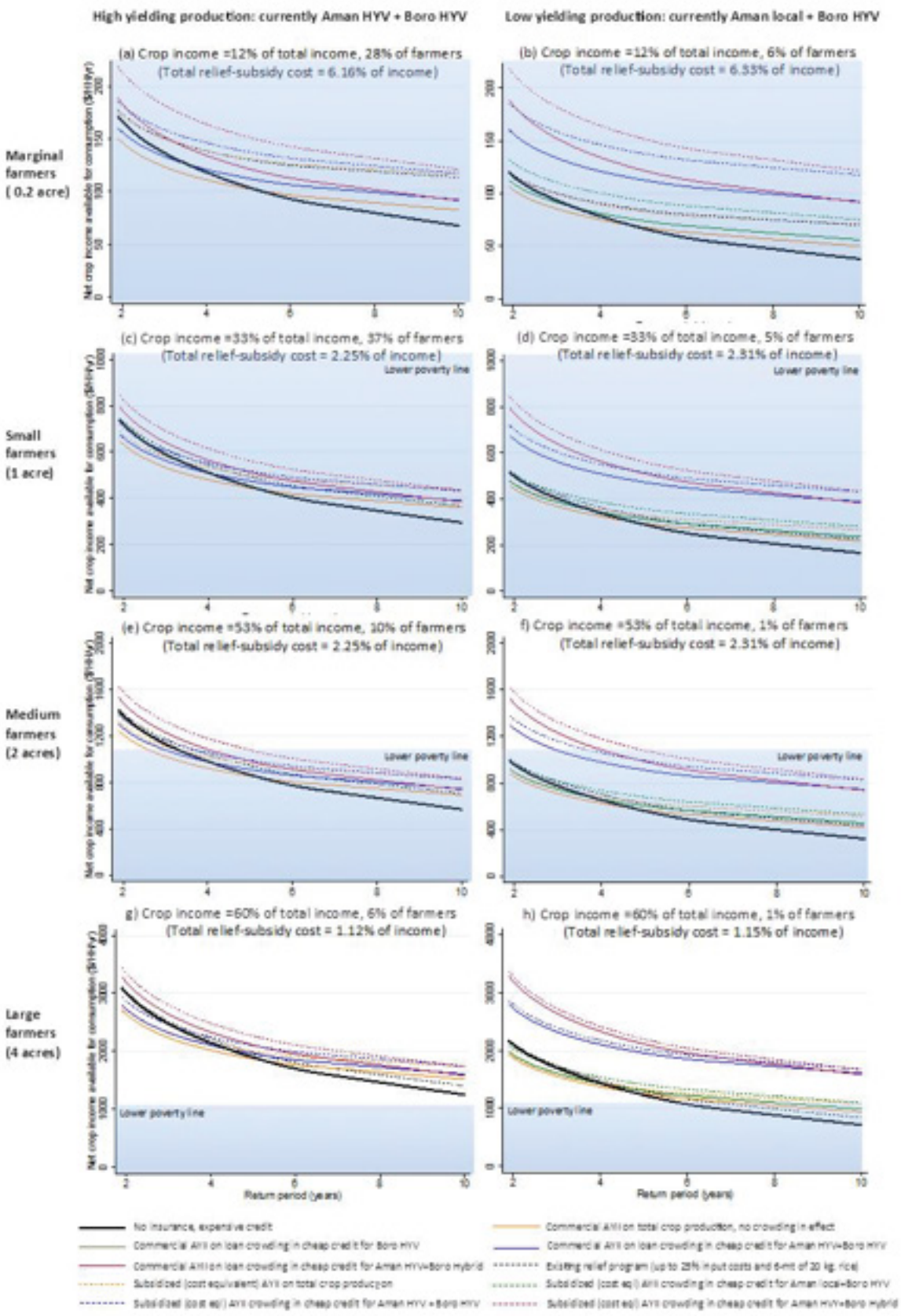
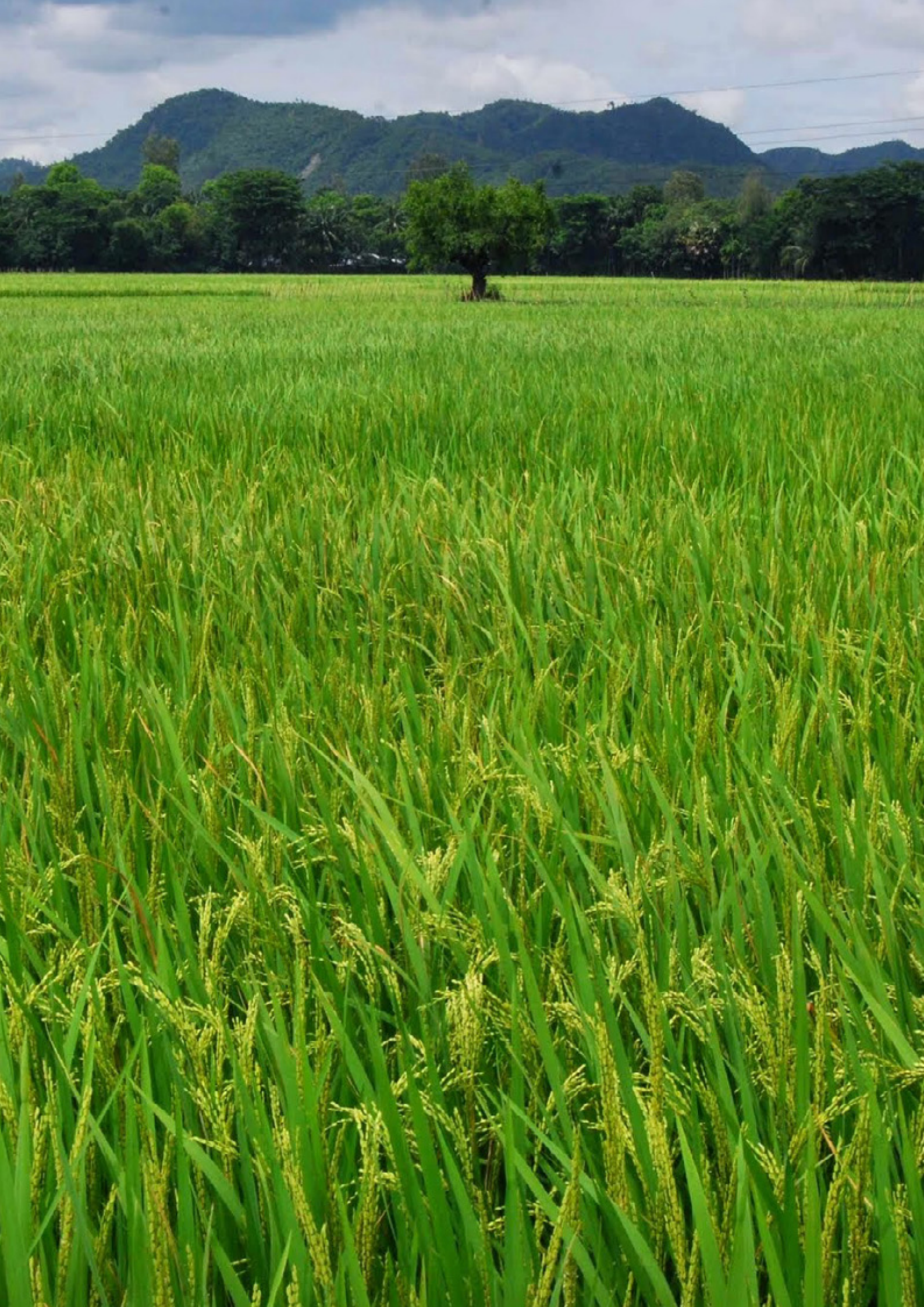


Figure 5.4. Potential Impacts of AYII on Net Crop Income Available for Consumption in Medium-Potential Aman-Boro Production Zone (28 percent of the country's rice-growing area)





6. Fully Subsidized Insurance Program for the Poorest

6.1. Context

Bangladesh is the most disaster-prone of the least-developed countries. Between 1970 and 2014, 281 large-scale water-related hazards such as cyclones, storm-surges, droughts, floods, and river erosion disasters killed over half a million people and affected more than 373 million.[57] The poor are hit hardest in these events because they are more densely concentrated in badly constructed housing and/or on land prone to hazards.

The combination of its geography, population density, and extreme poverty makes Bangladesh and its people especially vulnerable to risks and disasters. With about two-thirds of its territory less than 5 m above sea level, Bangladesh is especially prone to frequent floods[58] of various types.[59]In fact, 30 percent of the country experiences annual flooding, while extreme floods, such as severe flooding during monsoons, can affect up to two-thirds of the country. These floods can cause severe losses to the agricultural crop, livestock, and fisheries sectors, making floods one of the primary reasons for widespread poverty among rural households. Climate change seems likely to add to the destructiveness of monsoon floods and may also increase the frequency of cyclones.[60]

Bangladesh has made remarkable economic and social gains over the past decade, but extreme poverty remains prevalent, exacerbated by climate hazards; efforts are still needed to achieve its Vision 2021. Recent economic growth in Bangladesh, of a steady 5–6 percent despite frequent and multiple natural disasters, has led to a downward slope in poverty levels. Poverty fell from 48.9 percent in 2000 to 40 percent in 2005 and to 31.5 percent in 2010 (World Bank 2013a). Despite Bangladesh's progress in economic growth and food production, pervasive poverty and undernutrition persist. Extreme poverty is still prevalent, with an estimated 26 million people (or about 16 percent of the population) living below the extreme poverty line and with 83 million poor, the third-highest number

57 Data are EM-DAT: The CRED/OFDA International Disaster Database, Université Catholique de Louvain, Brussels, Belgium (accessed 2015), www.emdat.be.

58 Over the past 35 years Bangladesh has experienced eight major flood events, including the floods of 1988, 1988, 2004, and most recently 2007, with estimated losses to agricultural sectors of US$648.39 million (World Bank and ADB 2007).

59 Bangladesh generally experiences four types of floods: flash floods, riverine floods, rainfall-induced floods, and storm surge or cyclonic floods, but vulnerability to these four types of floods varies according to region. Flash floods carry a heavy sediment load, raising the level of river beds, and are caused by heavy monsoon rains falling on mountains and hills next to the floodplain. River floods occur between May and September as a result of heavy regional storms or melting of the Himalayan snow peaks. Rainfall floods result from localized precipitation during the monsoon rains, mostly in low-lying areas. Cyclonic floods are sea floods and occur when cyclones from the Bay of Bengal create a storm surge which moves inland.

60 Data are from Climate Change Cell, Department of Environment, Bangladesh Ministry of Environment and Forests.

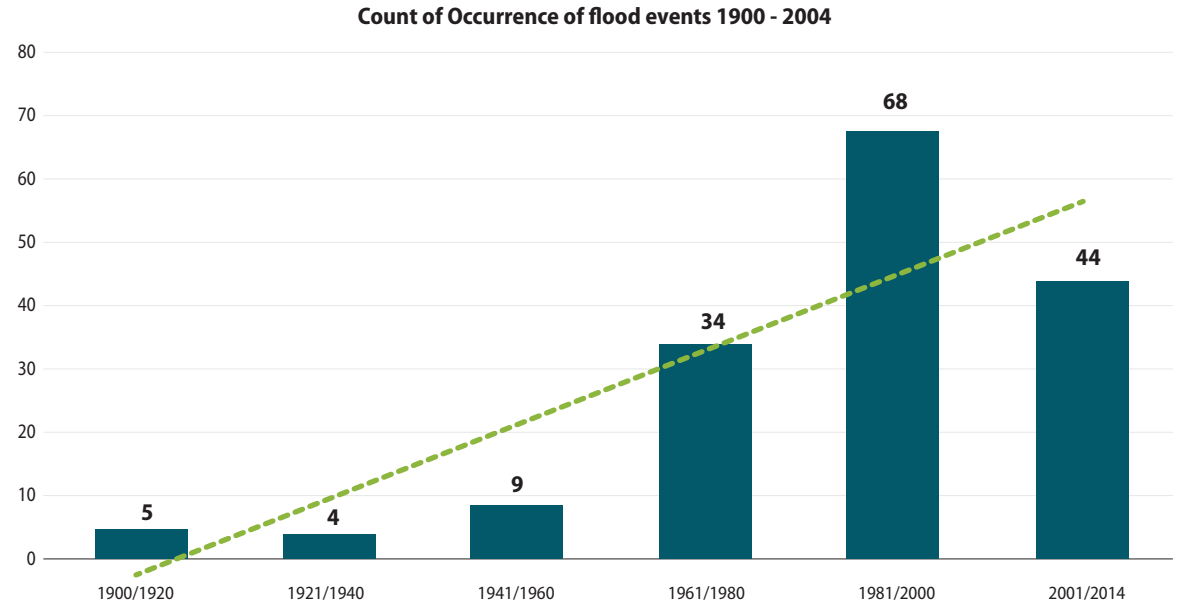
of poor people in the world.[61] Bangladesh's Vision 2021 has set a target for a poverty rate of 15 percent by 2021, which implies, given the population growth trends,[62] lifting approximately 15 million people out of poverty in the next six years while ensuring development sustainability, which will be achieved by improving protection from climate change and natural disasters and establishing sustainable safety nets for the poor (as stated in Vision 2021).

Table 6.1. Impact of Catastrophic Floods in Bangladesh

Year	% land area affected	Number of people affected	Number of deaths
1987	38%	30 million	1,657
1988	52%	45 million	2,379
1998	68%	—	1,050
2000/2002	—	20 million	—
2004	66%	35.9 million	726

Sources: Dewan, Nishigaki, and Komatsu 2003; EM-DAT 2014. Percentage for 2004 is from Rayhan 2005.
Note: — = not available.

Figure 6.1. Increasing Frequency of Flood Events in Bangladesh between 1900 and 2014



Source: EM-DAT 2014.

Extreme poverty has been disproportionally prevalent in rural areas, with the proportion of rural households living in extreme poverty three times higher than in urban areas. Poverty is especially persistent in the northwest, affected by droughts and river erosion, the central northern region, affected by extreme seasonal floods, and the southern coastal zones, affected by soil salinity and cyclones. Because of prevalent poverty and rural households' low capacity to cope with natural hazards affecting their crop production and livelihoods, many rural people have an inadequate diet and suffer periods of acute food shortages (World Bank 2014). This necessitates a substantial amount of emergency food aid and commercial imports, which causes government to divert efforts and resources away from long-run development priorities into short-term disaster relief. In particular, and despite progress, half of all rural children in Bangladesh remain chronically malnourished,[63] with subsequent impacts on the long-term household poverty levels.

61 Bangladesh follows India with 613 million and China with 162 million.
62 World Bank data from 2013 indicate that the population of 156.6 million will likely rise to 165 million by 2021.
63 2000–2005 Poverty Reduction Strategy Paper.

Table 6.2. Percentage of Population with Moderate and Severe Deficiency in Calorie Intake

Year	Moderate deficiency (<2,122 kcal/person/day)			Severe deficiency (<1,805 kcal/person/day		
	Rural	Urban	National	Rural	Urban	National
2000	42.3	52.5	44.3	18.7	25.0	20.0
2005	39.5	43.2	40.4	17.9	24.4	19.5
2010	36.8	42.7	38.4	14.9	19.7	16.1

Source: World Bank 2013a.

Most of Bangladesh's rural laborers are engaged in informal, low-income jobs with limited productivity. Although agriculture now accounts for less than 20 percent of GDP, the farming sector still employs 43 percent of the population (IFAD and Akash 2015). According to World Bank data from 2013, about 67 percent of the population (about 105 million) live in rural areas and are mainly engaged in agriculture and related nonfarm activities. Over two-thirds of the rural population is landless or functionally landless (owning less than 0.2 ha of land) and depends on wage-labor income; 44 percent are below the national poverty line and 29 percent are classified as very poor (BBS 2005).

Table 6.3. Poverty Trends in Bangladesh, 1983–2005

Year	National	Urban	Rural
1983/84	52.3	40.9	53.8
1988/89	47.8	35.9	49.7
1991/92	49.7	33.6	52.9
1995/96	53.1	35.0	56.7
2000	49.8	36.6	53.1
2005	40.0	28.4	43.8

Source: BBS 2005.

A number of social protection interventions are already being implemented or currently developed by the government and local and international partners to provide safety nets for the poorest households. These provide either long-term assistance to those unable to work (such as the elderly receiving pensions), or resource packages including food, public work programs, and other benefits, as well as post-disaster relief in food. Sometimes fodder for livestock is included for destitute households, such as under the Vulnerable Group Development Programme, which distributes food rations along with a development package (life skills training, income-generating skills training, a personal savings program, and access to microcredit/NGO membership) to 750,000 poor women and 3.75 million total beneficiaries. The government of Bangladesh has been allocating an average 1.8 percent of GDP annually between 1996 and 2008 to disburse through 22 ministries implementing over 100 social protection programs with annual allocations that range from Tk 55 billion (US$714 million) to Tk 0.01 billion (US$0.13 million). About a quarter—24.6 percent—of households nationally have received safety net benefits from at least one safety net program (HIES 2010). The government has also undertaken the development, with IDA support under the Safety Net Systems for the Poorest Project, of a unified targeting system for social safety nets to enable more accurate targeting and outreach to those most in need. A number of disaster microinsurance programs have also been tested to provide disaster protection to low-income populations.

Over the last decades, the government of Bangladesh, together with international agencies and local partners, has been working on building structural solutions[64] and providing post-disaster assistance to counter the losses caused by floods. The increasing vulnerability of the economy and people to flooding incidents implies, however, that these structural solutions still cannot provide complete protection against catastrophic floods—despite shift to recognize the critical roles of

64 Examples include building of embankments along the rivers and polders in coastal regions, cyclone-resilient housing structures, community shelters, etc.

nonstructural measures, as well as pre-disaster mitigation, preparedness, and post-disaster assistance, which currently relies on ex post risk financing.

Despite the establishment of a comprehensive disaster risk management structure by the government of Bangladesh, the application of financial protection in disaster risk management is still limited. Comprehensive structures and policy actions for disaster risk reduction and management have been set by the government in the National Disaster Plan, both at the national and subnational levels. In response to disaster events, the government generally allocates budgetary funds for disaster relief and rehabilitation from a contingency account[65] or reallocates funds across categories of expenditure, an approach that risks compromising long-term development programs and that remains limited both in terms of outreach and allocated budget. Variations and combinations of different types of disaster risk financing instruments, including insurance, reserve funds, etc., can be applied to provide a comprehensive set of solutions to the range of disaster risks facing Bangladesh (i.e., from high-frequency–low-severity to low-frequency–high-severity events).

Flood being a major risk for rural livelihoods, agricultural flood insurance in particular can be a means of extending or supplementing social protection benefits distributed in affected areas, particularly for the working rural poor. Complementing existing social protection with insurance programs for vulnerable rural households in the target areas might yield improved welfare impacts for those most in need. Financial tools and specifically insurance can be part of a social protection package delivered by the government and can support the distribution of social protection benefits to underserved populations, for example, households living in *monga*-affected areas.[66] They can also supplement the basic benefits of social insurance schemes while enhancing the ability of workers in the informal economy to cope with the impacts of natural disasters on their livelihoods, and in the case of the landless hit by floods, for example, to cope with the incapacity of households to work while the area is flooded.

Although agricultural insurance in general is widely available in more than 50 percent of countries, public and private insurers have traditionally shied away from offering flood insurance protection to the crop, livestock, and fisheries sectors. Agricultural flood insurance is very difficult to design and implement for a number of reasons: there are challenges over defining and measuring direct flood damage (each crop has a different tolerance to flood according to the stage of crop growth, depth of flooding, and duration) and indirect damage/loss arising from business interruption; flood risk mapping and modelling place very high requirements on time series local river-flow and flood data, which are often not available in developing countries; flood insurance is difficult to operate, and traditional voluntary farmer schemes suffer from problems of moral hazard, adverse selection, and prohibitively high costs of accurate in-field flood loss assessment; and finally, flood insurance is difficult to manage financially (Lotsch, Dick, and Manuamorn 2010).

