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The Value of Customized Insurance for Farmers in Rural Bangladesh

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ABSTRACT

Farmers in rural Bangladesh face multiple sources of uninsured risk to agricultural production and household assets. In this paper, we present results from an experimental demand-elicitation exercise in rural Bangladesh to shed light on smallholder farmers' interest in formal insurance products. We propose a suite of insurance and savings products, and we randomly vary the price of one insurance option (area-yield insurance) and the presence of one of the savings options (group savings). Consistent with economic theory, farmers buy more of the insurance products that cover the risks they primarily face. However, because farmers are subject to a variety of risks, they do not focus on only one type of insurance; instead, they evenly split their endowment between life and disability insurance and agricultural insurance. Demand for area-yield insurance falls with price; we also observe important cross-price elasticities with other insurance products. The presence of group savings does not alter demand for insurance, though group savings is found to be a particularly popular risk management tool, especially when decisions are made in groups.

Keywords: risk, insurance, savings, rural Bangladesh

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1. INTRODUCTION

Farmers in rural Bangladesh face multiple sources of risk to agricultural production and household assets. Using panel data from nearly 1,000 rural households in Bangladesh, Quisumbing (2007) found that from 1996 through 2007, floods affected one in seven families. Qualitative work from the same villages indicates dowry, illness, injury, and floods as the main cause of impoverishment during the same period (Davis 2007). Households appear to have limited ability to cope with these risks. Informal risk-coping mechanisms, such as savings, credit, gifts, and loans, appear to be used in the absence of well-developed insurance markets.[1] These informal mutual insurance networks differ depending on the targeted protected good—that is, neighboring (distant) households come together to shield food (nonfood) consumption (Park 2006). The effectiveness of all these mechanisms is challenged in Santos et al. (2011). Households can hardly insure themselves against covariant weather shocks, and poor households respond to large idiosyncratic shocks by selling productive assets. Formal insurance markets appear to have large potential. Although not completely absent, the penetration of these markets is limited, and their functioning is not accurately understood by rural farmers.

In addition to the welfare loss incurred when uninsured agricultural losses are realized, a considerable theoretical and empirical literature suggests that uninsured risk in Bangladeshi agriculture will affect the investment decisions of smallholder farmers. Specifically this literature suggests that these farmers will refrain from investing in agricultural production in order to limit their exposure to the sources of those risks that they cannot insure against. Empirical studies suggest that households with less insurance devote less land to high-yielding, but volatile, rice varieties and castor in India (Morduch 1990); more land to low-risk, low-return potatoes in Tanzania (Dercon 1996); and less labor to price-volatile coffee in Uganda (Hill 2009). They are also less likely to apply fertilizer available on credit in Ethiopia (Dercon and Christiaensen 2011). Walker and Ryan (1990) estimated that in semiarid areas of India, households may sacrifice up to 25 percent of their average incomes to reduce exposures to shocks. Indeed, recent experimental evidence in India has shown that once farmers have access to some form of insurance against agricultural risk, they are much more inclined to increase investment in higher-return, higher-risk investments (Cole, Giné, and Vickery 2011).

Developing insurance products that help farmers manage risks in agricultural production and risks related to health is thus an important goal in Bangladesh, as well as in other developing countries. However, designing cost-effective insurance products and establishing persistent insurance markets for smallholder farmers are challenging propositions. In this paper, we explore different options for developing useful insurance products for rural farmers—in particular, for agricultural-related risk—and we test the validity of the proposed products through an insurance demand-elicitation exercise.

We begin our work from an understanding that providing traditional indemnity-based crop insurance is not a sustainable strategy for insuring smallholder farmers in Bangladesh. Previous experience in Bangladesh and other countries indicates that traditional crop insurance programs, whereby farmers are compensated for the observed losses on their fields, are unsustainable (Hazell 1992). Moral hazard, adverse selection, and insurance fraud, combined with the high cost for the insurer of detecting fraudulent behavior by farmers, make these insurance products costly to provide. These problems are significantly reduced in the design of index insurance, where the payout is based on a cheaply observable, tamper-resistant index, such as monthly rainfall or total days of extreme temperatures. Therefore, index insurance alleviates concerns about hidden actions of farmers, information problems, and expensive verification costs. Yet we recognize that index insurance also has serious disadvantages that can make it unattractive as a stand-alone risk-management tool. Under such contracts, farmers only receive a payout for losses due to events captured by the aggregate index. Consequently farmers may be well insured against some covariant (community-level) shocks, but not against idiosyncratic (household-level) shocks or against covariant shocks not adequately captured by the index. The risk that a farmer may incur a large loss but receive no claim payment from the insurance contract due to an imperfect correlation between the

[1] Informal credit, government cash transfers, reduction in consumption, and sales of productive assets are among the most frequent risk-coping mechanisms adopted against large covariant shocks such as the 1998 and 2005 floods (Del Ninno et al. 2001; Brouwer et al. 2007).

loss and the index is referred to as *basis risk*; both theoretical and empirical work has shown that basis risk substantially reduces demand for index insurance products (Clarke 2011; de Nicola 2011; Hill, Hoddinott, and Kumar 2011; Mobarak and Rosenzweig 2012). To protect against basis risk, farmers may find it advantageous to complement the coverage offered by agricultural index insurance by investing in other risk-management options.

Based on the above considerations, we organized an insurance demand-elicitation exercise in which farmers could demonstrate their interest in formal insurance products by allocating a monetary endowment across various risk-coping financial instruments. To guarantee the meaningfulness of the exercise, we first identified the major agricultural risks faced by farmers in our study areas. We then designed index insurance products to provide protection against agricultural shocks, paying particular attention to minimizing basis risk.

In addition to the indexed agricultural insurance, we designed indemnity-based life and disability insurance to offer protection against some household-level shocks. Farmers could also choose to allocate some of their budget toward their existing individual savings accounts or to a new group savings account that was designed to allow groups to commit to offering each other mutual protection against specified individual shocks. If insurance is expensive, then retaining risk through individual or group savings or contingent credit may be more efficient than purchasing insurance for fairly severe, but not catastrophic, shocks (Gollier 2003). In addition, savings and indemnity-based life and disability insurance increase a household's ability to manage shocks not covered by the indices that nevertheless affect agricultural yields.

More than 300 farmers in Bogra and Manikganj districts participated in this demand-elicitation exercise; as such, the results provide an initial understanding about relative demand for these insurance products, as well as the degree to which demand varies with exposure to risk and household characteristics. In addition, elements of the demand-elicitation exercise were randomized across farmers in order to better understand the nature of demand for these products. Specifically, we randomized the presence of one of the additional risk-management options and the price of one of the index-insurance options in order to understand the complementarity between these insurance mechanisms. As part of the demand-elicitation exercise, we observed individual and group insurance choices, which provided us with a unique opportunity to describe differences between individual and group insurance choices.

The rest of this paper is organized as follows: Section 2 discusses the theoretical framework behind the experimental design and what types of complementarity we would expect to see; Section 3 describes the shocks and risk-coping mechanisms available to farmers in Bangladesh; Section 4 indicates the experimental design and data; Section 5 presents the results; and Section 6 draws conclusions from the experiment.