Many of the challenges to traditional indemnity-based agricultural flood insurance could be overcome by an index-based insurance approach. Key advantages of index-based insurance include the minimizing of moral hazard, elimination of the need for costly and time-consuming in-field loss assessment, and use instead of timely and objective index-based triggers and payouts (CIRM undated; Lotsch, Dick, and Manuamorn 2010). Applications of flood index insurance have, however, until recently lagged behind weather index pilots, with the notable exceptions of the following: (1) Vietnam: a Ford Foundation–funded, GlobalAgrisk–designed meso-level river-level gauge flood index providing business interruption insurance for banks lending to paddy producers located in the Mekong Delta (not yet been commercially launched) (GlobalAgRisk 2010); (2) Indonesia: a river-level gauge flood index for individual urban households, designed by GIZ and MunichRe and underwritten by Wahana Tata insurance company in 2010 (GIZ 2010); and (3) Peru: meso-level ENSO index designed to capture catastrophe flooding related to the El Niño phenomenon and marketed as a bank assurance business interruption cover to banks lending to farmers located in flood-prone coastal regions of Peru (launched in 2012–2013) (Skees and Murphy 2009).

65 For example, the government keeps a contingency fund (Tk 100,000) at the union level for immediate response.

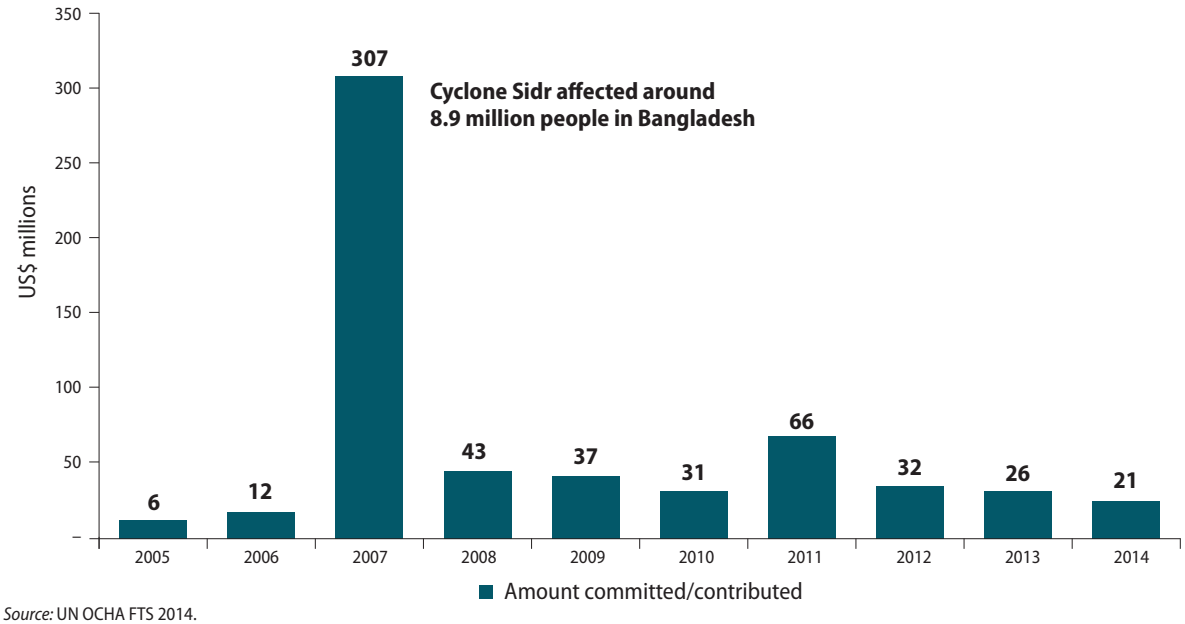
66 The seasonal hunger period called in Bangla *monga* occurs between planting and harvesting the aman rice crop (from September to November) and affects many river basin households.

6.2. Proposal for fully subsidized insurance program

Quick post-shock assistance to vulnerable households is essential to protecting their welfare. However, many developing countries rely heavily on humanitarian responses by the international community, for example food aid, which can be slow in reaching people in need at the onset of a shock. Since 1990, 16 percent of the over US$56 billion in post-disaster aid from the international community has been used to fund purely short-term humanitarian, mostly food-aid efforts, which, studies show, suffer from acute delays in mobilization (DFID 2013). In Bangladesh, 73 percent of the aid is spent on emergency and reconstruction relief, whereas investments in disaster prevention and preparedness have been low, averaging 13 percent between 2006 and 2009 (Global Humanitarian Assistance 2012). With an estimated average annual humanitarian spending of approximately US$720 million[67] for an affected population of 10 million, it is projected that early response could reduce needed spending by an average US$215 million per year, or a total US$3.4 billion to US$4.3 billion over a 20-year period (DFID 2013).

Innovative solutions are needed to move from ad hoc post-disaster relief to timely and predictable responses. Post-disaster relief provides crucial transitory support in the case of emergencies but should not be a de facto safety net for countries.[68] The long delays in raising funds and the insufficient levels of aid following a disaster leave families vulnerable. In addition, the costs of these shocks are unknown, which makes budgeting for government and donors difficult.[69]

Figure 6.2. Humanitarian Funding to Bangladesh, 2005–2014



Source: UN OCHA FTS 2014.

Contingent disaster-linked social protection coverage mechanisms, such as fully subsidized insurance schemes, can effectively address this challenge, as they enable timely, efficient, and targeted payouts on the onset of a disaster. Using rules-based insurance principles to enable the triggering of contingent disaster-linked social protection mechanisms, such as an index-based social protection coverage for the most vulnerable, can be a cost-effective ex ante risk management strategy that can enable rapid, transparent, and accountable responses to shocks by rapidly disbursing financial assistance to affected households immediately following a disaster such as flood.

Such index-based social protection programs can help fill the short-term post-disaster funding gap and complement the humanitarian system by providing funds immediately while additional assistance is sourced. Such early and preventive resources can provide immediate support to

67 Actual humanitarian aid has averaged an annual US$82 million, suggesting that need is nearly 10 times actual aid provided.
68 See for example DG ECHO (2013) for a discussion of programming for humanitarian food assistance, including entry and exit criteria.
69 The government of Bangladesh and donors spend between US$6 million and over US$300 million annually during shock years on disaster response.

affected households while post-disaster relief by the government and local and international partners is being mobilized.

A rules-based approach in implementing an index-based social protection mechanism can potentially lead to significant benefits for both households and government. An index-based social protection coverage mechanism could be implemented where social welfare payouts are disbursed if predefined agricultural shocks occur (for example average crop yield in an *upazila* falls below a set threshold, or river level rises above a certain level for a certain number of days). It can strengthen financial resilience to disasters by ensuring (1) adequate resources to respond to shocks; (2) the timely deployment of post-disaster aid to those most in need; (3) ownership of disaster preparedness and response measures by governments and communities; (4) improved fiscal discipline by governments; and (5) availability of more appropriate and high-quality risk data.

Vulnerable households receive faster and more predictable assistance following shock events. The increased timeliness of fund disbursement reduces the need to resort to extreme coping measures, and hence can increase family welfare in the short and long term (DFID 2013). The increased transparency enables households to budget and plan better for disaster events.

Government and donors benefit from being able to directly help the poorest and most vulnerable households in a transparent and accountable manner. Funds can be rapidly channeled to beneficiaries during an emergency through established mechanisms, which in turn increase transparency and accountability for the use of public funds and international aid. This approach can also increase the government's ability to set its own priorities in the management of relief and rehabilitation, and ensures transparency in the delivery of relief and reconstruction projects.

In addition, the government of Bangladesh and donors can manage and plan ahead for the fiscal cost of disaster and integrate this planning into a broader sovereign disaster risk financing and insurance strategy. When responding to a natural disaster, the government of Bangladesh will have to mobilize resources quickly without jeopardizing its fiscal balance. By building an ex ante financial protection strategy that combines a number of instruments to match potential financial needs posed by different layers of risk and in this way managing volatility on the fiscal accounts, the government will be able to secure contingent funding to protect the poorest against shocks before a disaster strikes, for example by purchasing an insurance policy. In addition, using financial instruments (such as insurance) to manage the cost of income support programs in times of disaster reduces the uncertainty of cost for governments and donors, as insurance companies manage some of the risk.

The proposed approach aims at fulfilling several of the stated broad objectives of Bangladesh's poverty reduction strategy laid out in the Sixth Five Year Plan (SYEP 2011–2015) and in line with the National Social Security Strategy (NSSS) and poverty reduction strategy paper for Bangladesh, namely (1) promoting sustainable human development and (2) achieving food security by ensuring food security for all and elevating nutritional status of the people living below the poverty line. The approach also aims to fulfill several key priorities of the Seventh Five Year Plan (SYEP 2015–2020), including (1) improving access of the poor to financial services, and (2) promoting climate change adaptation and disaster risk reduction and commitments of the poverty reduction strategy paper for Bangladesh. The 2009 Bangladesh Climate Change Strategy and Action Plan identified inland monsoon flooding as one of the three major climate hazards facing the country. Such agricultural insurance policies and instruments learn from and are consistent with the instruments and, more importantly, Bangladesh's long experience in social protection interventions.

The government of Bangladesh can build on international experience in developing index-based social protection mechanisms, and learn from successful international and local programs. For example, the Immediate Programa de Empleo Temporal (PETi) is a subcomponent of PET founded in 1995 in Mexico as a cash-for-work program providing temporary cash transfers in exchange for labor in public work projects to eligible households in marginalized municipalities or to those whose livelihoods have been affected by natural disasters; it had reached approximately 3.2 million beneficiaries by 2010. The program's annual budget was approximately Mex$68 million or US$4.8 million in 2013; funds are triggered based on either an early warning system or when an emergency declaration is issued by the government. The Char Livelihoods Programme (CLP), launched by the Bangladesh Ministry of

Local Government, Rural Development, and Cooperatives with support of DFID and AusAID, is a cash and asset transfer program that provides a core package of public works, asset transfers (cash-in-kind), livelihoods-related training, market development, and social development activities to char dwellers highly vulnerable to flooding in eight districts of the northwest of Bangladesh.[70] It aims to secure and promote livelihoods opportunities while at the same time strengthening the resilience of its target population to natural shocks and climate variability. Though not linked to a formal trigger mechanism, CLP has scaled up on the onset of floods by providing an additional 1 million person-days of public works, expanding into three further districts, and putting in place a cash-advance system to avoid any challenges with payout procedures due to the disaster. The Ethiopian Productive Safety Net Program, which was designed to create a predictable safety net for chronically poor and vulnerable households, was scaled up in response to the severe 2011 drought in the Horn of Africa, increasing the number of beneficiaries from approximately 6.5 million to 9.6 million and averting the famine that could have otherwise unfolded. Such an approach is also currently being piloted by an Oxfam-Pragati Insurance program in Sirajganj District, Bangladesh, for particularly vulnerable households that are regularly affected by extreme floods; the objective is to spread it across the country with support from government and national and international organizations.

Oxfam-Pragati Insurance Company flood index Insurance

Flood-prone areas, especially riverine banks and chars that form during the monsoon flooding period in Bangladesh,[71] are home to over 12 million people: poor and isolated, these rural communities are subject to seasonal unemployment, face multiple livelihood challenges, and are considered the most food insecure in Bangladesh.[72] An average 8 percent of the Bangladeshi population (12 million people) live on these areas covering 6 percent of the total land area of the country. Inhabitants of flood-prone areas are regularly subject to periodic floods, massive erosion, landslides, and drought, with very limited capacity to overcome calamities. Their economy is highly dependent on agriculture, resulting in few local employment opportunities for char dwellers. The period between planting and harvesting the aman rice crop (from September to November) is characterized by seasonal hunger (*monga*) for many households, especially the landless. In years of drought or flood, destruction of the rice crop further prolongs and intensifies the period of seasonal unemployment and subsequent food shortage. For the poorest households, this seasonal decline in employment can often lead to the sustained reduction of income, assets, and consumption through the loss of informal agriculture and cattle farming. Opportunities to smooth irregular household cash flow are limited, and households in the *monga*-affected areas regularly adopt severe coping strategies—such as the sale of productive assets, reduced food intake, and contracting of loans with high interest rates from moneylenders—to meet consumption and emergency needs.

Bangladesh's poverty reduction strategy identifies flood-prone areas and chars in particular as being a pocket of extreme poverty and as worse off than rural households overall. Char communities' livelihoods are also threatened by the consequences of climate change. Char dwellers face multiple vulnerabilities, including greater probability of cyclones and storm surges, increased rainfall during the monsoon season, drainage congestion, less precipitation in winter, higher temperature, droughts, salinity intrusion, erosion, and deteriorating ecosystems. All these have an adverse impact on livelihoods, threatening char dweller's food security and economic welfare. For example, a 2009 Results and Impact Management System (RIMS) baseline survey conducted by the International Fund for Agricultural Development (IFAD) for Noler, Caring, and Nangulia chars[73] in the Noakhali District estimated average household income to be Tk 3,103 per month—or Tk 18.80 per head per day, placing these households within the poorest 10 percent of the rural population. The rates of wasting and stunting

70 The program benefited over 900,000 people during its first phase (2004–2010), and a second phase (2010–2016) is targeting assistance to more than 1 million people. See the CLP website at http://clp-bangladesh.org.

71 During the flooding period, suspended sediments form new lands, or "chars," in the river channels along the bed or basin of big rivers (Jamuna, Padma, and Meghna). In the dynamics of erosion and accretion in the rivers of Bangladesh, the sandbars emerging as islands within the river channel, or as attached land to the riverbanks, often create opportunities to establish new settlements and pursue agricultural activities. Once vegetated, such lands are commonly called *chars* ("small islands") in the local Bangla language.

72 Data are from UN World Food Programme, 2002.

73 These chars are part of the Char Development and Settlement (CDSP) Project-IV, implemented by BRAC, a multi-sectorial project financed by IFAD, government of Bangladesh, and government of the Netherlands targeting four chars, of which these three account for 85 percent of the population of all five CDSP IV chars.

have also been found to be significantly higher for this population than for rural Bangladesh as a whole, with over 52 percent of children under five years of age stunted (suffering from chronic malnutrition), 18 percent of under-five children wasted (showing acute malnutrition), and 57 percent of children underweight for their age.

Despite many programs addressing the particular needs and vulnerability of flood-prone areas and char dwellers, outreach is still limited and challenges remain to be addressed. Such programs include the DFID's Chars Livelihoods Programme, which focuses on improving livelihood security and reducing the physical vulnerability of the Jamuna River Basin char dwellers through an intensive package of investment capital, basic infrastructure, training and financial stipends; or the Main River Flood and Bank Erosion Risk Management Program, implemented by the Bangladesh Water Development Board with support from the Asian Development Bank, aiming at sustaining households' incomes and livelihoods in the project area along the three main rivers of Bangladesh, and also seeking to enhance their resilience to flood and riverbank erosion risks through strengthening. Given the level of poverty and particular challenges faced by char dwellers, outreach is still limited, with only a third of the poor population receiving social benefits; safety net benefits do not properly reach those most in need, and the allocated resource packages are often inadequate to effectively reduce poverty (World Bank 2014).

The Oxfam GB flood index insurance initiative for Bangladesh represents a major breakthrough in catastrophe flood risk insurance for very poor rural households (including landless households) located in river flood–prone areas. Since 2009, OXFAM GB and the Centre for Insurance and Risk Management (CIRM) have collaborated in a pilot project to design and distribute a CAT Flood meso-insurance product in Bangladesh. The Bangladesh Institute of Water Modelling (IWM) was contracted to conduct the flood hazard modelling and flood risk mapping for the selected pilot project area—Sirajganj District, through which the Jamuna River drains southwards. The main exposure to riverine flooding is in the monsoon season (mana) from July to September, and the index was designed to cover this period. The biggest challenge faced by IWM was to develop a flood model that could relate historical (35-year daily) river-level gauge data from the Jamuna River to predict flooding (water depth and duration) in the selected villages/floodplain areas bordering the river. The predictive flood hazard model was tested on the ground and refined by IWM in 2011 and 2012. SwissRe, a leading reinsurer and specialist in agricultural index insurance, was appointed to design the flood index contract parameters. Pragati Insurance Company, a leading non-life commercial insurance company, agreed to underwrite the flood index insurance program.

From the outset, the Oxfam flood index insurance policy was planned as a meso-level cover, with the insured being a local microfinance institution—Manab Mukti Sangathi—and the beneficiaries being poor vulnerable households in selected villages as defined by Oxfam–Manab Mukti Sangathi. Manab Mukti Sangathi works very closely in Sirajganj District with poor and extremely poor, mainly female landless households living in *char* areas of the River Jamuna whose main source of income and livelihoods is working as agricultural laborers. Pragati Insurance Company does not have either the local infrastructure or local knowledge to promote, market, and administer flood microinsurance to individual households in remote rural areas of Sirajganj District—hence the early decision to implement a meso-level program.

The Oxfam meso-level flood index cover is a business interruption policy that makes payouts according to the duration of flooding in each defined flood risk zone. In the event of prolonged monsoon season river flooding in the zone/district, the vulnerable households cannot obtain daily wage labor from agriculture, or in other words, they face a major business interruption exposure. The sum insured was therefore based on the value of hired labor, with a maximum sum insured of Tk 8,000 per household (about US$120). The policy was designed so that progressive payouts start to be triggered if continuous flooding exceeds 10 days, with the maximum payout of Tk 8,000 issued if continuous flooding exceeds 26 days. Pragati Insurance Company is responsible for making payouts to Manab Mukti Sangathi in each risk zone/village, and Manab Mukti Sangathi then distributes the payouts to the affected beneficiaries according to their needs (Desai 2013; Oxfam 2013).

The meso-level flood index insurance program was launched in 2013 with 1,661 poor households identified as the beneficiaries in 14 villages in Sirajganj District, with Pragati Insurance

Limited acting as the local insurer and with reinsurance protection from SwissRe. In 2013, total sum insured amounted to Tk 13.3 million, with total premium of Tk 1.73 million (approximately US$20,000) and an implied premium rate of 10.3 percent. Oxfam financed 100 percent of the premium costs. Pragati Insurance purchased quota share reinsurance protection (80 percent cession) with SwissRe, one of the world's largest reinsurers and a specialist in index insurance for the agricultural sector. The policy cover period was from August 15, 2013 to September 9, 2013 to coincide with the main monsoon season rains and peak period of river flood exposure in Sirajganj. In 2013 the program was free of any flood payouts (Desai 2013; Oxfam 2013).

The policy was renewed in 2014. Severe floods in August and September led to significant damage in Sirajganj District, and the Pragati-insured flood index program triggered payouts in four villages (Boro Chouhali, Choto Chouhali, Fulhara East, and Muradpur): more than 700 families benefited from the payouts of Tk 1,982,400 (US$2,500).[74]

Going forward, Oxfam and its partners Pragati Insurance Company and SwissRe are examining the feasibility of scaling up the flood index insurance program for vulnerable rural households in other flood-prone areas of Bangladesh. The Oxfam-Pragati flood insurance product was initially distributed to 1,661 households across 10 villages in the Sirajganj District. The partners are currently reviewing options to significantly scale up the program in other riverine flood–prone areas of Bangladesh. The reviewed options aim within the upcoming three to five years to scale out to cover 30,000 households (approximately 138,000 people with an average of 4.6 people per household) in flood-prone areas spanning in an initial phase (2015–2017) the districts of Sirajganj, Gaibandha, and Barguna while adapting the model as needed to specific geographies (i.e., coastal areas).

Example of a Fully Subsidized Insurance Scheme for the Poorest: Scaling Up the Meso-Level Risk Sharing Oxfam-Pragati Pilot Project

Should the government policy choose to target extremely poor and vulnerable households that cannot afford voluntary or even partially subsidized insurance in an effort to alleviate extreme poverty in the most affected areas, one option would be to establish a fully government-subsidized insurance program or a macro policy, by for example covering the cost of scaling up programs such as the Oxfam-Pragati flood index insurance scheme.

1. Establishing a system that provides for the distribution and servicing of individual insurance policies is logistically complex and can take time to establish. Thanks to the existing income support programs and the Oxfam-Pragati program infrastructure, an initial focus on the meso-level product would be logistically less challenging in the short term.
2. The interim time period would allow testing of the product that will rely on the formally outlined business interruption approach. In particular, typical problems such as basis risk, consumer protection, and product quality can be identified and addressed adequately before reaching out to a larger target group in different locations.
3. Ultimately, if this option is to be considered by the government, a proper analysis of the delivery mechanisms would be conducted, during the preparation phase, for the scale up and alternative delivery mechanisms for payouts would be considered. In particular, the team would assess how to potentially create synergies with the Government's plan to use the National ID smartcards (planned to be rolled out over 2016-17) to enhance service delivery, especially to the poorest. Other delivery mechanisms would also be considered, including the feasibility of use of technologies such mobile banking channels.
4. Early lessons would help establish the eventual balance, in terms of poor and vulnerable households targeted, between full government support through the macro coverage policy and some form of partial premium subsidy for individual purchase through insurance programs described in previous sections of this report.
5. To avoid overlap between social protection programs and the proposed macro policy and to make sure benefits are disbursed to those most in need, we propose complementing the targeting methodology used by Oxfam's resilience building project by the use of the unified targeting

74 See SwissRe, "Bangladesh Flood Victims Benefit from First Index Insurance Payout," October 31, 2014, http://www.swissre.com/global_partnerships/Bangladesh_flood_victims_benefit_from_first_index_insurance_payout.html.

system for social safety nets being developed by the government of Bangladesh, which uses a proxy means test (PMT)–based database of poor households.[75] Adopting the unified targeting poverty ranking, the government-funded macro-level flood index insurance program would apply to registered vulnerable households immediately below a set poverty level to be determined by the government of Bangladesh.

To sustainably scale the Oxfam-Pragati flood insurance scheme to additional households and regions, key challenges will need to be considered. These challenges include obtaining detailed flood data and conducting the necessary risk modelling for these new areas. In the development of the Sirajganj pilot, Oxfam, CIRM, and the IWM spent two years calibrating their flood model for the 10 villages. A further key challenge to be addressed is whether the product can be adapted to provide flood coverage for aman paddy crops, since the issue of basis risk is likely to be a major potential problem for any crop insurance application of the product. The scale-up could further its outreach by linking operationally to other existing projects and partners depending on the geographic location, such as the Vulnerable Group Development Programme implemented by the World Food Programme in the north with over 85,000 registered households.

Careful consideration will also need to be given going forward as to who pays for the premiums. In the pilot phase, Oxfam agreed to finance premiums in recognition that these poor and very poor landless households could not afford to pay for their flood premiums: however, if the program is to scale up in the future, alternative premium financing arrangements will need to be secured. Potentially, the government of Bangladesh and partner donors may choose to get involved in covering the cost of premiums, for specific target beneficiaries and/or regions. Since government and donors are currently involved in ex post relief with subsequent costs, they may elect to jointly pay into such a program ex ante, which would help government mobilize resources quickly without jeopardizing its fiscal balance and allow donors to channel funds rapidly on the onset of shocks in an accountable and transparent manner.

Beyond potentially covering the flood insurance scheme premium costs, the government of Bangladesh can play a range of roles to support building the poor households' resilience to flooding, depending on its policy priorities and the level of development of the agricultural insurance market. If government choses to cover the cost of premium for the scale-up, target households and districts should be in line with the government's policy objectives. The government will also need to carefully consider whether subsidies will be provided for a limited time period or in perpetuity, with subsequent fiscal costs and welfare benefits for recipient households, in order to minimize potential distortions in the market (i.e., price signals, inappropriate incentives to poor rural households, encouraging risk taking, etc.) and mis-targeting of clients, while crowding in the private insurance industry. Beyond subsidies, however, the government of Bangladesh can play various roles: (1) coordinate, cofinance, and regulate the collection, management, and auditing of investments in key public goods (such as flood gauges) that are not available in all regions in sufficient numbers; (2) support the distribution and outreach of the scheme and build awareness among poor households; (3) provide an enabling legal and regulatory framework if necessary; or (4) create and build the capacity of public institutions to ensure that the incentives of market participants, if more insurers were to join the scheme in other regions, are aligned with those of target beneficiaries.

6.3.Indicative fiscal costing for scaling out the Oxfam-Pragati meso-level risk-sharing piloting project

The following provides indicative references on the potential fiscal cost of scaling up the Oxfam-Pragati flood insurance product as an example of a fully subsidized insurance scheme for vulnerable rural households living in flood-prone areas. In order to develop such projections, it is

75 This method of targeting identifies key characteristics of the poor from household data and uses them to develop a household level "poverty scorecard" with which to identify poor households. Recent experience from pilot studies suggests that adopting such a PMT formula–based targeting mechanism can substantially improve the current coverage of poor households.

Table 6.4. Indicative Fiscal Costing Estimation for Scaling up the Meso-Level Risk-Sharing Piloting Project to 30,000 Households in Sirajganj, Gaibandha, and Barguna

Activities	Year 2	Year 3	Total
	Apr. 2015–Mar. 2016	Apr. 2016–Mar. 2017	Apr. 2015–Mar. 2017
Project implementation cost			
Subtotal	5,639,742	6,203,716	11,843,458
Project operational cost			
Subtotal	3,334,000	2459,900	5,793,900
Total project implementation cost	8,973,742	8,663,616	17,637,358
Project activity cost			
Research & development			
Subtotal	5,450,000	1,800,000	7,250,000
Product scale-up to the Sirajganj, Gaibandha, and Barguna Districts			
Subtotal	31,998,750	46,702,500	78,701,250
Partnerships and product outreach			
Subtotal	8,643,000	4,323,000	12,966,000
Enabling legal and regulatory framework			
Subtotal	3,640,000	940,000	4,580,000
Capacity building and knowledge management			
Subtotal	3,320,000	3,920,000	7,240,000
Total project activity cost	53,051,750	57,685,500	110,737,250
Total project direct cost (Tk)	62,025,492	66,349,116	128,374,608
Total cost per household (Tk)	2,068	2,212	4,279
Budget in US$ (US$1 = Tk 78)	795,199	850,630	1,645,828
Total cost per household (US$)	26.51	28.35	54.85

Source: Oxfam 2014.
Note: See annex 5 for detailed indicative fiscal costing.

necessary to estimate the potential cost of the macro insurance policy covering 30,000 households and to define the key assumptions for potential policy choices.

An essential assumption underlying this indicative fiscal costing exercise is that the government of Bangladesh, potentially jointly with donors, will provide direct financial support to the flood insurance scheme scale-out.[76] The first means for channeling public support will be to finance the cost of risk. In the analysis it is assumed that the government (and partner donors) will cover a 100 percent share of such costs. Risk financing support can be structured in many ways, and for the purpose of this analysis it is assumed that it could come under the form of premium subsidies.

A second source of public support for the flood insurance scheme will be by providing resources to complement the data collection activities needed for operating the product. For this fiscal costing estimation, it is assumed that the government of Bangladesh will cover the cost of the activities needed to complement the estimation process carried out by the IWM. In particular, the total cost of data management performed by the IWM during the three piloting years amounted to over Tk 5.3 million (approximately US$68,800), including designing the module, collecting real-time data during the monsoon period, calibrating the real-time data with the module, and analyzing the data for the local insurance company (Pragati) and reinsurer (SwissRe). In order to scale up these functions, it is envisioned that the data management will be linked with government

76 See section 3.4 for a more detailed argumentation on the need for public support.

systems like the Flood Early Warning Institute at the Water Development Board, thus optimizing the cost of data acquisition.

Under the assumptions presented in the analysis, excluding expenses related to other support activities, and based on the cost estimations for the Oxfam-Pragati scale-up, the direct fiscal costs to be borne by the government of Bangladesh and potential partner donors for supporting the scale-out of the contingent disaster-linked social protection mechanism would amount to an approximate total of Tk 128.37 million (US$1.64 million) at the start of the program (2015–2017), and additional yearly resources should the program reach significant scale beyond the set target areas. The bulk of the estimated fiscal support would be directed to covering the cost of risk that would absorb nearly 60 percent of resources provided by the government and potential partners, with increased scale bringing the share of premium subsidies down. The total fiscal cost of Tk 128.37 million (US$1.64 million) at the start of the program (2015–2017) to scale out to an additional 30,000 households would amount to an average Tk 2,850 (US$36.5) per household per year. The total cost of scaling up a program such as the Oxfam-Pragati program for the government of Bangladesh and its partners would depend on the number of households that the government sought to extend the fully subsidized insurance program to.

6.4. Welfare impacts

Empirical work on poverty dynamics has indicated the importance of uninsured shocks as one of the key drivers of chronic poverty in Bangladesh. While low-income smallholder households have employed a wide range of coping strategies to manage these shocks, e.g., community risk-sharing arrangements, savings, and labor diversification, these strategies tend to be ineffective with extreme shocks such as floods, which potentially create widespread losses that affect the whole community at the same time. Some strategies could also have a high cost for long-term development, e.g., when households forgo the opportunity to concentrate investment in a higher-return, higher-risk production strategy by diversifying crops. Lacking effective risk management tools, poor households may be forced to sell productive assets, borrow at very high interest rates, reduce food consumption, or take their children out of school. These extreme coping measures could further deplete productive assets and drive poorer households into chronic poverty (Barnett, Barrett, and Skees 2008). Using three longitudinal household panel surveys, Quisumbing and Baulch (2013) found that the repeated occurrence of floods slows down asset accumulation especially among the poor in Bangladesh. Dasgupta (2007) further shows that catastrophic floods have been one of the major causes of persistent poverty in the country. Disaster-prone districts appear to be among the poorest regions with the worst development outcomes of the country (HIES 2010).

This section develops a dynamic household model and uses four years of Household Income and Expenditure Survey data (HIES 1995, 2000, 2005, 2010) to analyze the potential welfare impacts of existing social safety net programs (SSNPs) and our proposed fully subsidized index insurance for households living in flood-prone areas. The analysis is based for illustration purposes on Oxfam's meso-level flood index insurance program and focuses on vulnerable and poor households living in flood-prone char areas in the 10 northwestern districts of Bogra, Gaibandha, Jamalpur, Kurigram, Lalmonirhat, Nilphamari, Pabna, Rangpur, Sirajganj, and Tangail, where household-level data are largely available.

According to HIES (2010), vulnerable households living in char areas are relatively poorer and more food insecure than the rest of the country, with an overall poverty head count (based on the upper poverty line) of 35.6 percent, compared to 31.5 percent nationally in 2010. The *upazila* poverty rates range from 10 percent to 90 percent. The poverty gap in char areas is 8.2 percent, compared to 3.1 percent nationally in 2010. Poverty has also been relatively more persistent in char areas, with only 6 percent reduction from the rate in HIES (2005) compared to 8.5 percent reduction nationally. Average calorie intake for this population is 2,174 Kcal, compared to 2,317 Kcal nationally in 2010 (Char Livelihoods Programme 2014) found that 23 percent of children in 2010 suffered from wasting. Following World Bank (2014), we compute

a PMT[77] score for each HIES-sampled household in these 10 flood-prone districts and construct three tercile groups based on PMT ranking.[78] With an overall poverty head count of 35.6 percent, the bottom tercile group (associated with those living in poverty) is living with averaged consumption of US$1,043 (just at the upper poverty line) and averaged per capita calorie intake of 2,081 Kcal (below the minimum requirement of 2,122 Kcal used to calculate the food poverty line). The second tercile also appears with just slightly better-off outcomes, and thus is still largely vulnerable to falling into poverty by national standards. Table A5.1 provides summary statistics.

Sixty percent of char dwellers are landless and derive economic income from three main sources: wage labor (39 percent), livestock production (30 percent), and crop production (25 percent). The bottom tercile group, most of whom are landless, relies extensively on wage labor (up to 55 percent), while the top tercile group relies more on agricultural production. Overall, households own an average 0.66 acres of land, with the poorest owning as low as 0.21 acres and the richest owning up to 1.34 acres on average. Critically, 80 percent of the poorest are landless. Apart from land, livestock and agricultural assets represent the majority of productive assets in char areas, with the poorer households having a bigger share of livestock in overall productive assets.

Floods are one of the major shocks facing char dwellers, who have limited coping strategies (especially the poorest) and who have to rely primarily on extreme coping mechanisms to deal with shocks, e.g., expensive credit. Extreme coping mechanisms, e.g., the sale of productive assets or borrowing at high interest, are very common, especially among the poorer households. This implies char dwellers are still largely uninsured and are currently forced to employ destructive strategies, which could have long-term negative consequences for their welfare.

Although 28 percent of char dwellers receive payouts from at least one social safety net program, the amount actually received appears to be very limited, with potential issues in targeting (average of US$1 in cash and 1 kg of grain in kind).[79] A bigger proportion of poorer tercile groups receives SSNP, though about 20 percent of the nonpoor group (based on PMT scores) also benefits from at least one SSNP program—indicating a potential mis-targeting. Only 6 percent overall receive payouts from the big five programs[80](mainly from the gratuitous relief program) and less than 1 percent participate in income and asset transfer with the Char Livelihoods Programme. Among the key programs are stipend programs, an agricultural rehabilitation program, and old-age allowance programs.

We simulate welfare and poverty dynamics of vulnerable households living in char areas prone to floods using a dynamic household model with asset and human capital accumulation. Households are endowed with land, productive assets (livestock and productive agricultural assets), and human capital. They derive income from wage labor and crop and livestock production using their assets as key inputs. Each period, they thus choose to accumulate assets for future income generation and current consumption, which can then be financed by total economic income, selling of assets, or borrowing at a high market rate—all at the intertemporal cost of future consumption. The nutrition-productivity tradeoff is important within the context of the high food insecurity in Bangladesh and is captured through human capital accumulation, where there could be irreversible health (and as a consequence productivity) losses if households were forced to resort to extremely low food intake below some survival level. The Oxfam flood index is then used to represent flood risk in the model, which affects both income and asset, together with other risks. We then simulate welfare dynamics with and without various SSNPs of heterogeneous households with endowment distribution and characteristics observed in HIES data.

77 This method of targeting identifies key characteristics of the poor from household data and uses these to develop a household level "poverty scorecard" with which to identify poor households. Recent experience from pilot studies suggests that adopting such a PMT formula–based targeting mechanism can substantially improve the current coverage of poor households.

78 This results in the use of PMT percentile 33 (PMT = 683) and 67 (PMT = 714) as cut-off points. The first cut-off point can be used to determine eligibility for a social safety net program given the current poverty head count of around 36 percent. This is comparable to the World Bank's (2014) simulation exercise implemented for social safety net targeting for other targeted regions, which results in a PMT cut-off point of 696 for the first tercile.

79 Several empirical works concluded that the evidenced small participation in and receipt from SSNPs could partially be due to measurement errors.

80 The big five social protection programs in Bangladesh include vulnerable group feeding, test relief, gratuitous relief, Food for Works, and Employment Generation Program for the Poorest.

The presence of flood risk would contribute to increasing long-term poverty over time from the current 35.6 percent poverty rate to 41.9 percent long-term averaged poverty rate in 50 years in the char regions. The recurring floods could result in 26.3 percent long-term averaged probability of falling into destitution and 15.4 percent probability of losing economically productive health—the key indicator of the probability of falling into a chronic poverty. Table 6.5 and the black line in figure 6.3 reflect poverty dynamics of flood-prone char communities according to our stylized model, which adequately captures the potential long-term impacts of floods. Floods directly affect current income and indirectly affect future income when they destroy assets and when affected households are forced to sell off assets and/or borrow to finance their minimum required consumption. Households also face some borrowing constraints that limit the amount they can borrow to finance consumption in bad times. And so when a household reaches the borrowing and asset offtaking limit, it may be forced to reduce consumption below the survival level, causing irreversible damage to human capital and future productivity. The increasing long-term poverty thus may be due to the fact that (1) floods prevent the chronic poor from moving out of poverty by forcing them to decumulate assets and human capital below irreversible levels, and (2) floods knock more vulnerable nonpoor into poverty.

If social safety net programs (in the form of cash, food, or asset transfer) transfer resources to the poorest 30 percent (based on a unified PMT system[81]) just enough to afford required minimum consumption to sustain human capital, the result could be an instant reduction in poverty, from 35.6 percent to 33.8 percent. The dashed red line in figure 6.3 reflects this potential impact. This result assumes that transfer is just enough to raise the poor beneficiaries above the nutritional poverty line so as to avoid collapse of human capital. Cash transfers thus reduce downward decumulation of human capital, opening up at least some probability of accumulation out of poverty. As the program also reduces downward pressure on asset sales and human capital accumulation (and so results in a 5.8 percent reduction in the probability of falling into destitution and a 2.2 percent reduction in the probability of falling into irreversible health-productivity losses), the program could also contribute to reduction of long-term averaged poverty by 2.2 percent.

Over time, however, poverty will still grow with transfer programs, as shocks continue to prevent the program's beneficiaries from graduating from poverty, as well as to knock more vulnerable nonpoor into poverty. So while the social protection program still continues for the 30 percent poorest, this fixed budget will not cover transfers to all the needy poor with growing transfer eligible poor . This implies a critical need for social safety net programs to address the potential poverty consequence of shocks.

Bangladesh's current SSNPs that allocate social protection budget to include disaster response could improve long-term poverty up to 2.2 percent relative to baseline, but they do not necessarily result in better poverty reduction outcomes relative to pure transfer programs. The red line in figure 6.3 depicts the resulting poverty dynamics when (1) the same social protection budget is allocated to disaster response programs (e.g., gratuitous relief program, vulnerable feeding program) at the cost of reducing transfer beneficiaries to the bottom 20 percent, and (2) disaster responses use allocated contingent budget available each year to distribute resources to targeted bottom 50 percent populations (including both poorest and vulnerable households) that are affected by flood according to a village-level flood index; note that the amount of assistance per affected households could be up to the level that raises them just above the nutrition poverty line, but also would depend largely on available budget and number of affected households. With limited budget allotted each year and a potentially large number of beneficiaries in catastrophic flood years, the current disaster response programs thus could provide only US$23–US$47 to affected households, and so would potentially suffer at least from issues of adequacy and delay, all of which could force affected households to employ costly coping strategies and lessen the poverty reduction effectiveness of the program. The current program results in only a 4.7 percent reduction in the probability of falling into destitution, relative to 5.8 percent

81 PMT has performed well in targeting poor households for SSNP. Simulation analysis from World Bank (2014) also shows that improving the administration and improving the targeting of five of the largest SSNPs (vulnerable group feeding, test relief, gratuitous relief, Food for Works, and Employment Generation Program for the Poorest) (as is currently being done under the SSNP project) using the PMT has the potential to reduce the rural poverty head count rate from 34.6 percent to around 34.1 percent by allocating the existing budget more efficiently.

in the case with transfer alone. Overall, the country's current SSNP programs with disaster responses could result in up to 1 percent higher long-term averaged poverty relative to the case when all social protection budget is allocated to transfer-type programs.

Flood index insurance can complement existing SSNP programs to enhance timely and effective disaster response, which in turn could ensure adequate resources for necessary consumption during floods and reduce the need of households to engage in costly asset decumulation; this could lead to 1 percent lower short-term poverty relative to the current program and largely stabilized averaged long-term poverty at 37.6 percent (3.2 percent lower than the current programs). The blue line in figure 6.3 depicts this result when (1) the same social protection budget is allocated to prefinance flood index insurance at the cost of reducing transfer beneficiaries to the bottom 20 percent, (2) 100 percent subsidized flood index insurance is targeted to the bottom 50 percent poorest and vulnerable households using PMT scores, and (3) insurance makes payouts based on a village-level flood index to compensate for up to expected four-month wage losses (US$103 per household) in severe flood years. Annex 5 provides a detailed payout schedule for this contract. Thus long-term poverty impacts could result from a large reduction in the probability of households being trapped in chronic poverty, with 8.2 percent reduction in the probability of falling into destitution (relative to 4.7 percent under the current program) and 5.2 percent reduction in the probability of falling into irreversible bad health (relative to 1.4 percent under the current program).