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

Index-based insurance products have received much attention recently, where examples of such indices include rainfall measured at a rainfall station, or average yield estimates for a given area. Because these products are based on an independently observable index, they can significantly reduce problems of moral hazard and adverse selection. However, with claim payments contingent only on an index that is not perfectly correlated with individual farm losses, insured farmers may not receive a claim payment when they most need one. This basis risk can significantly reduce the level of "rational" demand for such products. Clarke (2011) found that for the levels of basis risk in some index products, the optimal level of coverage is 9.6 percent when demand is actuarially fairly priced. Even if the index captures what it is designed to capture, the existence of other sources of risk that affect crop income—such as a health shock, which usually leads to a contraction of farm income as a result of a reduction in available farm labor—can cause demand for index insurance to fall by almost 50 percent (de Nicola 2011). These findings suggest that offering other insurance options, along with index insurance, to help farmers manage risk not insured by the index will increase the demand for index insurance. This can be done in several ways: (1) offer cover for multiple perils—either multiple indices for many sources of covariate risk or indemnity insurance for major risks in rural Bangladesh (for example, death and disability) or (2) strengthen other mechanisms to manage agricultural risks, particularly those that are not covariate.

In this paper, we explore demand for index insurance when multiple index and nonindex products are available, as well as when other mechanisms to manage agricultural risk are strengthened. In this section, we discuss the theoretical literature on characteristics of demand and set out clearly testable hypotheses on the likely changes in demand under two conditions: (1) an increase in price for one indexed product and (2) an increase in other mechanisms available to manage agricultural risk.

We first test that demand for insurance products follows basic economic principles. We do this by verifying that farmers purchase insurance against the risks they are more exposed to; we expect a positive correlation between the stated—or the most prevalent—risks in the area and the take-up for the specific insurance product covering that risk. We then test which respondents' personal characteristics predict higher demand for insurance. A natural candidate is the degree of risk aversion that we elicited by asking participants to select their preferred gamble from a set of options increasing in both risk and expected income. Although we expect the degree of risk aversion to be positively correlated with the demand for insurance for indemnity products, such a correlation may not be present for indexed products, because of the basis risk those products hold (see Clarke 2011 for a more detailed discussion). We thus expect to see demand correlating with objective measures of exposure to risk and to collected data on risk aversion (though only one hypothetical question on risk preferences was asked). If this were the case, then observing participants allocating their resources to purchase both agricultural and life and disability insurance would provide suggestive evidence that farm production is subject to both agricultural and health shocks.

The price of one of the index insurance elements (area-yield insurance) was varied across experimental sessions, which allowed us to estimate own- and cross-price elasticities of insurance demand. Specifically, the price of the area-yield premium was randomly varied between a multiple of 0.67 and 2 of what we estimated the actuarially fair price to be. In essence, this first allows us to explore the effects of imposing a subsidy or a tax on the insurance premium.[2] By comparing the take-up rates of area-yield insurance between groups that were charged different premiums, we can verify that an increase in premium would correspond with a decline in demand, given that contract terms are held constant. Second, we can shed light on the more interesting question of how a change in the price of insurance cover based on one index (in this case, area yield) affects the demand for other types of insurance.

Predictions about how demand should be affected by such price changes depend crucially on the perceived joint distribution between the indices and losses from different sources. An expected utility

[2] We note, however, that the actuarially fair premium is a purely theoretical notion, and our estimate is an estimate of the mean payout, which probably has large standard errors.

maximizing farmer's maximization problem when offered a portfolio of N different types of insurance, ignoring the time dimension of the insurance purchase decision, may be written as

$$\max_{\alpha_i, i=1,\dots,N}\left[\int_\Omega u\left[w_0+\pi(\omega)+\sum_{i=1}^{N}\alpha_i(I_i(\omega)-m_i\mu_i)\right]dF(\omega)\right],$$

where w_0 corresponds to farmer's wealth, π denotes net agricultural profits, α_i is the number of units purchased, I_i is the claim payment per unit, m_i is the pricing multiple, and μ_i is the mean claim payment per unit for each line of insurance cover $i = 1, \dots, N$ and $\omega = (I_1, \dots, I_N, \pi) \in \Omega$ denotes the state of the world with cumulative density function F.

If a change in the price of area-yield indexed insurance (m_1, say) does not affect demand (α_1), which would occur, for example, when demand remains constant at zero, then demand for other insurance coverage α_1, where $i \neq 1$, would not be expected to change. This would also be true in the special case in which the loss comprises a number of additive independent background risks—that is $\pi(\omega) = \epsilon(\omega) + \sum_{i=1}^{N} I_i(\omega)$, with ϵ and each I_i jointly statistically independent, and in which individuals have constant absolute risk aversion, that is, $-u''(w)/u'(w)$ is constant.[3] Shocks that affect agricultural profits are highly unlikely to enter as additive independent terms (that is, as background risk), because if farmers lose a crop from drought, they cannot lose it again due to hail. In addition, it is not reasonable to assume that farmers can lose an entire crop only if every shock occurs to its maximum possible extent. As such, it is more appropriate to model agricultural losses as multiplicative. When risks are multiplicative, changing the insurance premium of one element of cover would affect the take-up of the other elements of cover offered.

In another extreme case in which the area-yield index is perceived to be perfectly correlated with one of the other indices $I_1 \propto I_i$ for some i, demand for I_i will be zero if $m_1 < m_i$, and demand for I_1 will be zero if $m_1 > m_i$; that is, perfect crowding out of the other insurance product would occur for a sufficiently low pricing multiple m_1. If different options for coverage are partial substitutes, then one might expect that a reduction in the price of one type would increase demand for that element and reduce demand for other partially substitutable elements. It is worth pointing out that although this intuition is persuasive, and likely holds in most cases, under specific circumstances, it may not be true. For example, Clarke (2011) showed that for general risk-averse utility functions, or even for risk-averse utility functions that satisfy decreasing absolute risk aversion, index insurance can be a Giffen good—that is, an increase in the price of one element of cover m_1 will not necessarily decrease demand α_1 for that element of cover. However, index insurance is a normal good for utility functions that satisfy constant absolute risk aversion.

Extending the above framework to include both insurance and individual savings, we may expect insurance and savings to be substitutes (Dionne and Eeckhoudt 1984). However, again, this is not necessarily the case. Beyond the existence of an impact on the demand of other insurance, it is interesting to explore the direction of such an impact. The change in take-up rates of the other insurance or savings products potentially induced by an exogenous variation of the area-yield price may allow us to identify products that are complements and substitutes for area-yield insurance. For instance, as the price for area-yield insurance increases, we may see that farmers allocate more resources toward purchasing the (individual or group) savings option. In this case, they are substituting away from area-yield insurance with the rationale that investing in savings is a better investment decision to protect against widespread production shocks. In summary, we expect that the own-price elasticity of demand will be negative and that the cross-price elasticity of demand will depend on whether the insurance element is a complement or a substitute to area-yield insurance.