Increasing prioritization of the social protection budget for disaster-linked programs could improve long-term poverty outcomes, but potentially at some short-term cost of intensified poverty for the chronic poor. We model flood index insurance to target the poorest and most vulnerable households with the intention that the program will help stabilize graduation from poverty among the current transfer beneficiaries and protect vulnerable nonpoor from falling into poverty. The program thus involves reducing the number of chronic poor targeted to be lifted out of poverty from transfer programs. But the net comparable effect on short-term poverty outcomes relative to pure transfer programs shows that the number of poor and vulnerable being protected by flood insurance from falling into poverty is larger than the number of chronic poor lifted out of poverty from transfer programs, using the same social protection budget. Together with better long-term poverty effects, the current result implies that complementing effective insurance with social protection programs could be more cost-effective in reducing poverty and vulnerability both in the short and long run.

Private-public finance for fully subsidized insurance can potentially further reduce the short-term poverty tradeoff of the program and further improve (by up to 2 percent) the long-term averaged poverty reduction outcomes relative to the pure public finance program. The dashed blue line in figure 6.3 illustrates the potential poverty outcomes when 100 percent subsidized flood insurance is targeted only to the poor and vulnerable bottom 30 percent, while the rest of the budget is used to finance a 50 percent subsidy aimed to induce private insurance demand among the rest of vulnerable households in the bottom30–70 percent of char populations. Overall, this potential private-public finance program could result in an 8.4 percent reduction in the probability of falling into destitution and a 6.1 percent reduction in the probability of falling into irreversible health-productivity losses.

An appropriate targeting strategy for this fully subsidized insurance would thus involve choosing the most cost-effective strategy given government's policy objectives. The bottom panel of table 6.5 illustrates the potential short-term and long-term poverty impacts per US$1 spent on social protection budget per averaged household. Well-targeted private-public finance for an insurance-linked social protection program appears with the largest short-term and long-term poverty impacts. And the use of index insurance to enhance effective disaster response in the social protection program also appears with larger poverty impacts relative to the current program, though with slightly less effective disaster responses. We note, however, that the modelled and simulated poverty impacts ignore other potential development interventions, which could further result in greater reduction in poverty over time.

Figure 6.3. Poverty Dynamics with and without SSNPs

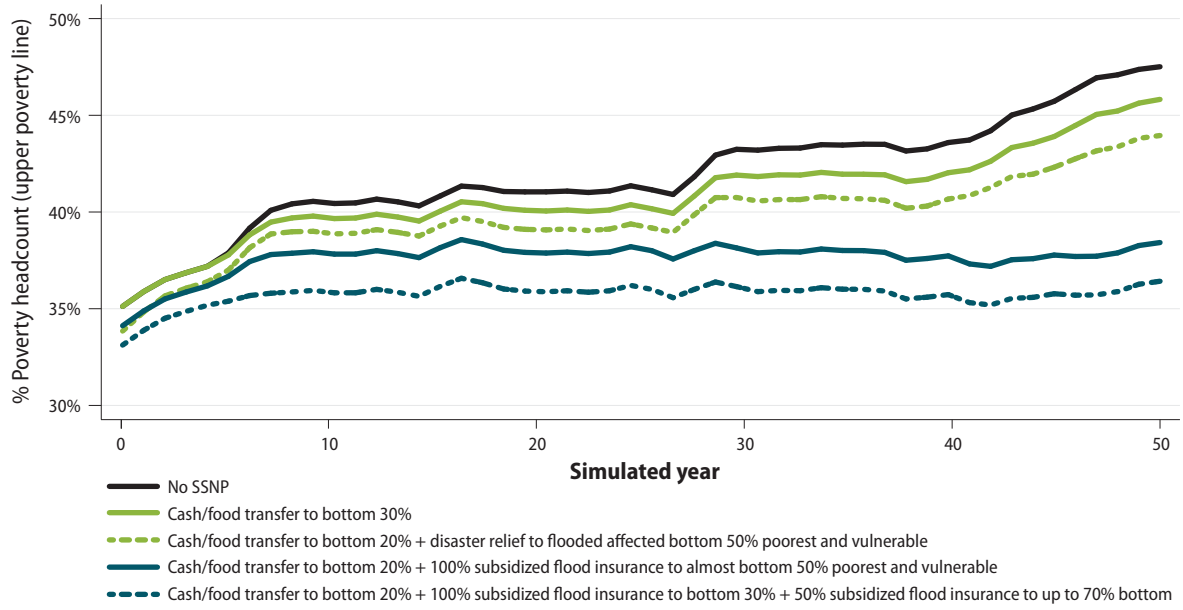


Table 6.5. Summary of Simulated Short-Term and Long-Term Poverty Impacts of SSNPs

7. Conclusion

If the Government of Bangladesh decided to go ahead with support for agriculture insurance, high-level buy-in from a broad range of stakeholders will be necessary, as will partnerships with the private sector. Government may consider: strengthening the overall legal, regulatory, and supervisory insurance environment; developing a centralized database of data for agricultural insurance purposes; provision of financial support to the program, particularly in the early stages of the program; and establishing a dedicated technical team within government with responsibility for implementation and for providing input to policy. One option for consideration would be for some or all of these activities to be carried out through a project with technical support and/or financial assistance of a development partner with adequate expertise in this field, such as the World Bank Group.

Table 1. Summary of Suggested Policy Options for Design and Distribution of Agricultural Insurance

	Design options	Distribution options	Fiscal cost & welfare impact
Dairy Cattle insurance	Traditioinal indemnity-based livestock accident and mortality cover • Cattle are owned by 36% of rural households (or 10.4 million households), the vast majority of which are small scale producers	5 distribution options: (1) Government-sponsored bundling of insurance with credit for select banks, (2) partner agent model with MFIs and NGOs and commercial banks, (3) partner agent model with dairy cooperatives, (4) underwriting and distributions by MFIs, and (5) community based schemes	A 50% subsidized national dairy cattle insurance program would cost between US$4 million and US$16 million in 2020: • When insurance can unlock credit and induce smallholder producers to switch to haigh value or hybrid breeds and improved inputs, this could allow them to double their productivity
Aquaculture insurance	Named-perils or all-risk insurance cover • 300,000 shrimp producers • 4 million finfish producers	To be assessed (e.g., value chaing stakeholders, banks)	Further research to be undertaken • Potential to double shrimp yields with significant impact on smallholders' income.
Crop insurance	Area-yield index insurace or weather-based index insurance • Paddy accounts for 83% of crop income of rural households	Distribution bundled with agricultural credit: • On voluntary basis or under legal requirement	A %0% subsidized national AYII program for aman and boro paddy would cost between US$6 million and US$9 million in the 2020: • AYII could increase loan repayment by up to 35% in bad (1-in-10) years and therefore unlock productive investments • The combined effect of enhanced protection and increased productivity is esetimated to redsult in a 100% encrease in small and medium-size farmers' crop income in baad years, compared to current disaster relief.
Fully subsidized insurance for most vulnerable	Fully subsidized insurance for the poorest households could be based on a flood index • 83 million people are poor • 30,000 households are particularly vulnerable	to be assessed • Currenbt flood index-based program piloted by NGO distributes payouts through an MFI	Estimated cost of scaling up currect flood-indez program (fromn less than 2,000 to 30,000 beneficiaries) is about US$2 million at the start of the program (2015-2017). • using 100% suybsidized flood index insurance to scale up social protection for the poor and vulnerable bottom 50% of char populations could reduce long-term welfare impacts of catastrophic floods and result in 5% reduction in averaged long-term poverty rate

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Annexes

Annex 1. Overview of Dairy Cattle Milk Production in Bangladesh

The government of Bangladesh–MOFL through the Department of Livestock Services (DLS), is actively promoting the development of the dairy sector, and over the past 12 years national milk production has increased by an average of more than 20 percent a year, from 1.84 million metric tons (MMT) in 2002–2003 to 6.09 MMT in 2013–2014.[82] In spite of this major growth, the DLS estimates that Bangladesh currently produces only 43.4 percent of its daily milk demand. Using FAO nutrition figures, which indicate that the daily milk requirement per adult is 250 ml per day, DLS estimates that with a current population of 153.6 million people, only 109 ml per person per day is currently available (DLS 2015). The country needs to produce 14.02 MMT milk, implying a deficit in 2013–2014 of nearly 7.93 MMT (56.6 percent of demand) (figure A1.1). In order to make up the gap between supply and demand for milk, Bangladesh imports powdered milk and cream: in 2012–2013, the country imported 20,000 metric tons of milk powder at a cost of US$93.4 million (Hamid and Hossain 2014).

Figure A1.1. Milk Production in Bangladesh 2002–2003 to 2013–2014

Sources: Hamid and Hossain 2014; DLS 2015.

In Bangladesh 10.4 million households, or 36.2 percent of the all rural households in the country, own cattle. According to a 2009 national livestock and poultry survey (BBS 2010), there is a total of 26.8 million head of cattle, or an average of 2.57 cattle per household.[83] Of these cattle, 15.8 million cattle are female, representing 59 percent of the national cattle herd (BBS 2010). The distribution of female cattle is as follows: calves under one year: 2.9 million head (18.1 percent of total female cattle); heifers/cows one year to less than three years: 4.4 million (28.1 percent); and cows three years and older: 8.51 million (53.8 percent). However, on average only 3.87 million cows over three years (45 percent) are in lactation and producing milk (BBS 2010).

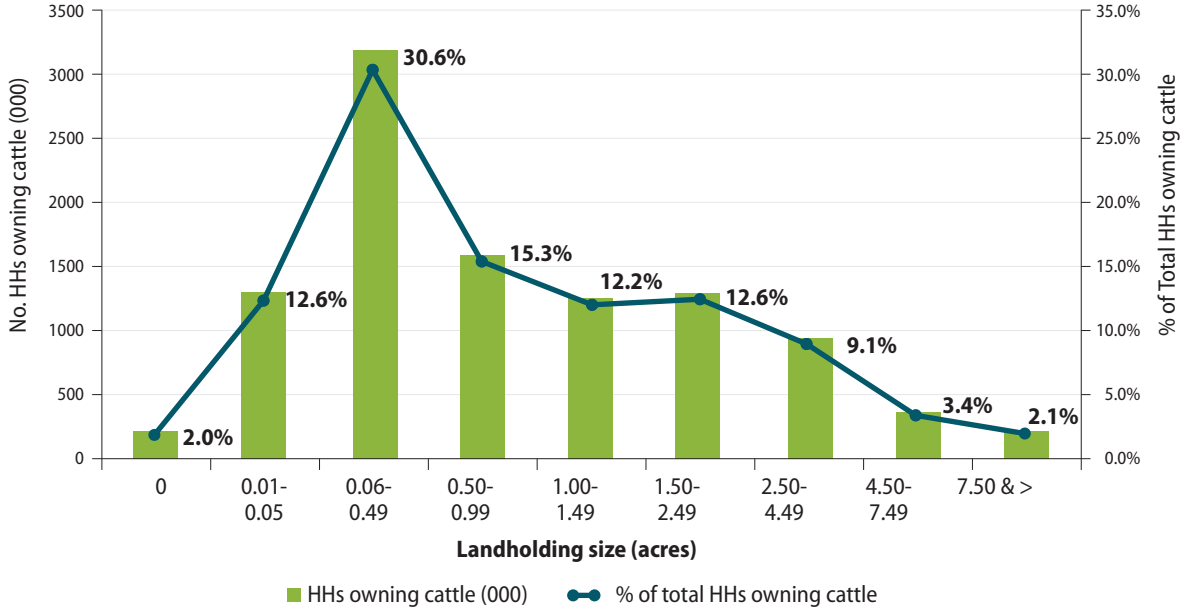
The distribution of the 10.4 million cattle-owning households by size of landholding is shown in Figure A1.2. According to the BBS 2009 survey, the largest category, or 31 percent of cattle-owning households, owns between 0.06 and 0.49 acres of land; only 2 percent of landless households own cattle; and overall, 85.3 percent of all cattle are owned by households with less than 2.5 acres (1 hectare)

82 In Bangladesh, cattle, buffalo and goats are considered as dairy animals and they account respectively for about 90 percent, 2 percent, and 8 percent of total milk production (Hamid and Hossain 2104 quoting BBS 2012 data).

83 This compares with an average of 3.5 cattle per household reported by Halder and Barua (2003) quoting Saadullah and Hussain (2000). The 2000 study found that landless households owned the smallest number of cattle, or an average of 2 cattle/household; small farmers (0.05 to 2.49 acres) owned an average of 2.9 head of cattle; medium-sized farmers (2.5 to 7.49 acres) owned an average of 3.7 cattle; and finally large farms owned an average of 4.4 head of cattle.

of land (BBS 2010). The small amount of land held by cattle owners is a reflection of the very small size of farm holding in Bangladesh, where the average holding per farm household is 1.2 acres (0.51 Ha) (BBS 2011).

Figure A1.2. Distribution of Cattle Owning Households by Size of Landholding (2009)



Source: BBS 2010.

The majority of dairy farms in Bangladesh are privately owned. On the basis of the primary use of the cows, the farm size, and the use of dairy products, the farms may be classified into five categories: (1) dairying for home consumption, (2) production from dual-purpose cows (draft and milk), (3) small-scale dairy farming, (4) medium-scale dairy farming, and (5) commercial dairy farming.[84] (See table A1.1).

Table A1.1. Classification of Dairy Farms

No.	Farm Type	Cows/farm	Ownership
1	Household dairy milk produced for home consumption and surpluses of milk are converted into market sales	1 to 3	Usually large and medium sized households
2	Dual Purpose Cows (Draft & Milk). Seasonal surpluses of milk are converted into milk sales	2 to 6	All types of household as secondary activities
3	Small dairy farms. Milk and milk products are converted into market sales	2 to 5	Small and medium sized livestock households (mostly with Government incentive, NGO or cooperative support)
4	Medium dairy farms. Milk and milk products are converted into market sales	6 to 25	Medium-sized household / private small commerecial dairy farm (mostly with Government incentive, NGO or cooperative support)
5	Large dairy farms. Milk and milk products are converted into market sales	26 &>	Private commercial dairy farms

Source: Saadullah 2001.

An alternative classification for dairy cattle production systems in Bangladesh is based on the following: breed of cattle; husbandry, management, and feed systems; milk production; and market access (table A1.2). This classification, which was developed by Uddin et al. (2011) reflects more accurately the current different dairy production systems in Bangladesh and identifies four categories of dairy producer:

84 This classification was reported in Saadullah (2001) and subsequently repeated by Hamid and Hossain (2014).

1. The largest system, **traditional subsistence dairy production,** is based on an indigenous breed of cattle with herd size from one to six cattle; family labor is the only source of labor; animals are primarily fed on crop residues, with very little purchased feed supplements; 40 percent to 50 percent of farmers use natural mating of their animals, although there is an increasing use of artificial insemination; and most milk is sold directly to neighbors, middlemen, or consumers in local markets. Under this low-input semi-subsistence system, average milk yields are low, at 600–700 L per six to nine month lactation.
2. **The extensive dairy production system** is practiced mainly by market-oriented dairy farmers operating on a small to medium scale and with superior local breeds of cattle and some purchased crossbred animals. These farmers hire some labor, and feeding is part grazing and part stall-feeding, supplemented by concentrates. Between 70 percent and 75 percent use AI, and the farmers sell both to local markets and through cooperatives and private milk processors. This group achieves average milk yields of 700–800 L/cow per lactation.
3. **The intensive diary production system** is a response to the increasing scarcity of land and is based on zero-grazing/stall-feeding of improved crossbreeds, along with use of AI and veterinary and extension services to achieve much higher milk production (average 1,000–1,400 L/cow/lactation): farmers are members of dairy cooperatives and sell their milk to the cooperatives.
4. The final system, the ***bathan*** system, is unique to Sirajganj and Pabna Districts and involves dry season grazing of cattle on pasture/fodder, which is cultivated in the river plains, followed in the monsoon season, when the river plains are flooded, with zero-grazing/stall-feeding. Almost all dairy cows (98 percent) are cross-breeds, *bathan* dairy farmers are members of dairy cooperatives (Milk Vita), and under a high input system they can achieve the highest average milk yields of 1,200–1,800 L/cow per lactation (Uddin et al. 2011).

Table A1.2. Dairy Milk Farming Systems in Bangladesh

Description of Dairy farming system	Traditional Subsistence	Extensive	Intensive	Bathan
Percent of national milk production	40%	n.a.	n.a	n.a.
System Boundary	Rural subsistence	Rural to peri-urban	Peri-urban	Peri-urban (cooperatives)
Average size of landholding (acres)	0.05 - 2.49	2.5 - 7.5	n.a. (zero grazing-stall fed)	n.a. (6-month bathan grazing river banks; 6 months zero grazing -stall fed)
Breed	Local, non-descript, indigenous	Superior local; few cross-bred with Jersey, Sahiwal	Superior local; mostly cross-bred with Hereford, Jersey, Sahiwal	Mostly cross-bred with Hereford, Jersey, Sahiwal; very few Pabna milking cows (local)
Herd size (No	1 to 6	1 to 6	2 to 10	2 to 30
Mik yield (litres/cow/lactation)	600 to 700	600 to 800	1,000 to 1,200	1,200 to 1,800
Feeding system	Cut and carry (crop residue); tethering	Periodic grazing on public land; stall fed produce fodder and purchase some concentrates	Stall feeding supplemented by concentrate and green fodder	6 months stall feeding followed by 6 months batahan feeding
Market access	Limited	Access to spot market only	Good	Good
Access to services (veterinary and AI)	Limited Access	Access with high costs	Good access	Good access with low cost

Source: Adapted from Uddin et al. 2011.

The majority of the cattle in Bangladesh are local indigenous breeds, but government is promoting AI to introduce crossbreeds capable of producing much higher yields of milk. In the 1990s the majority (97.2 percent) of the cattle in Bangladesh were local or *deshi* cattle characterized by small stature, low milk yields, short lactations, and long calving intervals; only 2.8 percent of cattle were crossbred (Saadullah 2001; Halder and Barua 2003). The government of Bangladesh has since then actively promoted AI both through the public sector (DLS) and private sector providers in order to introduce larger, higher-milk-yielding crossbred cows. According to the BBS 2009 national survey,

649,000 households, or 6.2 percent of total cattle-owning households, now own improved crossbreed cattle, and there are an estimated 1.1 million improved/crossbreed cattle, representing 4.1 percent of the national cattle herd. The same study estimated that 180,000 households, or 1.7 percent of cattle owners, have improved/crossbred milking cows, with a total estimated number of 427,000 improved/crossbred cows of milking age, or 5.0 percent of the total number of cows of milking age (BBS 2010).

The milk output of Bangladesh's mainly local indigenous cattle is low, with a 2009 average of only 1.73 L per cow per day, or about 350 L per lactation (BBS 2010). This compares with an average of about 4.5 L per cow per day (slightly greater than 1,000 L/cow/lactation) for crossbred dairy cattle (BBS 2010). There is, however, considerable variation in the milk production levels reported for local breeds in Bangladesh: MOFL (2007) and Halder and Barua (2003), Khan et al (2012) report milk yields as low as 200–300 L per cow per lactation, while Uddin et al. (2011) report very much higher average milk production for local breeds—600–700 L per lactation (table A1.3).

Table A1.3. Comparison of Dairy Cow Milk Production Levels for Local Breeds and Crossbreeds

Source / Study	Type of Cow	Daily Milk Production (Litres/Cow)	Average Milk Production per Lactation (Litres/Cow)	Lactation period (Days)
BBS 2010	Local breeds	1.73	348	201
	Cross-breeds	4.55	1033	227
Halder & Barua 2003	Local breeds	1.19	200 to 300	180-240
	Cross-breeds	4.00	800 to 1,000	210-240
Uddin et al 2011	Local breeds	n.a.	600 to 700	n.a.
	Cross-breeds	n.a.	1,000 to 1,400	n.a.
Khan et al 2012	Local breeds	1.67	300 to 400	180 to 240
	Cross-breeds	3.11	600 to 800	210 to 240

** Note.* Cross-bred

Traditionally the marketing of fresh milk by small-scale milk producers in Bangladesh was either through Goala and Paikers, who would collect milk from farmers through door-to-door visits and onsell this to local middlemen (Ghosh) or to sweetmeat shops, tea stalls, consumers, or neighbors (figure A1.3). According to Uddin et al. (2011), the traditional dairying model is characterized by high variability in milk price, low milk quality, poor market access, and poor access to veterinary services and extension as well as to artificial insemination services. Under this system small rural milk producers usually have to accept considerably lower prices for their milk.