However, savings (individual or group) and nonindexed elements of cover (insurance against death, death of one's spouse, and disability) may affect demand for index cover if they are able to reduce basis risk. When looking for an agricultural insurance product, farmers are interested in selecting a

[3] Eeckhoudt, Gollier, and Schlesinger (1996) and Gollier and Pratt (1996) partially characterized the effect on demand of additive independent background risks for preferences other than constant absolute risk aversion by using notions of prudence and temperance.

product that insures losses to crop yields (or, more accurately, crop revenue, but here we abstract from price risk). An index provides them with some coverage against yield losses; however, as noted above, the coverage is not perfect and results in basis risk. Consider that the basis risk experienced by a specific farmer from an indexed insurance product may be decomposed into two components: (1) the difference between the claim payment from the indexed product and the average yield loss incurred by a group of local farmers (covariate basis risk), and (2) the difference between the average group yield loss and the yield loss incurred by the specific farmer (idiosyncratic basis risk).

A group savings fund used to pool basis risk within the group can reduce the second source of basis risk (idiosyncratic), thereby reducing the basis risk experienced by an individual farmer (Dercon et al. (2011)). A reduction in basis risk can then be expected to increase demand for the indexed insurance product (Clarke 2011). For sufficiently risk-averse farmers, an increase in the purchase of indexed insurance increases the marginal benefits from reducing basis risk; therefore, this may increase demand for group savings, which are used to pool idiosyncratic risk. Similarly, individual savings may allow an individual to better insure against idiosyncratic basis risk by allowing that individual to accumulate savings in good years and use those savings to cover uninsured losses. In addition, improved insurance coverage against some of the specific sources of idiosyncratic risk that are likely to result in idiosyncratic basis risk (such as health shocks) may also increase demand for index insurance. For example, if yields are subject to health and agricultural risk in a multiplicative manner (as described earlier), farmers would not fully insure against one risk if they were not able to also protect themselves against the other (de Nicola 2011).

Individual savings and life and disability insurance were offered in all experimental decisions; as such, we cannot use the data to test whether increased access to one of these risk-management instruments increased demand for other forms of index insurance. However, access to group savings was randomized across experimental choices; as such, it is instructive to examine whether choices varied as a result of the provision of group insurance. The hypothesis posed here is that it would increase demand for indexed products.

3. AGRICULTURAL RISK AND INSURANCE IN RURAL BANGLADESH

Our experimental work is focused on smallholder tenant farmers in BRAC's Borga Chashi Unnayan Project (BCUP), or the Sharecropper Development Program. BRAC started the BCUP program in 2009 to provide microfinance loans that are tailored for agricultural investment to smallholder tenant farmers. Through this program, smallholder tenant farmers have received noncollateral loans to purchase high-quality seeds, inputs, and tools for crop production. Cognizant of the many uninsured risks these farmers face that jeopardize both their ability to invest in agriculture and their loan repayment potential, BRAC is interested in exploring how to best provide agricultural insurance to these farmers. Before turning to the experimental design, we provide additional information on the nature of agricultural risk and insurance in rural Bangladesh.

Data

Our analysis is based on information from multiple databases about farmers in rural Bangladesh. We rely on a number of externally collected datasets, as well as a dataset collected as part of the current experimental study to inform this discussion. For each data source, we focus on the types of risks farmers are commonly exposed to, the frequency of income shocks, and the risk-coping mechanisms currently in place.

Table 3.1—Knowledge and purchase of insurance products

Percentage of Households . . .	
. . . familiar with insurance	72.80
. . . that agree they would get the premium paid for an insurance back if the bad event for which the insurance was purchased does *not* happen	29.66
. . . that agree they can purchase insurance against a bad event *after* it has occurred	2.98
. . . that bought life insurance	16.74
. . . that bought health insurance	0.23
. . . that bought weather/crop insurance	1.07

Source: BCUP household survey (2011).

The following datasets were used for the analysis:

BCUP Census and Household Survey

Under the BCUP program, a census was fielded in 2010–2011 covering 29 districts, including our two study districts of Manikganj and Bogra, where we later conducted the demand-elicitation exercise in 2011. For our analysis, we focus on the sections of the census questionnaire related to knowledge and purchase of insurance products, as summarized in Tables 3.1 and 3.2.

Table 3.2—Events causing crop losses greater than 25 percent, 2005–2010

District	Upazila*	Included in Exercise	Proportion of Farmers Reporting: Flood	Drought	Insects	Disease
Bogra	Bogra	Yes	0.05	0.00	0.07	**0.35**
Bogra	Gabtali	Yes	0.01	**0.27**	0.02	0.02
Bogra	Sherpur	No	0.02	**0.12**	0.06	0.01
Bogra	Sonatala	No	**0.34**	0.09	0.01	0.03
Manikganj	Manikganj	Yes	**0.17**	0.12	**0.19**	0.01

Source: BCUP census (2010).
Note: * Upazila corresponds to subdistrict. The events more likely to cause crop losses are reported in bold.

IFPRI Survey Data

The International Food Policy Research Institute (IFPRI) conducted household surveys in 14 districts, including Manikganj and two districts next to Bogra—Naogaon and Tangail. We combine three separate household surveys fielded in 2006 and 2007, which are part of the "Chronic Poverty and Long-Term Impact Study in Bangladesh." The study, which aimed to identify the economic, social, and political factors leading to chronic poverty in Bangladesh and which evaluated the impact of selected antipoverty interventions. Our analysis focuses on the shocks that each household reported experiencing in the past 10 years: 1,900 households (84 percent of the sample) experienced some type of shock during the past 10 years, and 1,615 households (71 percent of the sample) experienced a shock being covered by one of the proposed insurance products in this study.

Customized Insurance in Bangladesh (CIB) Survey

This household survey was conducted in July 2011 among 340 BCUP tenant farmers—primarily rice cultivators—who participated in the insurance demand-elicitation exercise.[4] The study area covered three subdistricts in Bogra (Bogra Sadar, Gabtali, and Sherpur) and three subdistricts in Manikganj (Manikganj Sadar, Saturia, and Singair). In addition to basic demographic information, participants answered questions to measure their risk preferences and their understanding of the insurance products offered. Participants also reported the perceived major risks to their agricultural income, their agricultural input costs, and their current agricultural practices, as well as details about the most significant pest/crop disease outbreaks they experienced in the past 10 years (including the effects on their income and consumption).

Agricultural Risk

Our sample for this study consists of tenant farmers who live in noncoastal regions of rural Bangladesh. These are primarily smallholder farmers producing (rice) paddy in the two main agricultural seasons, one of which is rainfed, and the other is irrigated. As is true for most farmers in Bangladesh, these farmers face multiple risks with few insurance options. These risks include weather-related risks, such as droughts, floods, storms, and extreme temperatures, and other risks, such as crop diseases or pests. Because most agricultural activities among smallholder farmers in Bangladesh are still not mechanized, illness, injury, or death of a working member of the family has significant implications for welfare, as well as for production and household incomes. In particular, 63 percent of the respondents in the BCUP census, representative of the areas in which the experimental sessions were conducted, lost more than one-quarter of their crop at least once during the past five years. The major causes of crop losses were pests (19 percent), drought (17 percent), and flood (14 percent).

Using data collected in the BCUP census, we explore the degree to which these shocks vary across space. We look at whether the types of losses reported vary from subdistrict to subdistrict. If risks are uniform in all study areas, we would expect little variation in the reported causes of crop loss across districts. Reported causes of crop loss suggest that agricultural shocks are largely spatially covariant (Table 3.3) and vary quite substantially, even at low levels of disaggregation (that is, in subdistricts). Losses in the past five years in Bogra *upazila* were likely to be caused by crop disease; during that period, there had been minimal flood and drought risk. Pestilence risks are spatially covariant; this is partly due to the contagious nature of many of the pests and crop diseases described in focus groups and partly due to specific weather conditions that make certain crop diseases more likely to spread to nearby villages. In Gabtali and Sherpur upazilas (and in Bogra *upazila*) households had primarily been affected by drought. In contrast, Sonatala and Manikganj upazila in nearby Manikganj district were mainly exposed to flooding. During the *aman* season (summer, from June 15 to December 14), floods may be triggered by river flood inundation and waterlogging caused by heavy rainfall. The risk of waterlogging appears to be especially concentrated in June and July, during the planting period, and in September, during part of the flowering period. River flood inundation causes farmers to lose their crops if the water stagnates for more than one month in their fields.

[4] CIB is described further in the next section.

Table 3.3—Risk profile of Bogra and Manikganj upazilas (subdistricts)

District	Upazila*	Proportion of Farmers Reporting Major Risk Is: Flood / too much rain	Deficient rain in *aman* season**	Pest or disease	Lack of rain or irrigation in *boro* season**
Bogra	Bogra	0.00/0.00	0.29	**0.36**	0.12
Bogra	Gabtali	0.17/0.00	**0.36**	0.14	0.12
Bogra	Sherpur	0.11/0.00	**0.48**	0.14	0.18
Manikganj	Manikganj	**0.17/0.37**	0.19	0.08	0.05
Manikganj	Saturia	0.12/0.23	0.23	0.25	0.08
Manikganj	Singair	0.06/0.16	0.35	0.20	0.14

Source: CIB survey (2011).
Notes: *Upazila corresponds to subdistrict. ** *Aman* is the summer monsoon season, and *boro* is the dry winter season.

To verify the variations in reported risks, we assess the degree to which these events are identified as the main source of perceived risk to agricultural incomes. We may expect different results because the results based on the BCUP census data (Table 3.2) report realized shocks in the past five years, whereas the results from the CIB survey (Table 3.3) focus on perceived risks. Indeed, given that the former results only report adverse events that have occurred in the past five years, they may not capture largely disruptive, uncommon, infrequent agricultural shocks. However, we find that the results are consistent in Tables 3.2 and 3.3. Pestilence and crop disease are confirmed as the major risks in Bogra upazila; drought is the most important risk in Gabtali and Sherpur upazilas; and flood is the biggest risk in Manikganj upazila. In addition, the CIB survey highlights other specific risks. For example, although Bogra is characterized by a high prevalence of pests and diseases, deficient rain in the *aman* season is also a significant concern. In Manikganj, flooding is a serious concern—households are specifically worried about their crops receiving too much rain, rather than damage caused by a major river overflowing.

This subdistrict variation in sources of agricultural risk suggests that although drought or flood indices may be appropriate for some farmers, they may not be as useful in areas where the risk of pest and crop disease is also high. Because area-yield measures depend on several factors, including widespread pestilence and crop disease prevalence, as well as weather events, these indices may be a better measure of realized risk in the latter areas. We are able to test this hypothesis using the experimental data collected.

To further guide our design of the index insurance products, we organized focus groups among farmers to gain a better understanding behind the quantitative results. During these focus groups, farmers emphasized the importance of pests and diseases that affected their crops during the major seasons—*boro* (winter, dry) and *aman* (summer, monsoon). The risk of deficit rain in the *aman* season was also widely reported, with farmers stating that the number of consecutive days without rain was of greater concern than the total amount of rainfall in a given period. In particular, more than two weeks of consecutive dry days during the planting and flowering phases of the *aman* season was reported to result in significant crop losses for those who could not afford irrigation, as well as considerably higher costs of production for those who could invest in supplemental irrigation.

Insuring Agricultural Risk

Despite the prevalence of multiple agricultural risks to farmers in Bangladesh, very few insurance options are available to them. The most prominent insurance option available is life insurance. In a recent survey, 17 percent of households had purchased life insurance in the past, whereas less than 1 percent had purchased health or agricultural insurance (Table 3.1). These low percentages are largely due to unavailability of agricultural insurance. Although traditional indemnity-based multiple-peril crop insurance was offered in Bangladesh by Sadharan Bima Corporation as early as 1977, the program was suspended in 1995 due to low uptake by farmers and large underwriting losses, following similar experience with such products in other countries (Islam and Khan 2009; Hazell 1992). Currently no indexed agricultural insurance products are available.

Table 3.4—Three most popular coping mechanisms (percentage of total sample)

			Manikganj		
Peril	**Flood**	**Area Yield/ Drought**	**Death**	**Death Spouse**	**Health**
Most popular coping mechanism	Did nothing	Did nothing	Did nothing	Did nothing	Took loan from moneylender/ noninstitutional bank
	31.8	37	33.3	35	29.3
Second most popular coping mechanism	Took loan from moneylender/ noninstitutional bank	Took loan from moneylender/ noninstitutional bank	Took help from others	Took loan from moneylender/ noninstitutional bank	Other
	20.6	18.5	14.3	20	16.7
Third most popular coping mechanism	Took loan from NGO/institution	Took loan from NGO/institution	Sent nonworking household members to work	Took help from others	Took loan from NGO/institution
	17.2	14.1	14.3	15	12.3
			Naogaon and Tangail (close to Bogra)		
Peril	**Flood**	**Area Yield/ Drought**	**Death**	**Death Spouse**	**Health**
Most popular coping mechanism	Took loan from moneylender/ noninstitutional bank	Took loan from moneylender/ noninstitutional bank	Did nothing	Did nothing	Took loan from moneylender/ noninstitutional bank
	26.3	19	33.3	33.3	22.4
Second most popular coping mechanism	Took loan from NGO/institution	Ate less food to reduce expenses	Other	Took loan from moneylender/ noninstitutional bank	Did nothing
	17.5	16.7	33.3	25	12.7
Third most popular coping mechanism	Did nothing	Ate lower quality food to reduce expenses	Sent nonworking household member to work	Sold productive asset	Sold consumption asset
	12.3	16.7	33.3	25	10.4

Source: IFPRI survey (2006–07).
Note: The second row reports the percentage of the times such a mechanism is used.