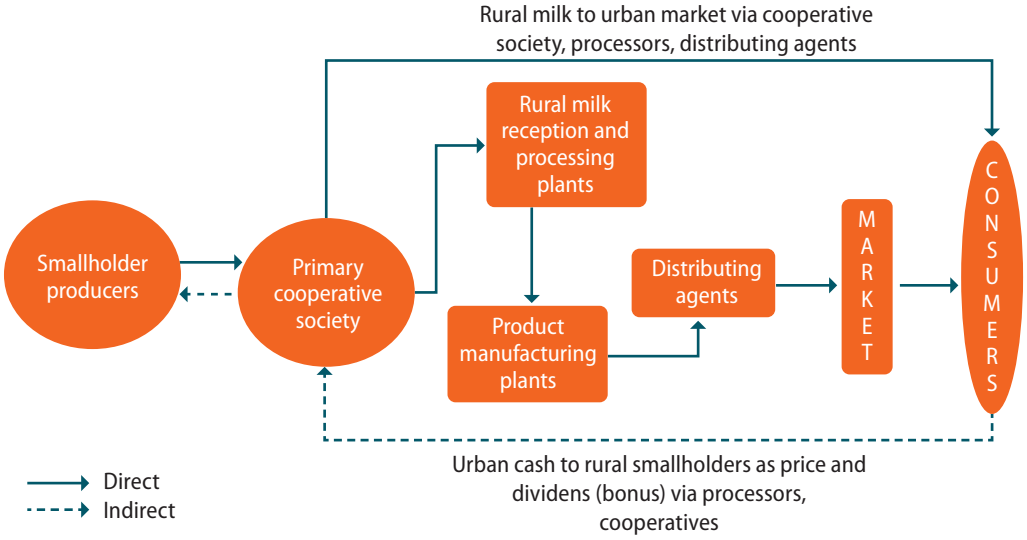
Figure A1.3. Traditional Milk Marketing Model, Bangladesh

Source: Uddin et al. 2011 (adapted from Haque 2009).

The origins of a formal milk marketing system in Bangladesh date back to 1973, when the government initiated a dairy cooperative for smallholder dairy farmers named the Eastern Milk Producers Cooperative Union and renamed the Bangladesh Milk Producers Cooperative Union Ltd. in 1977. Today, the cooperative—more popularly known as Milk Vita—is Bangladesh's largest dairy cooperative, with 160,000 dairy farmer members organized into 2,250 primary cooperative societies, owning 700,000 cattle (of which 300,000 are milking cows), and supplying 63 million L of milk in 2013–2014 to two Milk Vita Milk processing plants and to 41 Milk Vita milk-chilling centers located in 37 districts throughout Bangladesh.

The formal dairy cooperative milk-marketing model first developed by Milk Vita differs from the traditional model in that dairy farmers are guaranteed a higher price for their milk according to the fat content. This approach provides milk quality and market assurance for its members. The model is shown in figure A1.4.

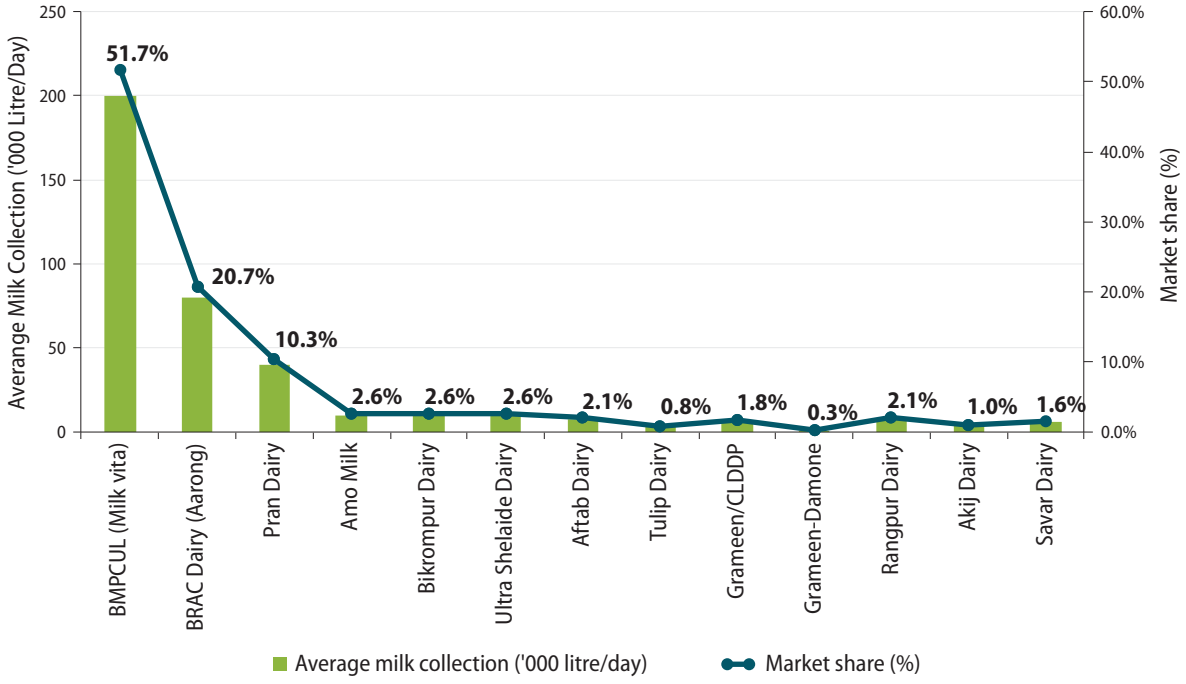
Figure A1.4. Cooperative Dairy Model (Milk Vita)



Source: Uddin et al. 2011 (adapted from Haque 2009).

In 1990 there were only two formal milk processors (cooperatives) in Bangladesh, but the Milk Vita model has been very successful and in 2007 there were 20 commercial milk processors. Figure A1.5 shows the share of the fresh (pasteurized) milk market by the top 13 milk processors in Bangladesh. Total daily milk supply is about 387,000 L per day, of which Milk Vita is the dominant supplier of 200,000 L milk per day (52 percent market share) followed by BRAC Dairy (80,000 L/day, 21 percent market share), and Pran Dairy (40,000 L/day, 10 percent share), while the other dairies are much smaller (Hamid and Hossain 2014) (see figure A1.5).

Figure A1.5. Market Share of Liquid Milk by Commercial Milk Processors and Cooperatives/ NGOs



Source: Hamid and Hossain 2014.

While the market share of the milk processors/dairies has increased significantly in recent years, the informal milk-marketing sector continues to dominate in Bangladesh. Between 10 percent (Uddin et al. 2011) and 15 percent (Hamid and Hossain 2014) of cow's milk is delivered to the milk processors, while the remaining 85 percent to 90 percent is marketed directly by small milk producers.

The private sector (cooperative and NGO) milk processors are active in providing a range of services to their dairy-supplying members. These services include milk collection facilities, veterinary and animal health services, artificial insemination services, balanced animal feed production and supply, and loans for the purchase of improved higher-yielding breeds of cattle. The milk processors often provide these services free or at cost in order to maintain member loyalty. BRAC for example, retains a network of over 2,500 trained livestock artifical inseminators who provide AI services to dairy producers at a highly subsisided cost (see Box A1.1 for further details). Likewise, MilkVita maintains a network of 235 Livestock Field Assistant and Artificial Inseminators (LFAI) who provide free AI services to its dairy producer members under the guidance and supervision of Milk Vita. In addition, MilkVita provides a range of other services to its dairy producer members (Box A1.2).

Box A1.1. BRAC Artificial Insemination

BRAC Artificial Insemination began in 1985 as a partnering initiative with the government of Bangladesh to provide the rural poor with an access to better quality breeds of cows. The objective of the program is to enable the rural poor to breed higher yielding cross bred dairy cattle. The program uses artificial insemination to breed higher yielding dairy cows thereby increasing milk and meat productivity and the incomes of Bangladesh's predominantly small-scale dairy milk producers. The program started with 130 volunteers who received training in livestock artificial insemination (AI) and today the BRAC AI program has now trained a national network of 2,141 AI technicians.

In 1998 BRAC officially split its AI operations from those of the government and formed BRAC Artificial Insemination as a social enterprise.. BRAC Artificial insemination has one bull station in Mymensingh, Bangladesh. When it was first built, it held 35 bulls. Today it holds 72 bulls. From the bull station, the semen gets distributed to depots. BRAC Artificial Insemination has 70 depots throughout Bangladesh. Here, artificial insemination technicians purchase semen for BDT 120. Then they charge the farmers BDT 180-200 for the semen and their services. Artificial insemination technicians not only impregnate the farmers' cows, but they also train the farmers to care for their cows' general health (housing, feeding, water management, disease prevention, and cattle breed selection.

Today, BRAC Artificial Insemination covers 61 districts across Bangladesh and has inseminated a total of 1,164,202 cows in the last 10 years. The districts covered also contribute to BRAC Dairy and Food Project. BRAC Artificial Insemination definitely contributes to the success of BRAC Dairy, helping to fuel the demand for milk in Bangladesh.

Source: http://enterprises.brac.net/brac-artificial-insemination

Box A1.2. MilkVita Services to its Dairy Members

- Livestock Extension Services aimed at Dairy Entrepreneurship Development
- Articial Insemination Programme. MilkVita employs 235 LFAIs (Livestock Field assistant and Artifical Inseminator) who provide AI free of cost, working under the guidance of MilkVita rules and regulations.
- Cattle Vaccination Programme. MilkVita maintains at least 1 Veterinarian officer in each of its 41 milk chilling centres who provide round the year cattle vaccination programs which are free for dairy cattle members of the cooperative. Vaccination is provided against a) Anthrax, b)FMD, c) HS, and d) Black Quarter. Vaccination records are maintained for each member
- Balanced Cattle Feed Supply services. MilkVita produces its own branded cattle feed and has plans to establish a maga cattle feed project costings BDT. 35 crore (BDT 350 million);
- Low Service Charged Cattle Loans. About a decade ago MilkVita received BDT 5 crore (BDT 50 million) from Government to establish a rotating (revlvong) cattle credit fund, carrying a 5% service charge (including interest on the loan) Moreover MilkVita also provides rotating cattle loans from it won funds namely the Cattle Development Fund Cattle Loan (CDFCL) and Model Farm Cattle Loan (MFCL). Farmers may obtian up to BDT 75,000 to purchase a single cow.
- Cooperative Management

- Training Programme: MilkVita has a training department providing training to Artifical Inseminator Technicians, primary society members, labority personnel etc.
- Guaranteed year round milk selling facilities with fair prices. MilkVita pays each Primary Milk Producers' Cooperative Society, PMPCS, according to the fat content of the raw liquid milk delivered to its chilliing plants. Thjese prices vary from Fat 3%; BDT 30.14/L, to Fat 6%, BDT 58.23/L.
- Free Cattle medication/Treatment Facilities. At a field level, MilkVita's veterinarians provide cattle treatment as a) Every day routine based treatment in the Primary Society premises and b) Mobile cattle treatment on an "as and when needs" basis. Annually about BDT 2 crores (BDT 20 million) of treatment is provided.

Source: Azad 2015

Under any future PPP for dairy cattle insurance in Bangladesh, the partners should actively work with the dairy cooperatives and seek ways of using their networks of trained articifical insemniators and livestock field assistants and veterinarians to assist in implementing this program. Specific tasks that these trained technicians could perform include registration and tagging of insured cattle (& buffalo), animal health inspections and routing vaccination, through to assistance in loss inspection and reporting to insurers.

Annex 2. India Community Livestock Insurance Scheme in Andhra Pradesh

India has operated a community-based livestock mortality insurance scheme for small-scale dairy cattle producers in Andhra Pradesh State since 2005. The scheme 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; it includes coverage and originally carried a 4 percent premium rate applied to the sum insured (this rate was reduced to 3 percent in 2009). Key features of the scheme are summarized in box A2.1.

The community-run livestock insurance scheme operated for two full years, from 2005/2006 to 2006/2007, 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, or only 6 percent of premium.

On the basis of the success of the scheme, at the 2007/2008 renewal Tata AIG Insurance Company Ltd. 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 issues a master policy to the self-help groups and district-level administration (Zilla Samakhya) on receipt of a deposit premium; the company receives a schedule of each cow that is purchased with a bank loan and that is insured under the scheme; it periodically receives a premium adjustment; and finally, 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 of bank loans to purchase the animal, tagging and vaccination of the animal, 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.

In 2007/2008 the dairy livestock insurance scheme for women had operated for three full years and had insured a total of over 25,000 dairy cattle. On the basis of the success of the Andhra Pradesh model, the scheme was subsequently replicated in other states in India and elsewhere in South Asia with financial assistance from the World Bank. The objective was by 2010 to achieve an insurance coverage of between 3 to 5 million head of cattle.

Box A2.1. Community-Run Livestock Insurance Scheme in Andhra Pradesh State, India

Livestock are susceptible to different types of risks, both idiosyncratic and covariant. Death of the animals in accidents is not uncommon. The mortality among livestock is one of the principal reasons for the loan defaults of the poor. In the absence of comprehensive insurance for livestock, disease and death of livestock may result in a grievous loss in the livelihoods of the poor.

Loan Protection Scheme for Dairy Cows and Buffalo

The Andhra Pradesh community-run livestock insurance scheme provides relief to the members/family of the self-help group that owns the milk cattle in the case of death of the animal. This is a premium-based scheme: every individual animal (buffalo or cow) is covered against an annual premium equal to 4 percent of the value of the animal (plus a small entry fee). The value of the animal is estimated by a veterinarian. The coverage value decreases with the age of the animal. The insurance policy is renewed during the next year after deducting a depreciation of 20 percent in the animal cost. For milch cows the insurable age is from 2 to 10 years; for milch buffalo it is from 3 to 12 years age.

The scheme is totally self-managed by the community. Accounting, monitoring, and documentation systems are conceived and designed in house.

Claim Procedure

Upon the death of an insured animal, the claim form is sent to the village organization. A member of the subcommittee verifies the claim by visiting the village. After discussing the issue with the subcommittee, the claim

is either settled or rejected. The settled claim is given to the village organization by way of check. The village organization pays the claim amount to the beneficiary.

Performance

This animal insurance scheme is among the first of its kind in India. The scheme is community-based and relies on peer monitoring.

The number of animals insured increased from 3,500 in 2005/2006 to 25,500 in 2007/2008. Premium collected increased from US$3.7 million in 2005 to US$8 million in 2008. The claims ratio has been stable, at around 2.6 percent of the total insured animals. This makes this scheme financially viable. Operating costs represent 12 percent of the premium income. It is essential to keep the operating costs (e.g., underwriting cost, loss-assessment costs, and claims processing costs) at the minimum to ensure the sustainability of the scheme. The success of the scheme critically relies on the peer monitoring system, which enables the community-based organization to prevent false claims. The community supervision and vigilance has been found to be very effective and should rise further.

Source: World Bank 2008b.

Annex 3. Livestock Insurance Fiscal Analysis

Table A3.1. Fiscal Analysis, LOW Insurance Penetration Rate and Low Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars[1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
LOW INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	0.25%	0.5%	1.0%	2.5%	5.0%	
No Insured Dairy Cattle	11 million dairy cattle	27,500	55,000	110,000	275,000	550,000	1,017,500
LOW SUM INSURED based on value of dairy cattle investment loan (US$)	US$ 200 (BDT 15,000) per adult cross-bred cow [3]	5,500,000	11,000,000	22,000,000	55,000,000	110,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	137,500	275,000	550,000	1,375,000	2,750,000	
Premium US$ Median Rate	5.00%	275,000	550,000	1,100,000	2,750,000	5,500,000	
Premium US$ High Rate	7.50%	412,500	825,000	1,650,000	4,125,000	8,250,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	68,750	137,500	275,000	687,500	1,375,000	2,543,750
A.2. Medium Premium rate	50%	137,500	275,000	550,000	1,375,000	2,750,000	5,087,500
A.3. High Premium Rate	50%	206,250	412,500	825,000	2,062,500	4,125,000	7,631,250
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	41,250	82,500	165,000	412,500	825,000	1,526,250
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	41,250	82,500	165,000	412,500	825,000	1,526,250
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	13,750	27,500	55,000	137,500	275,000	508,750
B. 4. Total Subsidies on Operating Costs		96,250	192,500	385,000	962,500	1,925,000	3,561,250
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		165,000	330,000	660,000	1,650,000	3,300,000	6,105,000
A.2. Medium Premium rate + B.4.		233,750	467,500	935,000	2,337,500	4,675,000	8,648,750
A.3. High Premium Rate +B.4.		302,500	605,000	1,210,000	3,025,000	6,050,000	11,192,500

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured for a cross breed adult dairy cow based on livestock investment loan of BDT 15,000 (US$ 200) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Table A3.2. Fiscal Analysis, MEDIUM Insurance Penetration Rate and Low Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars[1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
MEDIUM INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	0.5%	1.0%	2.5%	5.0%	7.5%	
No Insured Dairy Cattle	11 million dairy cattle	55,000	110,000	275,000	550,000	825,000	1,815,000
LOW SUM INSURED based on value of dairy cattle investment loan (US$)	US$ 200 (BDT 15,000) per adult cross-bred cow [3]	11,000,000	22,000,000	55,000,000	110,000,000	165,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	275,000	550,000	1,375,000	2,750,000	4,125,000	
Premium US$ Median Rate	5.00%	550,000	1,100,000	2,750,000	5,500,000	8,250,000	
Premium US$ High Rate	7.50%	825,000	1,650,000	4,125,000	8,250,000	12,375,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	137,500	275,000	687,500	1,375,000	2,062,500	4,537,500
A.2. Medium Premium rate	50%	275,000	550,000	1,375,000	2,750,000	4,125,000	9,075,000
A.3. High Premium Rate	50%	412,500	825,000	2,062,500	4,125,000	6,187,500	13,612,500
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	27,500	55,000	137,500	275,000	412,500	907,500
B. 4. Total Subsidies on Operating Costs		192,500	385,000	962,500	1,925,000	2,887,500	6,352,500
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		233,750	467,500	1,072,500	2,337,500	3,987,500	8,098,750
A.2. Medium Premium rate + B.4.		371,250	742,500	1,760,000	3,712,500	6,050,000	12,636,250
A.3. High Premium Rate +B.4.		508,750	1,017,500	2,447,500	5,087,500	8,112,500	17,173,750

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured for a cross breed adult dairy cow based on livestock investment loan of BDT 15,000 (US$ 200) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Source: World Bank Group Fiscal Analysis.