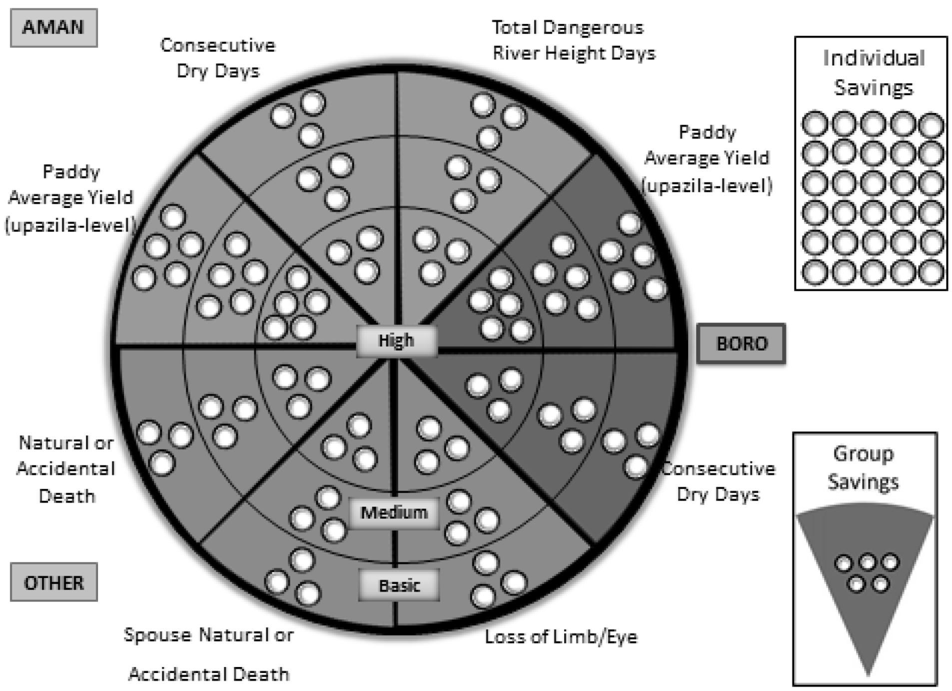
Survey data show that although households help each other in times of need for events, such as death and illness, they find it hard to manage losses that affect all households in the village simultaneously, such as catastrophic weather events. The findings in Table 3.4 indicate that, other than taking a high-interest loan, few coping mechanisms are available to households for the types of risks covered by our insurance products.

4. EXPERIMENTAL APPROACH: DESIGN AND DATA

Experimental Design

The experimental sessions were designed to explore the issues outlined earlier, in which individual farmers and groups of farmers were asked to customize their own bundle of insurance policies and savings products.

Figure 4.1—Sample CHAT board



Source: Authors' calculations.

Each session began with a brief discussion on agricultural and nonagricultural risks, current risk-coping mechanisms, and the potential role of insurance. The group was then presented with a CHAT (Choosing Healthplans All Together) board, which is a participatory tool borrowed from the health insurance field that aims to elicit consumers' preferences about different health insurance options (see Goold et al. (2005) for details). Figure 4.1 depicts a typical board, and Table 4.1 summarizes the insurance products offered for the upcoming year. The three main sections on the board correspond to the major categories of insurance offered: agricultural insurance for the *aman* (summer, monsoon) season, agricultural insurance for the *boro* (winter, dry) season, and other types of insurance that offer coverage for the full year. Each slice represents a different type of insurance—such as dry days insurance or death of spouse. Each slice is then divided into three segments that correspond to the available levels of coverage—basic, medium, and high. The number of empty (white) circles on each segment represents the number of stickers required to purchase that level of insurance or savings. If a participant were interested in one of the insurance products, he must first purchase the basic level of coverage, then the medium level, and finally the high level. For example, purchasing loss of limb/eye coverage would cost three stickers for the basic level, a total of six stickers for the medium level, and a total of nine stickers for the high level.

Table 4.1—Details of insurance offered

Insurance Type	Event Insured	Amount Paid Out (in taka) Basic	Medium	High	Approx. Probability of Payout
	Aman Insurance				
Aman area yield	If the average yield of paddy (rice) at the upazila level is below 19 (Bogra) / 17.5 (Manikganj) maunds per acre during *Aman*, you receive a payout.	600	1,200	1,800	1 in 10 years
Aman dry days	If the total number of consecutive days without rain during the *aman* season is above 63 (Bogra) / 60 (Manikganj) days, you receive a payout.	600	1,200	1,800	1 in 10 years
Aman flood	If the total number of days with dangerous river height levels during the *aman* season is above 73 (Bogra) / 30 (Manikganj) days, you receive a payout.	600	1,200	1,800	1 in 10 years
	Boro Insurance				
Boro area yield	If the average yield of paddy (rice) at the upazila level is below 35.5 (Bogra) / 35 (Manikganj) maunds per acre during the *Boro* season, you receive a payout.	600	1,200	1,800	1 in 10 years
Boro dry days	If the total number of consecutive days without rain during the *Boro* season is above 107 (Bogra) / 99 (Manikganj) days, you receive a payout.	600	1,200	1,800	1 in 10 years
	Life and Disability Insurance				
Loss of limb or eye	If you lose at least one arm, one leg, or one eye, you receive a payout.	15,000	30,000	45,000	0.004
Death of spouse	If your spouse dies due to natural causes or due to an accident, you receive a payout.	15,000	30,000	45,000	0.004
Death of self	If you die due to natural causes or due to an accident, your family receives a payout.	15,000	30,000	45,000	0.004

Source: Authors' calculations.

The facilitators explained to participants the various insurance products, the events that would trigger a payout, and, for the index products, which recent years would have given a payout. Each participant then received an individual board and 30 stickers to be allocated according to the types of insurance and levels of coverage they wanted. The 30 stickers corresponded to 600 taka (approximately US$8), which represents a reasonable amount that a typical farming household would spend on an annual insurance premium.[5]

Participants who preferred not to purchase insurance could elect to keep their money in their current individual savings account, with each sticker worth 20 taka in savings. Savings was described as earning a fixed rate of 5 percent annual interest and could be withdrawn at any time. In selected rounds, participants were offered a group savings option. If they decided to opt for group savings, they had to contribute 100 taka (five stickers), and BRAC would contribute 100 taka for each member in the village organization (VO) into the group savings fund. The terms of this fund would be decided upon by the group, which allowed the group to offer its members low-interest loans in the event of specified (agricultural or nonagricultural) emergencies not covered by any of the insurance offered. For example, farmers who experienced household-level shocks, such as illness in the family or localized pests, would be able to borrow from the fund.

Each experimental session had three decision rounds. The first two decisions were made individually on two separate boards, and the last decision was made as a group. The group savings option was included on one individual board and excluded from the other one.[6] In addition, the group savings

[5] Mahul, Verma, and Clarke (2012) reported that for Indian farmers who purchase under the government of India's National Agricultural Insurance Scheme, the average farmer premium paid is around US$9.

[6] The order of which board was used first was randomized between sessions.

option was included on the group decision board in half of the sessions, which were randomly selected. During the first two individual sessions, facilitators sat with each participant to talk through the possible choices on the board and how to put the stickers in the segments corresponding to their decisions. Illiterate participants, in particular, needed assistance with understanding the exercise. Once a participant completed the first decision round, a facilitator asked him or her four simple questions to ensure the proper understanding of the board. This short test ensured that a farmer's decision was not driven by misinterpretation of the board.

We randomly varied the price of area-yield insurance across sessions. This was the only price that was varied; all other prices were constant across sessions. Varying the price of coverage allows a demand curve to be sketched. This is particularly important for area-yield indexed insurance, because it is typically more costly to offer than other indexed insurance because of the cost of conducting enough reliable crop cuts with which to calculate the average yield and determine payout. However, despite the high costs, area-yield insurance is attractive because it offers protection against any aggregate shock that may affect average yields, including severe weather, widespread pestilence, and crop disease. On average, the cost of this insurance was one-third more than the authors' estimate of the actuarially fair price.

To incentivize the participants, facilitators told them that the entire VO had a chance to be given one of the insurance packages they created for free, which would provide coverage for the upcoming year. Because farmers did not know which decision round (insurance package) would be chosen, they were told to think carefully about their decisions in each game. By framing the exercise in this manner, participants were encouraged to choose the optimal insurance package for their household.

Design of Indexes

We start by selecting the indexes that appropriately capture the major investment risks identified by Bangladeshi farmers and by explaining the specific design of each index insurance product. As mentioned earlier, both the survey outcomes and the results of other qualitative fieldwork informed the selection of indexes, and historical weather and yield data guided their design. Where possible, we examine how well the resulting insurance product would have performed in previous years—that is, whether the insurance offered would have given payouts in years when farmers suffered significant losses. Our indices, though not perfect, perform well given the longitudinal data available.[7]

Designing a credible, informed index for agriculture is challenging, because some elements of index design and evaluation are objective. In practice, however, there is substantial latitude for subjectivity because local agronomic knowledge and private-sector and marketing expertise are included in the process. Although significant innovations in index design for smallholder farmers have been developed in recent years, widely accepted best practices to identify and design good indices are still absent in the literature.

In this subsection, we detail how we designed the flood, drought, and area-yield indexes that were used to create insurance products offered to our sample of farmers in Bangladesh. Given the variation in reported sources of agricultural risk, we sought to design indices that would cover the following events: flood, deficient rain, and any other event that affects average yields in the subdistrict, such as pestilence or crop disease. A flood index was included for the *aman* season, which is more flood-prone, and the area yield and dry day indices covered both the *aman* and the *boro* seasons. (For details, see Table 4.1.) Separate indices were tailor designed for each of the two study districts—Manikganj and Bogra. To keep the premium at an affordable level, the indices were designed to cover catastrophic events that occur once in 10 years. In practice, indices can be calculated to provide coverage for 1-in-3-year or 1-in-5-year events, but the premium levels would increase.[8]

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[7] Further details can be provided upon request from the authors.

[8] A two-tailed t-test on the number of dangerous river height days in the *Aman* season suggested a statistically significant trend over the 30-year period, with best-estimate trends (and p-values) of +0.50 days per year (8.5 percent) for Manikganj and –1.38 days per year (2.1 percent) for Bogra. Hence, using the raw data to fix the thresholds would lead to overstating (understating) the number of dangerous river height days for the upcoming *Aman* season in Bogra (Manikganj). A linear trend of

The different index insurance products were designed using official weather data, river height data, and crop yield data. The Bangladesh Meteorological Department has collected high-quality data since 1952. Rainfall is recorded every three hours from 35 weather stations throughout Bangladesh, primarily for the purposes of weather forecasting. The index insurance contract offered in Bogra is based on the information from the weather station in Bogra, whereas the contract offered in Manikganj is based on the weather station in the adjacent district of Faridpur. Moreover, over the past 30 years, the Flood Forecasting and Warning Center of the Bangladesh Water Development Board has collected daily water height data at 342 water-level stations in order to assess the timing and duration of river flooding during the monsoon season. These data are used to identify the days when water levels were higher than the official danger level for each station.

The Bangladesh Bureau of Statistics (BBS) has collected yield data for major crops for several decades, with yield estimates based on a sample of crop cutting experiments (CCEs). District-level yield estimates are publicly available. The sampling is sufficient to allow yield estimates at the subdistrict level or yield estimates for distinct varieties of major crops at the district level. For example, for the *boro* season, separate yield estimates for local paddy, high-yielding paddy, and *paijam* paddy are available per district.

Extreme Flooding Index

This index is binary: it pays either zero or the full sum insured if the number of days when the river height rises above the danger level exceeds the threshold stated in the insurance contract. This threshold is fixed so that in a given year, the product is estimated to pay a claim with a probability of 10 percent.

The thresholds are based on data collected from government-operated river height stations along the Brahmaputra-Jamuna River for Manikganj, and along the Brahmaputra River for Bogra. The government-defined danger levels are 9.4 meters above sea level for Manikganj and 16.32 meters above sea level for Bogra. Historical data of river height levels are available from 1980 to 2009 for both districts. The presence of a trend in the number of dangerous river height days is detected by a t-test on the raw data and is appropriately factored in the calculations of the contractual thresholds in order to correctly capture the magnitude of the shock.

Extreme Drought Index

The extreme drought index is also binary: it pays either zero or the full sum insured and has a claim payment with an estimated probability of 10 percent (that is, 1-in-10-year events are covered by the index). To calculate the appropriate threshold, we use the definition of a *dry day* typically adopted in India (Clarke et al. 2012)—that is, a dry day is a day with recorded rainfall of fewer than 2 millimeters, which usually evaporates before entering the soil. In both Manikganj and Bogra, the total number of consecutive dry days for the *aman* and *boro* seasons does not exhibit a statistically significant trend; thus, thresholds are calculated by applying a kernel smoother to the historical consecutive dry days data before determining the trigger threshold.

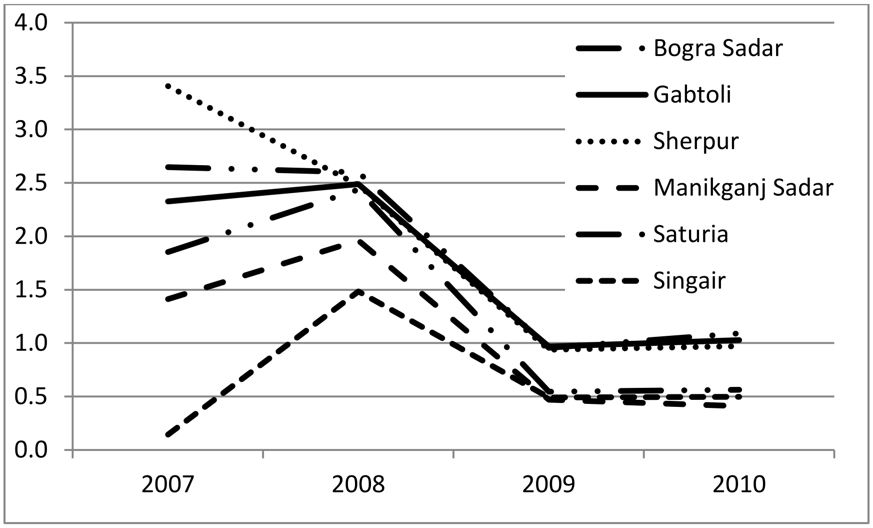
Area-Yield Indexes

For the sake of consistency with the other two indices, the area-yield index insurance for (rice) paddy pays either the full sum insured (with an estimated probability of 10 percent) or zero (with a probability of 90 percent). The area-yield index is modeled on historical data that have been collected by the BBS since 1987 on subdistrict yields of different rice varieties; other data sources were also used to create some

–1.38 days per year (+0.25 days per year) is used in Bogra (Manikganj). Applying a kernel smoother to the historical detrended dangerous days data suggests that the number of dangerous days equals or exceeds 73 (30) days for Bogra (Manikganj) with a probability of 10 percent.

adjustments. The procedure followed by the BBS for estimating yields has not changed significantly over the years: estimates are based on CCEs conducted during every harvest period.[9]

Figure 4.2—Paddy yields (tons per acre) in selected subdistricts



Source: Based on Bangladesh Bureau of Statistics (2007–2010) data.