Table A3.3. Fiscal Analysis, HIGH Insurance Penetration Rate and Low Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars (Exchange rate BDT 78 = US$ 1.00)

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
HIGH INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	1.0%	2.5%	5.0%	7.5%	10.0%	
No Insured Dairy Cattle	11 million dairy cattle	110,000	275,000	550,000	825,000	1,100,000	2,860,000
LOW SUM INSURED based on value of dairy cattle investment loan (US$)	US$ 200 (BDT 15,600) per adult cross-bred cow [3]	22,000,000	55,000,000	110,000,000	165,000,000	220,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	550,000	1,375,000	2,750,000	4,125,000	5,500,000	
Premium US$ Median Rate	5.00%	1,100,000	2,750,000	5,500,000	8,250,000	11,000,000	
Premium US$ High Rate	7.50%	1,650,000	4,125,000	8,250,000	12,375,000	16,500,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	275,000	687,500	1,375,000	2,062,500	2,750,000	7,150,000
A.2. Medium Premium rate	50%	550,000	1,375,000	2,750,000	4,125,000	5,500,000	14,300,000
A.3. High Premium Rate	50%	825,000	2,062,500	4,125,000	6,187,500	8,250,000	21,450,000
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	55,000	137,500	275,000	412,500	550,000	1,430,000
B. 4. Total Subsidies on Operating Costs		385,000	962,500	1,925,000	2,887,500	3,850,000	10,010,000
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		371,250	880,000	1,760,000	3,025,000	4,675,000	10,711,250
A.2. Medium Premium rate + B.4.		646,250	1,567,500	3,135,000	5,087,500	7,425,000	17,861,250
A.3. High Premium Rate +B.4.		921,250	2,255,000	4,510,000	7,150,000	10,175,000	25,011,250

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured for a cross breed adult dairy cow based on livestock investment loan of BDT 15,000 (US$ 200) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Table A3.4. Fiscal Analysis, LOW Insurance Penetration Rate and HIGH Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars[1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
LOW INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	0.25%	0.5%	1.0%	2.5%	5.0%	
No Insured Dairy Cattle	11 million dairy cattle	27,500	55,000	110,000	275,000	550,000	1,017,500
HIGH SUM INSURED based on market value of cross-bred dairy cow (US$)	US$ 350 (BDT 26,250) per adult cross-bred cow [3]	9,625,000	19,250,000	38,500,000	96,250,000	192,500,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	240,625	481,250	962,500	2,406,250	4,812,500	
Premium US$ Median Rate	5.00%	481,250	962,500	1,925,000	4,812,500	9,625,000	
Premium US$ High Rate	7.50%	721,875	1,443,750	2,887,500	7,218,750	14,437,500	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	120,313	240,625	481,250	1,203,125	2,406,250	4,451,563
A.2. Medium Premium rate	50%	240,625	481,250	962,500	2,406,250	4,812,500	8,903,125
A.3. High Premium Rate	50%	360,938	721,875	1,443,750	3,609,375	7,218,750	13,354,688
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	41,250	82,500	165,000	412,500	825,000	1,526,250
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	41,250	82,500	165,000	412,500	825,000	1,526,250
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	13,750	27,500	55,000	137,500	275,000	508,750
B. 4. Total Subsidies on Operating Costs		96,250	192,500	385,000	962,500	1,925,000	3,561,250
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		216,563	433,125	866,250	2,165,625	4,331,250	8,012,813
A.2. Medium Premium rate + B.4.		336,875	673,750	1,347,500	3,368,750	6,737,500	12,464,375
A.3. High Premium Rate +B.4.		457,188	914,375	1,828,750	4,571,875	9,143,750	16,915,938

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured based on market value for a cross breed adult dairy cow valued at BDT 26,250 (US$ 350) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Table A3.5. Fiscal Analysis, MEDIUM Insurance Penetration Rate and HIGH Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars[1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
MEDIUM INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	0.5%	1.0%	2.5%	5.0%	7.5%	
No Insured Dairy Cattle	11 million dairy cattle	55,000	110,000	275,000	550,000	825,000	1,815,000
HIGH SUM INSURED based on market value of cross-bred dairy cow (US$)	US$ 350 (BDT 26,250) per adult cross-bred cow [3]	19,250,000	38,500,000	96,250,000	192,500,000	288,750,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	481,250	962,500	2,406,250	4,812,500	7,218,750	
Premium US$ Median Rate	5.00%	962,500	1,925,000	4,812,500	9,625,000	14,437,500	
Premium US$ High Rate	7.50%	1,443,750	2,887,500	7,218,750	14,437,500	21,656,250	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	240,625	481,250	1,203,125	2,406,250	3,609,375	7,940,625
A.2. Medium Premium rate	50%	481,250	962,500	2,406,250	4,812,500	7,218,750	15,881,250
A.3. High Premium Rate	50%	721,875	1,443,750	3,609,375	7,218,750	10,828,125	23,821,875
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	82,500	165,000	412,500	825,000	1,237,500	2,722,500
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	27,500	55,000	137,500	275,000	412,500	907,500
B. 4. Total Subsidies on Operating Costs		192,500	385,000	962,500	1,925,000	2,887,500	6,352,500
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		336,875	673,750	1,588,125	3,368,750	5,534,375	11,501,875
A.2. Medium Premium rate + B.4.		577,500	1,155,000	2,791,250	5,775,000	9,143,750	19,442,500
A.3. High Premium Rate +B.4.		818,125	1,636,250	3,994,375	8,181,250	12,753,125	27,383,125

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured based on market value for a cross breed adult dairy cow valued at BDT 26,250 (US$ 350) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Table A3.6. Fiscal Analysis, HIGH Insurance Penetration Rate and HIGH Sum Insured Value per Cow

Bangladesh Livestock Insurance Fiscal costs in US Dollars [1]

Item	Unit Value	2016-17	2017-18	2018-19	2019-20	2020-21	Total
HIGH INSURANCE PENTRATION RATE (% of national dairy cattle herd)	11 million dairy cattle [2]	1.0%	2.5%	5.0%	7.5%	10.0%	
No Insured Dairy Cattle	11 million dairy cattle	110,000	275,000	550,000	825,000	1,100,000	2,860,000
HIGH SUM INSURED based on market value of cross-bred dairy cow (US$)	US$ 350 (BDT 26,250) per adult cross-bred cow [3]	38,500,000	96,250,000	192,500,000	288,750,000	385,000,000	
Premium projections:[4]							
Premium US$ Low Rate	2.50%	962,500	2,406,250	4,812,500	7,218,750	9,625,000	
Premium US$ Median Rate	5.00%	1,925,000	4,812,500	9,625,000	14,437,500	19,250,000	
Premium US$ High Rate	7.50%	2,887,500	7,218,750	14,437,500	21,656,250	28,875,000	
Fiscal Costs to Government							
A) Premium Subsidies (50% paid by GOB)							
A.1. Low Premium Rate	50%	481,250	1,203,125	2,406,250	3,609,375	4,812,500	12,512,500
A.2. Medium Premium rate	50%	962,500	2,406,250	4,812,500	7,218,750	9,625,000	25,025,000
A.3. High Premium Rate	50%	1,443,750	3,609,375	7,218,750	10,828,125	14,437,500	37,537,500
B) Subsidies on Livestock Insurance Administration and Operating costs (100% paid by GOB)							
B.1. Costs of Tagging / Registration [5]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.2. Costs of Pre-inspections [6]	US$ 1.50/ animal	165,000	412,500	825,000	1,237,500	1,650,000	4,290,000
B.3. Awareness creation and eduction [7]	US$ 0.50/ animal	55,000	137,500	275,000	412,500	550,000	1,430,000
B. 4. Total Subsidies on Operating Costs		385,000	962,500	1,925,000	2,887,500	3,850,000	10,010,000
Total Costs of Premium Subsides and Operating Cost Subsidies per Year							
A.1. Low Premium Rate + B.4.		577,500	1,395,625	2,791,250	4,571,875	6,737,500	16,073,750
A.2. Medium Premium rate + B.4.		1,058,750	2,598,750	5,197,500	8,181,250	11,550,000	28,586,250
A.3. High Premium Rate +B.4.		1,540,000	3,801,875	7,603,750	11,790,625	16,362,500	41,098,750

Assumptions:

[1] Exchange rate of BDT 75 = US$ 1.00 used in this analysis

[2] Dairy Cattle Insurance Uptake rate to be reviewed and confirmed with SDL

[3] Average Sum Insured based on market value for a cross breed adult dairy cow valued at BDT 26,250 (US$ 350) per cow

[4] Premium rates based on international experience and will need confirmation for Bangladesh

[5] Costs of Tagging and Registration per cow will need to be confimed by SDL

[6] Costs of Tagging and Registration per cow will need to be confimed by SDL and Private sector veterinarians

[7] Costs of Livetsock Insurance awareness creation, eduction and training to be confirmed by Insurers and SDL and Agents

Annex 4. Summary of Modelling and Simulations of Welfare Analysis for Crop Insurance

A. A simple economic model

1. Net income from crop production

Consider a one-period model of an average household from one of the four farm-size groups i (marginal, small, medium, and large) in each of the two key rice production zones in the country. An average household owns medium farm size A_i acres and grows two crops per year with crop yield derived in each crop season described as y_i^c kilograms per acre, where can be aman local or aman HYV in the Kharif season and boro HYV or boro hybrid in the Rabi season. This average household is resource constrained and so needs to take out loan L^c at the beginning of each cropping season to afford all the required minimum cash input costs (excluding family labor and rental cost for own land) for each crop c at the average interest rates r_i observed empirically for different farm-size groups. The household then pays back with crop income earned at the end of each harvest season.

The household's net crop income available for consumption each year can thus be written as

$$C_i = \sum_c (y_i^c p^c - (1 + r_i)L^c) \times A_i,$$

where p^c is the ongoing crop price per kilogram and the summation is across the chosen two crops in the two cropping seasons. The net crop income available for consumption is then used as welfare indicator in this simple model.

2. Crop production risk

Both crop price and yield are uncertain. Crop prices p^c are assumed to follow a normal distributionCrop production also faces various kinds of risk, including both farm-specific risk, e.g., disease or illness of farm labor, as well as the covariate risk, e.g., droughts and floods that tend to affect all farmers in the area. With the presence of common covariate shocks, we should thus expect (1) individual crop yields to track area average yields in their area to some extent and (2) average crop yields of different crops to be correlated to some extent.

Area average crop yields and prices at sub-district level. In order to understand this empirical relationship, we first describe joint distribution of subdistrict yields of all the crops (y_s^c)and the crop prices p^c with a multivariate normal distribution:

$$f\left(y_s^{Al}, y_s^{Ahy}, y_s^{Bhy}, y_s^{Bhb}, p^{Al}, p^{Ahy}, p^{Bhy}, p^{Bhb}\right) \sim N(\mu_{y,p}^c, \sigma_{y,p}^c)$$

Here Al = aman local, Ahy = aman HYV, Bhy = boro HYV, and Bhb = boro hybrid; $\mu_{y,p}^c$ is a matrix of long-term mean; and $\sigma_{y,p}^c$ is a variance-covariance matrix of these crop yields and prices, which captures information on long-term standard deviations and correlation structures of these crop yields and prices.

Household-level crop yields. The relationship between household-level crop yields and subdistrict crop yields can be described as

$$y_i^c = \delta_i y_s^c, \text{ where } \delta_i \sim N(1, \sigma_{\delta_i}),$$

and δ_i is a farm-size group-specific coefficient that describe how well the individual crop yields co-move with the subdistrict crop yields with the mean of 1 and standard deviation of σ_{δ_i}. In the areas with large exposure to common covariate shocks, we should expect individual yields to move together with the area-averaged yield. On the other hand, when farm-specific shocks dominate the covariate shocks, δ_i will deviate largely from 1 and so σ_{δ_i} could be large. For simplicity, assume that δ_i is the same across different crops for each farm-size group.

3. **Loan repayment**

Input credit is obtained at the interest rates r_i. In the optimistic case, the average household should try to pay back the loan as much as possible using the realized crop income at the end of each crop season. Loan default is however possible and can be partial or total. While full repayment is an option, we more realistically assume that farmers will try to pay back their loans as much as they can after meeting their subsistent consumption $\bar{c}$.[85] An average households, loan repayment at the end of the year will be

$$LR_i = \left(\sum_c (1+r_i)L^c \times A_i, \sum_c (y_i^c p^c - (1+r_i)L^c) \times A_i - \bar{c}\right).$$

4. **Area yield index insurance**

AYII payouts. We consider AYII contracts for aman HYV, boro HYV and boro hybrid. Each AYII contract is designed to protect farmers from covariate shocks that could affect all farmers in the area and that are not effectively managed by existing "mutual risk-sharing mechanisms" within the community. Specifically, AYII compensates insured farmer at an expected crop price p per kilogram when area-average (subdistrict) yield y_s^c falls below a prespecified coverage level y^* Indemnity payout per insured acre of each insured crop c can thus be written as

$$\pi^c = \max[0, y^* - y_s^c] \times p^c,$$

where the coverage level is set as some percentage of the expected area yield, i.e., $y^* = coverage \times \mu_{y_c^s}$.

Actuarial fair premium per insured acre for this contract is equal to the expected indemnity payout. Insurance company will however add some premium multiple $x > 1$ to the commercial premium to cover other fixed administrative costs. Total premium per insured acre for AYII on crop c can be written as

$$\rho^c = xE(\pi^c).$$

With AYII offering protection of total crop income shortfall, farmer's insured net crop income available for consumption can thus be rewritten as

$$C_i^{Yinsured} = \sum_c (y_i^c p^c - (1+r_i)L^c + \pi^c - \rho^c) \times A_i.$$

We note that this analysis assumes away the optimal insurance coverage decision of farmers, given that information to calibrate utility function (e.g., risk and time preferences, etc.) is not available.

Basis risk. Note that insurance is written on subdistrict yields, not individual yields. While this resolves asymmetric information and reduces transaction cost, it also could limit the value of insurance to individual farmers with the presence of basis risk—when indemnity payment deviates from individual losses. The value to farmers will thus depend on the how closely individual yield tracks that of area average. AYII will be valuable to farmer as $\delta_i \to 1$.

5. **Potential values of AYII**

Value to farmers, AYII could reduce crop income variability by providing compensation to buffer against sharp drop of net crop income available for consumption in the event of severe shocks.

85 This should capture the important feature from reality that farmers will not give away everything in order to repay the loans. They would rather satisfy their basic needs before relaying any loan.

Value to lenders. Based on our assumption that households will try to pay back loan after meeting required consumption, AYII will increase loan repayment rate on average. To make this assumption more realistic, lenders can make insurance a prerequisite for obtaining loan and/or link insurance with loan directly. With increasing loan repayment, lenders could eventually be willing to extend more credit to farmers.

Potential crowding in value of AYII through credit market. In the medium term, insurance could potentially unlock access to formal credit market for famers and so could potentially enhance farmers' agricultural productivity and crop incomes in at least two ways:

- ***AYII crowding in cheaper credit to existing technology.*** If formal financial institutions consider lending to farmers who at least have insurance coverage for their loan, this could substantially lower cost of credit for (especially) smallholder farmers— bringing it down from current high rates, mainly from informal institutions, at r_i, to the lower bank rate r. Household i's net income available for consumption when household purchases AYII coverage for input loan and can obtain input credit from formal financial institutions at cheaper interest rate r can be written as

$$C_i^{Linsured} = \sum_c (y_i^c p^c - (1+r)L^c + (\pi^c - \rho^c)(1+r)L^c) \times A_i.$$

- ***AYII crowding in adoption of better technology.*** If AYII could relax demand-side constraint (i.e., enhancing farmers' investment incentives and credit demand when agricultural production is de-risked) as well as supply-side constraint (i.e., allow lenders to increase credit supply to farmers who at least purchase insurance coverage for their loan), AYII could promote smallholder farmers' adoption of high-yielding technology, e.g., aman HYV for the current aman local producers, or other technology that results in large yield gap but requires expensive input costs, e.g., boro hybrid. Household i's net income available for consumption when household purchases AYII coverage for input loan and obtains input credit from formal financial institutions at cheaper interest rate r to invest in better production technology $chigh$ can be written as

$$C_i^{Linsuredhigh} = \sum_{chigh} (y_i^{chigh} p^{chigh} - (1+r)L^{chigh} + (\pi^{chigh} - \rho^{chigh})(1+r)L^{chigh}) \times A_i,$$

where y_i^{chigh} and p^{chigh} represent individual yields and prices of high-yielding technology, L^{chigh} is the required loan for input costs of high-yielding technology, and π^{chigh} and p^{chigh} are insurance payout and commercial premium rates of AYII contract for the high-yielding crop production.

6. Public supports to AYII

Subsidized AYII. For simplicity, this analysis considers a simple form of public support through insurance premium subsidy, which could result in $s\ percent$ reduction in commercial insurance premium rate for some insurable interest for I_i^c each crop, which could be cover some or part of crop production or input loans. Total expected public cost per household i is thus

$$S_i = \sum_c s\rho^c I_i^c.$$

The model simulates the potential impacts of subsidized AYII at the same expected public cost as the existing post-disaster relief program for farmers.

Existing post-disaster relief program for farmers. We model an optimistic post-disaster relief payment to household i living in subdistrict s based on subdistrict crop yield for each cropping season such that

$$R_s^c = \begin{cases} (y^* - y_s^c) \times R & if\ \ y^{**} \le y_s^c < y^* \\ R & if\ \ y_s^c < y^{**} \end{cases}.$$

Here R represents the maximum compensation that government can provide in extreme bad years, including (1) post-disaster food aid (similar to VGF or gratuitous relief), which could possibly be provided in the amount of up to 20 kilograms of grain monthly for up to six months (total of up to US$76.29 per households with two beneficiaries) in bad years; and (2) input supports, which could again possibly be provided for up to 25% input costs (including seeds, insecticides, and irrigations) in bad years, capped at 2 acres of operating lands. Here y^* is the level of subdistrict yields that triggers relief compensation, and y^{**} is the level of subdistrict yield below which relief triggers maximum compensation. The modelled relief program is thus rather very optimistic, as it does not take into account the current empirical issues of delay and unreliability of the existing program (World Bank 2013b), which could make the program even less effective in buffering income losses.

B. Calibrating economic model with actual data

1. Household parameters

Statistics from the farm-level rural household survey data in the 2011–2012 Bangladesh Integrated Household Survey (BIHS) (IFPRI 2011) are used to calibrate median farm sizes (A_i), current interest rates faced (r_i), and the ongoing bank interest rate (r) according to Table A4.1. The BIHS is nationally representative of rural households, with sample size of 6,500 households sampled randomly from 325 sampling units (villages) across the country. The survey includes detailed plot-level agricultural production and practices and various welfare indicators (IFPRI 2013).

2. Crop production

We first obtained cleaned and de-trended subdistrict yield data on aman local, aman HYV, and boro HYV for all subdistricts in Bogra, Pabna, and Dinajpur from the World Bank (2010) study, which were obtained directly from BBS for 1992–2008. We then complement this with cleaned and de-trended district yield data obtained from BBS for all current crops plus boro hybrid for 2007–2012.

Crop production zone. We then complement these with statistics from Bangladesh Agricultural Research Council's suitable crop production zone, which identify at subdistrict level the growing areas that are "very suitable," "suitable," "moderately suitable," "marginally suitable," and "not suitable." We use these statistics to first perform simple classification of rice production into two distinct rice production zones such that (1) the high-potential rice production zone includes subdistricts with more than 60% of areas very suitable for aman and boro (9 out of 11 subdistricts in Bogra, all subdistricts in Pabna, and 2 out of 13 districts in Dinajpur), and (2) the medium-potential rice production zone with 30–60% of areas very suitable for and more than 50% of areas suitable for aman-boro (the rest of the subdistricts, especially in Dinajpur). Overall, the high-potential zone occupies 31% of total rice-growing areas while the medium-potential zone occupies comparable 48% of total rice-growing areas.

Yield and price distributions. The mean and standard deviation of subdistrict yield in each zone is calibrated with 1992–2008 subdistrict yield data of the subdistricts in each of the two zones (for aman local, aman HYV, and boro HYV) and 2007–2012 district-level yield data (for boro hybrid).[86] The correlation structure of these yield data and prices is calibrated using 2007–2012 district-level yield of all crops matched with aggregate level crop prices obtained from the FAO Food Security Portal in the same periods. Coefficient of individual crop yield is estimated using variations of yields across households in 2011 based on BIHS household-level yield data.[87]

86 One potential caveat to our yield calibration is that there could be trends and event shifts in yield data from the years before and after 2007, which the study does not take into account.

87 We note the potential limitation of this estimated household yield parameter with limited temporal observations. The distributions of household coefficients vary slightly across farm-size groups and zones, but the mean and variance comparison tests imply that these differences are not significant at 95 percent confidence interval. Also for simplicity's sake, we assume that the distribution is similar across groups and zones.

Cost of production for each production technology (and so input loans). This cost is estimated using farm-level production data obtained from BIHS. These estimated costs matched well with the gross margin study by IRRI (2014). The table below presents the summary of our calibrated data.