We use data on *aman* paddy yields from BBS crop-cutting experiments in the six selected upazilas in Bogra and Manikganj to look at yield experience over the last four years (Figure 4.2). With the exception of Singair, yields were relatively good in 2007 and 2008 and relatively bad in 2009 and 2010. In Bogra district (covering Bogra Sadar, Gabtoli and Sherpur upazilas) the high pest incidence in 2009 and the long dry period in 2010 could have caused poor yields. In Manikganj district (covering Manikganj Sadar, Saturia and Singair) the very high pest incidence recorded in 2010 could explain the low yields.

Other Financial Products

Given the importance of household-level income shocks resulting from death or from health-related reasons within families (as reported during focus group discussions), three insurance products were developed to offer farmers protection against these often-unexpected shocks. Each insured event is easily observable, and the insurance can be easily administered. Quite simply, if one of the events described below were to occur within the coverage period (the upcoming year), the policy would give a payout of 15,000 taka, 30,000 taka, or 45,000 taka corresponding to whether the farmer bought the basic, medium, or high level of coverage, respectively.

- **Natural or accidental death.** If the farmer dies due to natural or accidental causes (during the coverage period), his or her family receives a payout. This is essentially life insurance, which is one type of insurance that seems to have a relatively high penetration level in rural Bangladesh.
- **Natural or accidental death of spouse.** If the farmer's spouse dies due to natural causes or due to an accident (during the coverage period), the farmer would receive a payout.
- **Loss of limb or eye.** If the farmer loses at least one arm, one leg, or one eye (during the coverage period), the farmer would receive a payout. Clearly, physical disability impairs the farmer's ability to be a productive member of the household; thus, this insurance payout would provide some support to the family and smooth their income.

[9] Specifically, the BBS uses a multistage stratified sampling procedure to estimate paddy yields for three major classes of rice varieties for each season. More than 10 CCEs are performed per subdistrict, paddy variety, and season.

Data on the prevalence of death and illness (a broader category than the disability classification used for the insurance product) are presented in Table 4.2. It is clear that these reported events are spread quite evenly across the years from 1996 to 2006, though recall error possibly caused higher reports of health shocks within the most recent years. Beckett et al. (2001) found that health problems are reported more often in years just prior to a survey, in the Malaysian Family Life Surveys.

Table 4.2—Number of households experiencing bereavement and illness each year

	Manikganj			Naogaon and Tangail		
Year	Death	Death of Spouse	Health	Death	Death of Spouse	Health
1996	0	0	0	0	0	0
1997	1	0	2	0	0	0
1998	2	4	19	1	0	2
1999	1	2	21	0	2	3
2000	1	2	28	0	0	3
2001	0	0	20	0	0	3
2002	1	1	22	0	0	9
2003	3	4	43	0	4	7
2004	6	4	52	0	2	4
2005	3	3	60	2	0	12
2006	3	0	93	0	1	25

Source: IFPRI surveys (2006–07).

Group Savings

To choose the group savings option, each farmer had to allocate five stickers (corresponding to 100 taka, or approximately US$1.20) on the CHAT board. By contributing the same fixed amount to the group savings account, each member of a village organization would be entitled to apply for withdrawing funds from this account in case of agricultural or nonagricultural (such as health) emergencies. The account would yield a 5 percent annual interest rate and be administered in accordance with well-defined rules agreed on by the group. Farmers were informed that if they chose this option, at the start of the year, the VO would choose clear rules for what qualifies as an emergency and for the maximum amount that could be lent for each emergency. Members would not be able to access their group savings contribution, except for in the case of an emergency loan, until mid-December. At that point the group could decide whether to keep the funds for the next year or whether the funds—plus 5 percent interest—would be returned to each member.

To some farmers, group savings may serve as a substitute for the life and disability insurance products that offer coverage against idiosyncratic household-level shocks. Alternatively, group savings may be viewed as a complement to index insurance. Because index insurance cannot cover idiosyncratic events that affect one farmer, that farmer would be able to leverage his group savings account to cover an emergency (thus reducing the basis risk associated with index insurance). Conversely, because group savings cannot cover catastrophic events that affect an entire village, index insurance would provide this coverage. Consider, as an example, these concrete situations in which group savings may or may not be useful: If a flood (the covariant shock) affects all the members of a village organization at a similar magnitude, the group savings fund will not be able to cover everyone's costs. However, if a localized pestilence significantly damages the crops of one group member, this farmer will be able to borrow from the group savings account to cover harvest losses.

Individual Savings

Farmers can allocate as many stickers as they want, up to the maximum endowment of 30 stickers (600 taka), toward their individual savings account. These accounts, which earn 5 percent annual interest and do not have withdrawal restrictions, were opened for each farmer as part of the BCUP program.

Savings can substitute for insurance by allowing an individual to pool risks across time (accumulating savings in good times and drawing down savings in bad times). However, choosing savings was also a farmer's way of opting out of purchasing any of the insurance products offered. Farmers are more likely to allocate the endowment toward individual savings (for safe-keeping and for the flexibility to withdraw at any time) if one or more of the following occur: (1) The farmer does not value the insurance products offered—for example, the farmer may face other risks not currently covered by the existing products, or the proposed contracts do not seem to be profitable. (2) The farmer has trust issues—for example, the farmer does not trust the insurance provider to offer fair products and administer the payments on time or does not trust other group members and thus would not consider participating in a group savings fund.

Characteristics of Participants and Tests of Balance

The insurance demand-elicitation exercise included 340 tenant farmers in the districts of Bogra and Manikganj. Under each district, three subdistricts were selected (see Table 3.3). Within each subdistrict, four BCUP village organizations (VOs) were chosen. Each session involved five to eight members of the same BCUP VO. Multiple small-group sessions were held to reach all the members in the VO, which typically had a total membership of about 20 farmers. A total of 54 sessions were completed to cover 24 VOs.

Summary statistics of the characteristics of these participants are presented in Table 4.3, which shows that farmers were middle-aged, had a low level of formal education but a good understanding of the insurance products, and were highly risk averse. Table 4.3 also shows that the characteristics of farmers were not significantly different across sessions in which group savings was offered first or second and when it was offered to the group or not (with the exception of age). To test for balance of observable characteristics across the differing price levels, we run a regression of the price on each characteristic of the participants; the coefficient on price and significance value is shown in the final column of Table 4.3. We find that men were more likely to receive lower area-yield prices, so we control for gender when interpreting coefficients on price.