Crop varieties	Aman Local	Aman HYV	Boro HYV	Boro Hybrid
District Yield (Kg/Acre)*				
- High potential zone: Mean	610.04	1130.07	1597.63	2121.80
SD	219.60	350.32	351.48	509.23
- Medium potential zone: Mean	600.84	1169.81	1554.91	2039.53
SD	288.40	456.23	450.92	693.44
Household Yield***				
Mean correlation parameter with sub-district yield	1.00	1.00	1.00	1.00
SD	0.40	0.40	0.40	0.40
Crop price ($ per kg)******				
Mean	$0.42	$0.42	$0.42	$0.42
SD	$0.06	$0.06	$0.06	$0.06
Cost of production***				
Cash cost per Acre ($ per Acre)**********	$134.73	$163.58	$261.82	$343.82

* Bangladesh Bureau of Statistics, 2007-2012
** Bangladesh Bureau of Statistics, 1992-2012 in all sub-districts in Bogra, Dinajpur and Pabna districts.
*** IFPRI Bangladesh Integrated Household Survey 2011-2012, IRRI CSISA Bangladesh Technical Report (2014)
****FAO Food Security Portal
***** This excludes land rental, family labor costs and interest cost on working capital.
Exchange rate = Taka 75.45/$ (September, 2011).

3. **Area yield index insurance**

Premium multiple. Following a common rule of thumb in the industry, $x = 1.5$.

Coverage level and commercial premium rates. These are presented in the table below.

Crop-zone	High coverage (Maximum 7.5%)		Low coverage (Maximum 5%)	
	Coverage level	Commercial Premium	Coverage level	Commercial Premium
Aman HYV - High potential rice	85%	6.3%	80%	4.8%
Aman HYV - Med. potential rice	80%	7.5%	70%	4.9%
Boro HYV - High potential rice	90%	6.4%	90%	4.7%
Boro HYV - Med. potential rice	85%	7.2%	80%	4.2%
Boro Hybrid - High potential rice	90%	7.2%	80%	4.2%
Boro Hybrid - Med. potential rice	85%	7.3%	75%	4.6%

4. **Post-disaster relief for farmers and public supports to AYII**

Maximum possible compensation in bad years. Empirical evidence of the government of Bangladesh's existing post-disaster relief for farmers is obtained from World Bank (2013). We calibrate R = 25% of costs of production of up to 2 acres plus US$79.30 of food aid similar to VGF or gratuitous relief (20 kilograms of grain per beneficiary at Tk 23.88 for a household with two beneficiaries). This results in maximum compensation per year and expected budget cost/household/year as shown in the table below:

	Aman local - Boro HYV	Aman HYV - Boro HYV	Aman local - Boro HYV	Aman HYV - Boro HYV
Maximum possible relief				
Marginal farmers	$82	$101	$80	$101
Small farmers	$164	$203	$160	$203
Medium farmers	$328	$406	$321	$405
Large farmers	$326	$403	$319	$403
Expected public cost/household/year				
Marginal farmers	$7	$9	$11	$14
Small farmers	$13	$16	$21	$26
Medium farmers	$26	$32	$42	$51
Large farmers	$26	$32	$42	$51

Triggers of disaster relief. Relief is triggered when $y^* = 80\%$ and $y^{**} = 30\%$.

Subsidy to AYII. The public subsidy rates to AYII on input loan in each season at the total cost equivalent to the expected post-disaster relief cost are in the table below. The public subsidy rates to AYII on all crop production in each season are 40% of the current rates for AYII on input loan only. As this analysis assumes away farmers' optimal insurance coverage decision, the estimated subsidy rates are thus based on the assumption that the chosen AYII coverage level remains the same.

High coverage	Subsidy rate (% of commercial premium rate) equivalent to cost of disaster relief		
	Marginal	Small-Medium	Large
Aman HYV - High potential rice	100.0%	37%	18%
Aman HYV - Med. potential rice	100.0%	62%	31%
Boro HYV - High potential rice	100.0%	44%	22%
Boro HYV - Med. potential rice	100.0%	72%	36%
Boro Hybrid - High potential rice	100.0%	41%	20%
Boro Hybrid - Med. potential rice	100.0%	68%	34%
Low coverage			
Aman HYV - High potential rice	100.0%	57%	28%
Aman HYV - Med. potential rice	100.0%	100%	53%
Boro HYV - High potential rice	100.0%	58%	29%
Boro HYV - Med. potential rice	100.0%	99%	50%
Boro Hybrid - High potential rice	100.0%	57%	28%
Boro Hybrid - Med. potential rice	100.0%	98%	50%

C. Simulations

We took the following steps to simulate key outcome indicators based on the calibrated parameters.

1. We simulate 1,000 years of district-level yield from all crops and their prices for average households in each of the four farm-size groups and in each of the two production zones from a multivariate normal distribution based on the calibrated means and variance-covariate matrix of subdistrict crop yields and prices using @Risk.
2. For each annual realization of simulated subdistrict yields, we draw 1,000 replicates of individual household parameters, again using @Risk. Note that the calibrated mean and standard deviation is similar across groups and crops.

3. We can then generate 1,000 years of household-level yield data from all crops for 1,000 replicates of average household in each of the four farm- size groups in each zone based on the simulated subdistrict yields and household parameters.
4. Using all the simulated data, we can then simply generate 1,000 years of AYII and disaster relief payouts, as well as all the welfare indicators with and without insurance and across contract variations, for 1,000 replicates of average household in each group and zone.

Table A4.1. Summary Statistics of Rice-Growing Households

Group of agricultural households	Marginal	Small	Medium	Large	Overall
Socioeconomics					
Share in total rural households	36%	45%	12%	7%	100%
Share in total crop lands	10%	38%	22%	31%	100%
Agricultural land range (Acres)	< 0.5	0.5-1.49	1.5-2.5	>2.5	
Median agricultural land (Acres)	0.23	0.91	1.90	4.18	1.06
Household size (person)	5.00	4.70	4.60	4.50	4.70
Agricultural production and income					
Consumption expenditure ($/year/hh)	$1,467.73	$2,340.72	$2,864.42	$5,297.81	$2,301.89
Poverty headcount ($1.25/day)	71%	36%	14%	7%	43%
% Grow Aman HYV	83%	89%	92%	88%	87%
% Grow Boro HYV	95%	93%	94%	93%	94%
% Grow Boro Hybrid	6%	11%	12%	16%	9%
% Grow Auz HYV	65%	89%	81%	79%	79%
% irrigated cropped land	65%	64%	61%	65%	64%
% Crop income in total income	12%	33%	53%	60%	30%
Livestock asset					
Bullock	0.40	0.50	0.50	0.50	0.50
Milk cows	0.40	0.50	0.70	0.60	0.50
Goats	0.40	0.50	0.50	0.30	0.60
Poulty	4.10	5.20	8.30	8.20	6.00
Access to credit					
% with no credit	33%	26%	34%	17%	29%
Avg Loan size/hh	$326.76	$320.82	$348.51	$1,230.13	$392.75
% Loan size from banks/MFIs	0%	25%	35%	17%	17%
% Loan size from informal institutions	100%	75%	65%	83%	83%
Sources of credit					
Friends and relatives	25%	24%	25%	30%	26%
Bangladesh Krishi Bank	3%	4%	1%	10%	5%
Rajshashi Krishi bank	0%	1%	0%	1%	1%
Other banks and MFIs	12%	11%	14%	15%	13%
NGOs	37%	35%	28%	23%	34%
Money lenders, traders	13%	11%	15%	6%	10%
Others	9%	14%	18%	15%	11%
Interest rates by loan source					
Friends and relatives	9%	9%	7%	5%	8%
Public banks	12%	12%	12%	12%	11%

Group of agricultural households	Marginal	Small	Medium	Large	Overall
Other banks	13%	13%	13%	13%	13%
MFIs	16%	12%	8%	11%	14%
NGOs	15%	14%	14%	14%	14%
Money lenders, traders	71%	66%	56%	47%	63%
Avg interest costs from all loans (% annual)	30%	23%	23%	19%	25%

Table A4.2. Summary of Key Simulated Impacts of Commercial AYII

IMPACTS OF COMMERCIAL AYII		Δ expected income (normal year)		Expected reduction in income shortfalls (1-in-10 bad year)	
Production zone		High potential rice zone	Med potential rice zone	High potential rice zone	Med potential rice zone
Marginal farmers	Expected crop income and shortfalls	$165	$175	-55%	-60%
	Commercial AYII	-14%	-14%	9%	6%
	AYII crowding in cheap loan for existing technology	-6%	-8%	18%	13%
	AYII crowding in adoption of Aman HYV	32%	35%	44%	40%
	AYII crowding in adoption of Boro Hybrid	11%	9%	30%	11%
Small farmers	Expected crop income and shortfalls	$725	$750	-48%	-60%
	Commercial AYII	-10%	-14%	10%	9%
	AYII crowding in cheap loan for existing technology	-7%	-9%	13%	11%
	AYII crowding in adoption of Aman HYV	30%	32%	41%	40%
	AYII crowding in adoption of Boro Hybrid	11%	7%	24%	12%
Medium farmers	Expected crop income and shortfalls	$1,432	$1,444	-50%	-58%
	Commercial AYII	-9%	-11%	9%	8%
	AYII crowding in cheap loan for existing technology	-7%	-9%	13%	11%
	AYII crowding in adoption of Aman HYV	30%	32%	41%	40%
	AYII crowding in adoption of Boro Hybrid	11%	7%	24%	11%

IMPACTS OF COMMERCIAL AYII		Δ expected income (normal year)		Expected reduction in income shortfalls (1-in-10 bad year)	
Production zone		High potential rice zone	Med potential rice zone	High potential rice zone	Med potential rice zone
Large farmers	Expected crop income and shortfalls	$3,169	$3,177	-49%	-60%
	Commercial AYII	-8%	-10%	9%	8%
	AYII crowding in cheap loan for existing technology	-8%	-9%	12%	9%
	AYII crowding in adoption of Aman HYV	24%	29%	34%	38%
	AYII crowding in adoption of Boro Hybrid	10%	6%	22%	11%

Table A4.3. Summary of Simulated Impacts on Loan Repayment Rates of the Lending Portfolio to the Two Key Rice Production Zones

	Subsistent consumption = 50% food poverty line			Subsistent consumption = 80% food poverty line		
	Overall average	Expected rate in 1-in-5 bad years	Expected rate in 1-in-10 bad years	Overall average	Expected rate in 1-in-5 bad years	Expected rate in 1-in-10 bad years
No AYII	91%	72%	53%	66%	44%	33%
Commercial AYII	94%	72%	73%	71%	44%	39%
Commercial AYII crowding in cheap loan	96%	74%	74%	72%	46%	40%
Commercial AYII crowding in cheap loan and adoption Aman HYV	99%	98%	88%	78%	65%	49%
Commercial AYII crowding in cheap loan and adoption Boro Hybrid	99%	98%	88%	78%	65%	49%
Disaster relief	94%	73%	73%	72%	46%	41%
Subsidized AYII	96%	73%	81%	75%	46%	45%
Subsidized AYII crowding in cheap loan	98%	83%	78%	78%	53%	48%
Subsidized AYII crowding in cheap loan and adoption Aman HYV	99%	98%	92%	82%	72%	65%
Subsidized AYII crowding in cheap loan and adoption Boro Hybrid	99%	98%	92%	82%	72%	65%

Note: Since the gross crop income of marginal households is already well below even 30% of the food poverty line and crop income only make 12 percent of total economic income. We assume for simplicity that for members of this group, the subsistent consumption is set at 30% and 50% of their expected net crop income.

Table A4.4. Summary of Key Simulated Impacts of Public Supports to AYII

IMPACTS OF GOVERNMENT SUPPORTS		Δ expected income (normal year)		Expected reduction in income shortfalls (1-in-10 bad year)	
Production zone		High potential rice zone	Med potential rice zone	High potential rice zone	Med potential rice zone
Marginal farmers	Total public cost ($/household)	$9	$14	$9	$14
	Disaster relief	0%	0%	15%	26%
	Subsidized AYII	-6%	-1%	26%	27%
	Subsidized AYII crowding in cheap loan for existing technology	2%	7%	29%	27%
	Subsidized AYII crowding in adoption of Aman HYV	42%	52%	58%	65%
	Subsidized AYII crowding in adoption of Boro Hybrid	30%	34%	21%	20%
Small farmers	Total public cost ($/household)	$16	$26	$16	$26
	Disaster relief	0%	0%	6%	11%
	Subsidized AYII	-7%	-4%	18%	17%
	Subsidized AYII crowding in cheap loan for existing technology	0%	0%	18%	17%
	Subsidized AYII crowding in adoption of Aman HYV	30%	36%	43%	46%
	Subsidized AYII crowding in adoption of Boro Hybrid	18%	20%	17%	4%
Medium farmers	Total public cost ($/household)	$32	$51	$32	$51
	Disaster relief	0%	0%	6%	8%
	Subsidized AYII	-7%	-6%	19%	16%
	Subsidized AYII crowding in cheap loan for existing technology	0%	0%	20%	16%
	Subsidized AYII crowding in adoption of Aman HYV	32%	41%	39%	51%
	Subsidized AYII crowding in adoption of Boro Hybrid	20%	24%	14%	5%
Large farmers	Total public cost ($/household)	$32	$51	$32	$51
	Disaster relief	0%	0%	5%	4%
	Subsidized AYII	-9%	-7%	18%	16%
	Subsidized AYII crowding in cheap loan for existing technology	-3%	-2%	18%	16%
	Subsidized AYII crowding in adoption of Aman HYV	26%	30%	42%	40%
	Subsidized AYII crowding in adoption of Boro Hybrid	17%	23%	11%	3%
IMPACTS PER $1 OF GOVERNMENT SUPPORTS		**$ Δ expected income (normal year)/$ budget cost**		**$ reduction in income shortfalls in bad 1-in-10 year/$ budget cost**	
Marginal farmers	Disaster relief	$0	$0	$3	$3
	Subsidized AYII	-$1	$0	$5	$4
	Subsidized AYII crowding in cheap loan for existing technology	$0	$1	$5	$4

IMPACTS OF GOVERNMENT SUPPORTS		Δ expected income (normal year)		Expected reduction in income shortfalls (1-in-10 bad year)	
Production zone		High potential rice zone	Med potential rice zone	High potential rice zone	Med potential rice zone
	Subsidized AYII crowding in adoption of Aman HYV	$8	$7	$7	$6
	Subsidized AYII crowding in adoption of Boro Hybrid	$6	$4	$4	$2
Small farmers	Disaster relief	$0	$0	$3	$3
	Subsidized AYII	-$2	-$3	$7	$5
	Subsidized AYII crowding in cheap loan for existing technology	$0	$0	$8	$5
	Subsidized AYII crowding in adoption of Aman HYV	$16	$11	$13	$10
	Subsidized AYII crowding in adoption of Boro Hybrid	$8	$6	$8	$1
Medium farmers	Disaster relief	$0	$0	$3	$2
	Subsidized AYII	-$3	-$3	$8	$5
	Subsidized AYII crowding in cheap loan for existing technology	$0	$0	$9	$4
	Subsidized AYII crowding in adoption of Aman HYV	$15	$11	$13	$10
	Subsidized AYII crowding in adoption of Boro Hybrid	$9	$7	$6	$1
Large farmers	Disaster relief	$0	$0	$1	$2
	Subsidized AYII	-$7	-$6	$18	$10
	Subsidized AYII crowding in cheap loan for existing technology	-$4	-$3	$18	$10
	Subsidized AYII crowding in adoption of Aman HYV	$32	$23	$26	$17
	Subsidized AYII crowding in adoption of Boro Hybrid	$18	$14	$11	$2

Annex 5. Summary of Modelling and Simulations of Welfare Analysis for Fully Susidized Flood Index Insurance for the Poorest

A. A dynamic household model

1. Two types of assets

Consider a dynamic model of heterogeneous households living in a flood-prone char region. These households are endowed with a heterogeneous combination of two types of initial endowments: physical asset (A_{i0}, L_{i0}) and human capital (H_{i0}). Physical asset includes owned land and total values of livestock and productive agricultural assets necessary as key inputs in income generation. Human capital, for simplicity, reflects health and nutritional status that are also necessary for income-generating activity. Human capital in any period t (H_{it}) ranges from 0 (highly malnourished and not physically able to work) to 1 (healthy and physically able to work). The inclusion of human capital in this model thus captures consumption-productivity linkages that actually exist in Bangladesh. While land ownership is fixed, households accumulate productive assets and human capital over time. The two-asset accumulation model thus allows us to elicit patterns of households' physical and human capital accumulation in the face of income shocks.

2. Income and income risk

In any period t, a representative household in the flood-prone char region derives income from at least two key sources: subsistent crop (mainly aman rice) and livestock production and wage labor. And two assets complement each other in a household's income generation according to

$$y = \theta_{it} y(A_{it}, L_{i0}, H_{it}) = \theta_{it} H_{it}(f(A_{it}, L_{i0}) + w),$$

where $f(A_{it}, L_{i0})$ represents income from subsistent crop and livestock production using physical asset (A_{it}) and endowed land and (L_{i0}) represents average subsistent wage. Human capital $(0 \leq H_{it} \leq 1)$ that directly represents capacity of family members to produce income thus affects total productivity as well as productivity of physical asset in income generation. And $\theta_{it} \geq 0$ reflects an income shock that affects total household's economic income.

3. Household utility maximization problem

Each period , representative household derives utility from consumption and chooses the optimal level of consumption (c_{it}), which can be financed by total economic income, selling off (offtaking) physical asset (o_{it}), or borrowing (b_{it}) at an ongoing (high) interest rate r. The household's intertemporal decision thus involves maximizing the present value of its utility over an infinite horizon with a fixed discount parameter β according to

$$\max_{c_{it}} E \sum_{t=0}^{\infty} \beta^t u(c_{it}) \text{ subjected to } c_{it} \leq \theta_{it} y(A_{it}, L_{i0}, H_{it}) + o_{it} + b_{it}$$
$$b_{it} \leq A_{it}, o_{it} \leq A_{it}.$$

The model reflects the reality of constraints on vulnerable households for borrowing and selling off asset such that in each period t, household can borrow and sell off asset up to the value of physical asset in that period.

4. Asset and human capital accumulation

Over time, physical asset (net offtake $o_{it} \leq A_{it}$) is accumulated to the next period with an average growth rate g and could be deteriorated by asset shock $(0 \leq \theta^A_{it+1} < 1)$. The next period asset needs to further net out borrowing from the last period according to

$$A_{it+1} = \left(1 + g - \theta^A_{it+1}\right)(A_{it} - o_{it}) - (1 + r) b_{it}.$$

Selling off asset (o_{it}) or borrowing (b_{it}) to finance current consumption thus directly affects physical asset accumulation.

The linkage of consumption and productivity is reflected in the human capital accumulation, where consumption directly contributes to the intertemporal accumulation of human capital according to

$$H_{it+1} = \begin{cases} 0 & if \quad c_{it} < \underline{c} \\ (1 - x_1)H_{it} & if \quad \underline{c} \leq c_{it} < \bar{c} \\ \min[(1 + x_2)H_{it}, 1] & if \quad c_{it} \geq \bar{c}, \end{cases}$$

where $0 < x_1, x_2 < 1$. $\underline{c}$ reflectsthe minimum subsistent level of nutrition below which household can experience irreversible destruction in physical condition, e.g., the possibility of losing labor power through either ill health or death. We calibrate $\underline{c}$ empirically at the level of the food poverty line (70% of upper poverty line). $\bar{c}$ is the minimum required consumption bundle necessary to sustain a physically healthy condition, calibrated empirically at the level of the upper poverty line (reflecting the total expenditure needs to obtain required calories and other needs per day). Household with consumption below $\bar{c}$ thus could still be subjected to severe physical health problems, which could be hard or slow to reverse. Sustaining consumption at least at $\bar{c}$ could allow household to enjoy healthy condition with maximum physical capacity (i.e., $Ht = 1$) or could over time slowly improve the household's health status toward the maximum physical capacity. The functional form also reflects the reality that increasing nutritional consumption does not quickly contribute one to one to improving nutritional status.

Critically low current consumption thus implies not only low current utility, but also the prospect of utility losses in the future through this consumption–productivity linkage.[88] All households would try to avoid falling below minimum subsistent $\underline{c}$ and try to reach $\underline{c}$ to sustain healthy economic life. But it is still possible that some households could fall below $\bar{c}$ especially when shocks affects income and they reach limits in selling off assets and borrowing.

5. Shocks, coping and welfare impacts

A vulnerable household faces income shock such that

$$\theta_{it} = \varepsilon_{it} - \theta(F_t),$$

where shock can be disaggregated into (1) idiosyncratic factors $\varepsilon_{it} \sim [\mu^{\varepsilon}, \sigma^{\varepsilon}]$ capturing those shocks that affect household only, such as health problems during the work season or localized climate events, and (2) income losses from covariate flood $\theta(F_t) \sim [\mu^{\theta(F_t)}, \sigma^{\theta(F_t)}]$. $\theta(\cdot)$ is some function that translates objective-measure village-level flood index (F_t) into some level of income losses. We note that $\mu^{\varepsilon} - \mu^{\theta(F_t)} = 1$.

Household also faces asset shock such that

$$\theta^A_{it} = \gamma_{it} + \theta^A(F_t),$$

where shocks include both idiosyncratic $\gamma_{it} \sim [\mu^{\gamma}, \sigma^{\gamma}]$ and covariate floodwith $\theta(\cdot)$ as some function that translates objective-measure flood index into some level of asset losses with $\theta^A(F_t) \sim \left[\mu^{\theta(F_t)}, \sigma^{\theta(F_t)}\right]$.

Shocks thus directly affect household welfare by affecting current economic income and physical asset. Shocks can indirectly affect household through destructive coping strategies to finance minimum necessary consumption. While the shock impact on current income can be regarded as a short-term effect, a shock can have long-term welfare consequences when it destroys physical assets and induces households to sell off assets and/or borrow to finance consumption,

88 The importance of subsistent consumption has been noted in many empirical and theoretical works in economics. (Baudoin 1975; Dasgupta 1997; Dercon 1998; Glomm and Palumbo 1993; Menezes et al. 1980; Platteau 1991; Dre`ze and Sen 1989).

both of which create downward pressure on asset accumulation and so future income. When household reaches borrowing and asset offtaking limit, it may be forced to reduce consumption below the necessary level $\bar{c}$ or even below minimum subsistent $\underline{c}$, both of which further cause long-term and/or irreversible damage to human capital and future income.

6. Existing social safety net protection programs

The model considers two general types of safety net programs available for the poor in risk-prone regions of the country.

Food or cash transfer programs. These transfer food and/or cash directly or in exchange for labor work (e.g., vulnerable group feeding program, vulnerable group development Program, the workfare program under Char Livelihoods Programme) to the poorest targeted based on a unified targeting system being developed by the government of Bangladesh using PMT-based poverty ranking database of poor households. For simplicity, we assume a perfect targeting system such that the amount of transfer to each household is just enough to lift the poor up to the poverty line and so allow them to consume the minimum required nutrition necessary for building working life. In each period , the total budget SP_t^T can constantly lift N^T poorest households ranked by PMT out of poverty, and so we write in any period t

$$SP_{it}^T = \begin{cases} \bar{c} - c_{it} & if\ PMT_{it} \le PMT^{N^T} \\ 0 & if\ \ PMT_{it} > PMT^{N^T} \end{cases}, \qquad SP_t^T = \sum_{i=1}^{N^T} SP_{it}^T \ .$$

Using a PMT poverty ranking to target individual poorest, households 1 to N^T are thus ranked with a cut-off point PMT^{N^T} at some bottom % of total population.[89] This program thus could instantly reduce the short-term poverty rate and also reduce the need for households to offtake productive asset and borrow to finance necessary consumption. But the presence of floods that could result in large income losses could easily knock households back in poverty and potentially force them to employ destructive coping, which could have long-term consequences.

Disaster relief programs as disaster-linked social protection. These provide food and/or cash directly or in exchange for labor work to affected households conditional on the occurrence of extreme disaster events (e.g., vulnerable group feeding program, gratuitous relief program, the flood-contingent scaling up workfare under Char Livelihoods Programme, etc.) These programs are targeted to poor and vulnerable households (identified using unified PMT poverty ranking with some cut-off points), who are affected by disasters in the vulnerable regions identified by some regional indicator of occurrence and intensity of disasters, e.g., the village-level flood index F_t in this case.

The relief typically has two components:

1. Early response intervention (SP_t^{RE}) represents some budgetary funds generally allocated for disaster relief and rehabilitation from a contingency account (e.g., the government of Bangladesh keeps a contingency fund of Tk 100,000 at the union level for immediate response) and/or can be reallocated from other development projects by the government each period and would be available instantly to finance timely emergency response to shocks. We model for simplicity that early response relief to be paid out to N^R targeted households (ranked by PMT with cut off-point $PMT^{N^R} > PMT^{N^T}$) will be contingent on occurrence of disaster, e.g., the flood index F_t in this case, and the number of targeted households who are affected by N^{RFlood} such that

$$SP_{it}^{RE} = \begin{cases} \min\left(\dfrac{SP_t^{RE}}{N^{RFlood}}, \theta(F_t) sy(A_{it}, H_{it})\right) & if\ F_t \ge F^*\ and\ \ PMT_{it} \le PMT^{N^R} \\ 0 & if\ F_t < F^* \quad or\ \ PMT_{it} > PMT^{N^R}. \end{cases}$$

89 Existing programs target from the bottom 20–30% of the poorest ranked by PMT scores (World Bank 2014).

Thus in not-so-bad years with small numbers of affected households, the early response budget could be adequate to cover almost all the critical portion of income losses from flood, $\theta(F_t)sy(A_{it}, H_{it})$. But in very bad years, when the number of affected households increases, the limited early response budget SP_t^{RE} will be far less than adequate, and so each household could end up receiving only $\frac{SP_t^{RE}}{N^{RFlood}}$, which could be far less than adequate to cover household's income losses. The model assumes that some portion of the leftover disaster relief budgets in good years would be saved for the following years, while the rest could be put back to support a cash/food transfer program in lifting more of the poorest out of poverty.

2. Later arrival relief (SP_{t+1}^{RL}) represents another component of disaster relief that could be available contingent upon the occurrence of disaster (i.e., village-level flood index) to complement the early response intervention in bad years, though this could take more time to arrive, e.g., with a lengthy fund-appeal process from donors, etc. As empirical evidence shows that delay could last up to three to six months after the occurrence of disasters, we thus model this so that flood-affected targeted households receive this part of assistance one period later. SP_{t+1}^{RL} can be used to complement early response intervention to compensate for the rest of income losses and some part of asset losses for N^R targeted households (ranked by PMT with cut-off point PMT^{N^R}) according to

$$SP_{it+1}^{RL} = \begin{cases} \min\left(\frac{SP_t^{RL}}{N^{RFlood}}, \theta(F_t)sy(A_{it}, H_{it}) + \theta^A(F_t)s(A_{it} - o_{it}) - SP_{it}^{RE}\right) & if\ F_t \geq F^* \\ 0 \quad if\ F_t < F^*. \end{cases}$$

There are two key points to note here. First, empirical literature still documents a large funding gap, especially in bad disaster years. The payout function above reflects this fact when affected households might receive only $\frac{SP_t^{RL}}{N^F}$ which is still far less than their uncompensated income and asset losses in the bad years, with large numbers of affected households. Second, the model could reflect the fact that late arrival of assistance could be ineffective in saving key asset, especially human capital, when household already has to reduce consumption below the minimum subsistence level $\underline{c}$ or required level $\bar{c}$, both of which would not be easily reversed via additional delayed assistance.

Overall, household's budget constraint with existing social protection programs becomes

$$c_{it} \leq \theta_{it}y(A_{it}, H_{it}) + o_{it} + b_{it} + SP_{it} \quad \text{where } SP_{it} = SP_{it}^T + SP_{it}^{RE} + SP_{it-1}^{RL}.$$

7. Flood index insurance (FI) to enhance early response of disaster-linked social protection

With 100% subsidized FI. The government of Bangladesh and/or international organizations can use disaster relief budget SP_t^{RE} already set aside each year to prefinance early response intervention by buying flood index insurance for poor and vulnerable households (again identified using unified PMT poverty ranking at some cut-off point). This is equivalent to providing 100% subsidized FI to the targeted population. In bad years, FI makes payout to insured government of Bangladesh or organization to finance its early disaster responses conditional on expected income losses, which are based on the village-level flood index $\theta(F_t)$. The FI can be designed at meso-level where the policyholder is the government of Bangladesh or the organizations, which could then distribute insurance payouts to individual affected households according to

$$SP_{it}^{FI} = \begin{cases} \theta(F_t)sy(A_{it}, H_{it}) & if\ F_t \geq F^* \ \ and \ \ PMT_{it} \leq PMT^{N^R} \\ 0 & if\ F_t < F^* \ \ or \ \ PMT_{it} > PMT^{N^R}, \end{cases}$$

where $sy(A_{it}, H_{it})$ is total sum insured per vulnerable household set at some critical portion s of household expected income. And so with some premium loading $\delta > 1$ to the commercial premium to cover other fixed administrative costs, the total premium cost and total number of insured vulnerable households N^I that can be afforded with available budget SP_t^{RE} can be written as $SP_t^{FI} = \delta N^I E\left(SP_{it}^{FI}\right) = SP_t^{RE}$.

With 100% subsidized FI to complement existing social protection program, household's budget constraint with FI-enhanced social protection programs thus becomes

$$c_{it} \leq \theta_{it} y(A_{it}, H_{it}) + o_{it} + b_{it} + SP_{it} \quad \text{where } SP_{it} = SP_{it}^{T} + SP_{it}^{FI} + SP_{it-1}^{RL}.$$

Our modelled FI can enhance existing early response intervention in two ways. First, FI could provide reliable, timely, and more adequate finance for effective disaster response relative to the existing program. Adequate and timely emergency response thus could reduce the likelihood that affected households have to deploy destructive coping strategies, e.g., asset sale, borrowing, or reduced consumption, which could have long-term welfare impacts. FI can thus complement overall disaster-linked social protection intervention by enhancing effective, timely, and adequate early response while additional humanitarian fund is sourced. Second, using an index-based approach for triggering of disaster relief allows assistance to be more transparent and better targeted to those most in need.

With partial subsidized FI. To reduce cost and increase scalability of the FI program, the government of Bangladesh and/or organization can further consider complementing the 100% subsidized program with partial subsidization to induce voluntary insurance demand among the slightly better off but still largely vulnerable households. Unified PMT poverty ranking can be used to effectively target beneficiary households for the 100% and partially subsidized programs.

With z% subsidized FI, the targeted household's budget constraint thus becomes

$$c_{it} \leq \theta_{it} y(A_{it}, H_{it}) + o_{it} + b_{it} + SP_{it} - z\delta E\left(SP_{it}^{FI}\right) \text{ where } SP_{it} = SP_{it}^{T} + SP_{it}^{FI} + SP_{it-1}^{RL}$$

$$\delta N^{I} E\left(SP_{it}^{FI}\right) = 0 \ for\ PMT_{it} \leq PMT^{N^{R}} \ and \ \delta N^{I} E\left(SP_{it}^{FI}\right) > 0 \ for\ PMT^{N^{R}} < PMT_{it} \leq PMT^{N^{RR}}.$$

Basis risk. Note that as FI is written on village-level expected income losses, which are based on a village-level flood index and not individual income losses, basis risk exists—when FI payouts deviate from individual income losses. The value to beneficiary households will thus depend on how closely individual income loss could be explained by the village-level flood index.

B. Calibrating economic model with actual data

1. Household statistics

Upazila pseudo-panel data are constructed from the four years of Household Income and Expenditure Survey data (HIES 1995, 2000, 2005, 2010). The analysis covers flood-prone char areas in 65 *upazilas* spanning 10 northwestern districts (Bogra, Gaibandha, Jamalpur, Kurigram, Lalmonirhat, Nilphamari, Pabna, Rangpur, Sirajganj, Tangail). Table A5.1 provides summary statistics of vulnerable char dwellers in these 10 districts, with all dollar-equivalent values PPP-adjusted to 2005 price.

Initial asset endowments (L_{i0}, A_{i0}). PMT-score is first constructed for all the sampled households in 10 char districts. Median land owned and total values of livestock and agricultural assets of each of the 10 PMT quintiles are then calculated to represent heterogeneous endowment distributions:

PMT quintile	Land (Discimal)	Total asset ($)
1	25	30
2	30	30
3	35	30
4	40	50
5	45	130
6	50	260
7	55	450
8	60	730
9	100	1040
10	200	2300

Asset growth (g). Asset growth is estimated using the following 4-year pseudo-upazila (l) panel data model

$$A_{lt+1} = \gamma + gA_{lt} + \sum \delta^k X_{lt}^k + \sum \delta^t T_t \quad + u_l + \varepsilon_{lt,}$$

where X_{lt}^k are set of time-varying characteristics, T_t is year dummy, and u_l is upazila-specific factor. The estimated $g = 0.05.$

Interest rate (r). The interest rate is obtained by averaging rates of borrowing for consumption from all sources. $r = 25\%$ per year.

Human capital (H_{i0}). Human capital is assumed at a scale of 1, $\bar{c}$ is upper poverty line ($1,030 per [4.2 member] household per year), and is food (lower) poverty line ($850 per [4.2-member] household per year. And $x_1 = x_2 = 0.1.$

Income. Crop and livestock production function $f(A_{it}, L_{i0})$ is assumed to be Cobb-Douglas form, and so the related parameters are estimated from the 4-year pseudo-upazila panel (l) data model

$$lny_{lt} = \gamma + alnA_{lt} + lL_{i0} \sum \delta^k X_{lt}^k + \sum \delta^t T_t \quad + u_l + \varepsilon_{lt,}$$

where X_{lt}^k are again set of time-varying characteristics, T_t is year dummy, and u_l is upazila-specific factor. The estimated $a = 0.3, l = 0.6, C = 11.5$, and so production function of any simulated household i can be constructed as

$$f(A_{it}, L_{i0}) = C \times A_{it}^a \times L_{i0}^l.$$

2. **Shocks**

$\theta_{it} = \varepsilon_{it} - \theta(F_t)$, where ε_{it} is obtained from 4-year pseudo-panel HIES data by constructing from deviation from upazila average income. $\theta(F_t)$ is obtained from estimated income losses based on Oxfam's constructed village-level flood index using sophisticated flood modelling (Oxfam 2014). Distribution of village-level flood index is obtained from pooling of indexes across 10 available villages in the district of Sirajganj.

$$\varepsilon_{it} \sim [1.1, 0.5], \theta(F_t) \sim [0.11, 0.3]$$

3. **Social protection programs**

PMT is constructed from World Bank (2014) using recently constructed rural weights based on HIES 2010. The amount of transfers and maximum disaster relief are just enough to reach food poverty line at US$850 per [4.2 member] household per year.

4. **Flood index insurance**

Payouts based on flood index F reflecting the number of consecutive days that the inundated level is higher than the village-specific water-level trigger (Oxfam and IWM 2014).

$$Q(F) = \begin{cases} 0.35 \ \ if \ 11 < F < 20 \\ 0.55 \ \ if \ 20 \leq F < 26 \\ 1 \ if \ F \geq 26 \end{cases}$$

Total sum insured per household is US$100 (about Tk 8,000). Premium loading

5. **Simulations**

We took the following steps to simulate key outcome indicators based on the calibrated parameters.

1. We start with 1,000 simulated households divided into 10 groups, each initially assigned a median-level endowment of land and productive asset as reported above.
2. We simulate 1,000 replicates of 50-year series of flood index based on the best-fit distributions of pooled village-level flood index.
3. For each simulated year, we draw 1,000 replicates of individual risk parameters from a normal distribution with specified mean and variance above. We then match these 1,000 risk variables to 1,000 simulated households.
4. We can then simulate dynamics of income, consumption, asset offtake, borrowing, asset, and human capital according to the model with various SSNPs.

Table A5.1. Summary Statistics of Flood-Prone Households in 10 Char Districts

	Overall*		By PMT poverty ranking tercile**		
	Mean	S.D	T1 Mean	T2 Mean	T3 Mean
			PMT<683	683<PMT<714	PMT>714
Household size	4.21	1.68	4.81	3.95	3.87
Consumption and poverty dynamics					
Consumption expenditure ($/HH/year)	$1,324	$926	$1,043	$1,189	$2,046
Food expenditure ($/HH/year)	$786	$417	$714	$743	$994
Calorie intake (per capita/day)	2,174	522	2,081	2,360	2,492
Poverty headcount (upper poverty line***)	35.6%	21.0%	68.1%	32.7%	5.2%
Poverty gap	8.2%	6.4%	17.6%	6.2%	0.9%
Poverty head cout (2005 HIES)	42.2%	23.0%	72.0%	41.0%	7.3%
PMT	701	32	667	699	738
Income and sources					
Economic income ($/HH/year)	$1,389	$1,839	$969	$1,276	$2,297
Crop income (%)	25%	36%	21%	28%	27%
Livestock income (%)	30%	79%	25%	32%	22%
Wage laborer income (%)	39%	51%	51%	26%	5%
Fishery income (%)	2%	13%	2%	2%	3%
Productive Assets	95%				
Land owned (Acres)	0.66	1.26	0.21	0.45	1.34
Landless (%)	61%	49%	80%	65%	36%
Agricultural asset	$88	$498	$21	$65	$179
Livestock asset	$420	$740	$338	$413	$511
Shocks and coping strategies					
Flood last year	7%	26%	10%	6%	6%
Other disasters last year	6%	24%	4%	8%	8%
Crop and livetock disease last year	4%	20%	2%	5%	6%
Price shocks last year	0%	6%	0%	0%	0%
Illness and death last year	2%	15%	1%	3%	3%
Conflicts last year	1%	8%	0%	0%	1%
Coping_ social insurance	6%	15%	6%	7%	5%
Coping_government or NGOs	0%	4%	0%	1%	0%
Coping_labor work	8%	16%	5%	13%	6%
Coping_migration	4%	13%	10%	2%	0%
Coping_asset sell	4%	11%	5%	4%	2%

*Based on 1,940 representative households in 65 upazilas in 10 flood-prone northwestern districts in HIES 2010.
**Households are divided into tercile groups with PMT cut off at 33 percentile (based on poverty headcount)
***Upper poverty line is averaged at $1,030 per household per year (with 4.2 members/hh and 2005 exchange rate 75 Taka/$)

	Overall*		By PMT poverty ranking tercile**		
	Mean	S.D	T1 Mean	T2 Mean	T3 Mean
			PMT<683	683<PMT<714	PMT>714
Coping_saving	6%	15%	4%	6%	7%
Coping_loan	11%	19%	13%	10%	11%
Coping_reduce health and education	0%	1%	0%	0%	0%
Social safety net programs					
GR	6%	23%	9%	6%	2%
VGF	0%	0%	0%	0%	0%
TR	0%	2%	0%	0%	0%
FFW	0%	2%	0%	0%	0%
EGPP	0%	6%	0%	0%	0%
Char Livelihood Development Program	0%	5%	0%	0%	0%
Stipend and other allowance programs	28%	45%	33%	31%	20%
Cash entitled to receive (Taka)	$1.1	$4.6	$1.0	$1.3	$0.8
Cash actually received (Taka)	$1.0	$4.1	$0.9	$1.1	$0.9
Inkind entitied to receive (kg)	2	9	3	2	1
Inkind actually receive (kg)	1	8	2	2	0

*Based on 1,940 representative households in 65 upazilas in 10 flood-prone northwestern districts in HIES 2010.
**Households are divided into tercile groups with PMT cut off at 33 percentile (based on poverty headcount)
***Upper poverty line is averaged at $1,030 per household per year (with 4.2 members/hh and 2005 exchange rate 75 Taka/$)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