Table 4.3—Test of balance of the respondent characteristics

	All	Group Savings First in Ind. Choices			Group Savings in Group Choice			Premium
		Treatment	Control	Difference	Treatment	Control	Difference	Difference
Age	36.84	38.01	35.81	2.2	35.13	38.27	-3.15**	-0.83*
				(1.14)			-1.11	(0.40)
Education	4.47	4.05	4.83	-0.78	5.04	3.99	1.05*	-0.01
				(0.44)			-0.44	(0.15)
Male (Yes = 1)	0.63	0.64	0.63	-0.78	0.65	0.63	0.02	-0.07***
				(0.44)			-0.06	(0.02)
Understanding	0.82	0.81	0.82	-0.01	0.82	0.81	0.01	0
				(0.03)			-0.03	(0.01)
Risk aversion	6.05	6.07	6.03	0.04	6.19	5.93	0.26	0.19*
				(0.25)			-0.24	(0.09)

Source: CIB survey (2011).
Notes: Standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. ASSESSING DEMAND FOR INSURANCE

Demand for Insurance Products

During the demand-elicitation exercise, about 90 percent of the endowed stickers were spent on insurance options, and the remaining 10 percent were spent on individual savings. However, this is not an accurate reflection of demand for insurance, in part because farmers were participating in a session that was specifically framed around risk management, which thus increased the salience of insurance products vis-à-vis other alternatives. The framing also suggested that participation involved moving stickers from savings (the default) to the insurance products covered in the circle (or to group savings once it was introduced), and, as a result, individuals may have had an increased tendency to select the insurance options offered. Therefore, we focus our analysis on the relative value that participants placed on agricultural, life, and disability insurance by comparing the allocation of stickers across the different insurance products.

Table 5.1 provides a description of the number of segments purchased for each type of insurance. Overall, farmers split their stickers quite evenly between life/disability insurance, where the death and death of spouse products were the most popular choices, and agricultural insurance, where dry days and area-yield products were the most commonly selected. This finding is consistent with the observation that these households face multiple sources of uninsured risk.

Table 5.1—Summary of type of insurance requested (percentages)

	Chose not to Buy	Number of Segments Purchased				Average Number of Segments Bought
		1	2	3	4 or more	
Grouped Insurance Products						
Life and disability insurance	7.93	4.37	8.74	27.83	51.13	3.90
Agricultural insurance	9.55	7.12	8.09	20.23	55.02	3.96
Aman insurance	25.40	11.65	17.64	28.96	16.34	2.13
Boro insurance	23.62	18.12	24.27	26.86	7.12	1.83
Separate Insurance Items						
Aman insurance						
Aman area yield	60.52	18.28	8.58	12.62	n/a	0.73
Aman dry days	61.17	14.24	9.06	15.53	n/a	0.79
Aman flood	66.83	14.72	9.22	9.22	n/a	0.61
Boro insurance						
Boro area yield	51.78	22.49	12.30	13.43	n/a	0.87
Boro dry days	52.43	17.96	11.00	18.61	n/a	0.96
Life and Disability Insurance						
Loss of limb or eye	48.54	17.80	16.02	17.64	n/a	1.03
Death of spouse	35.44	18.28	18.28	27.99	n/a	1.39
Death	32.20	16.67	21.84	29.29	n/a	1.48
Savings						
Individual	71.04	24.27	3.56	1.13	n/a	0.35
Group	42.40	n/a	n/a	57.60	n/a	1.70

Source: CIB survey (2011).
Note: n/a = not applicable.

To test whether demand for each insurance product reflects the prevalence of risks faced, we run a regression of demand for each product on the prevalence of the risk it was insuring against (using the proportion of households affected by each shock in the subdistrict as captured in the BCUP census, Table 3.2) and whether the individual reported being concerned about that risk in the CIB survey (Table 5.2).

Table 5.2—Relative significance of perceived importance versus prevalence of risk on insurance purchases

	***Boro* Area Yield**	***Boro* Dry Days**	***Aman* Area Yield**	***Aman* Dry Days**	***Aman* Flood[1]**	***Aman* Flood[2]**
Importance risk	0.05	-0.01	0.16	0.12	-0.16	0.26**
	(0.09)	(0.07)	(0.10)	(0.07)	(0.10)	(0.09)
Prevalence risk	1.83**	36.76***	1.69*	72.51***	-45.95	-8.65
	(0.67)	(6.24)	(0.74)	(6.87)	(42.40)	(37.38)
Price	-0.13*	-3.13***	-0.31***	-6.48***	5.33	0.69
	(0.06)	(0.54)	(0.07)	(0.60)	(5.17)	(4.55)
N	616	616	616	616	616	616

Source: CIB survey (2011).
Notes: Tobit regressions. The dependent variable is the number of segments of insurance purchased. *Aman* flood[1] offers coverage against too much rain in the *aman* season. *Aman* flood[2] offers coverage against flood in the *aman* season. Standard errors are clustered at respondents' level. * p < 0.1, ** p < 0.05, *** p < 0.01.

In columns 1 and 3 of Table 5.2, we look at whether demand for area-yield insurance was higher for those living in subdistricts where pest and disease had been more prevalent in the past five years ("prevalence risk") and, controlling for this pest prevalence, for individuals who reported being more concerned about pest and disease risk ("importance risk"). We find that demand for area-yield insurance is significantly higher among farmers living in subdistricts with higher pest and disease prevalence. However, controlling for subdistrict prevalence, variations in the reported importance of pest and disease risk across farmers does not affect their individual demand decisions.

In columns 2 and 4, we look at whether demand for drought insurance was higher for those living in subdistricts where drought had been more prevalent in the past five years ("prevalence risk") and, controlling for prevalence, for individuals who reported being more concerned about drought risk ("importance risk"). Again, we see that demand for drought insurance was much higher for those in subdistricts where drought was more recently prevalent and that, controlling for this, there was no additional variation in demand as a result of variations in the importance of this risk across farmers. Together, these results suggest that insurance demand does vary with the prevalence of the risk that it is insuring and that much of the important variation in prevalence of these two risks is well-captured in subdistrict measures of prevalence.

The results for flood insurance are quite different, and with good reason. Our flood index is designed to insure against river flood inundation; however, the prevalence risk data for flood asked only about flood in general. As such, it combines both river inundation and flash floods. The importance risk data distinguished between too much rain and river floods; as such, we can construct two measures of flood importance risk. The first definition for flood importance (used in column 5) refers to too much rain; the second definition for flood importance (used in column 6) refers to river inundation. In column 5, we see that neither the too-much-rain importance risk nor the general flood prevalence is a significant determinant of demand for flood insurance. In column 6, however, the river-inundation importance risk is a significant determinant of demand (as we would expect), although the general flood prevalence risk is still insignificant. The insignificance of the general flood prevalence could either be because it is capturing the wrong measure of flood risk or because flood risk is more locally concentrated, so that a subdistrict measure of prevalence is too aggregated to be accurate for any given household.

Demand for area-yield insurance falls with increasing price, as expected. To test this, we run a regression of demand for area-yield insurance on the price, and we control for other individual characteristics, round fixed effects (to control for any learning about insurance across rounds), and order fixed effects, which reflect whether group savings was offered in the first or second individual round. Results are presented in columns 1 and 6 of Table 5.3. We find the coefficient on price to be negative for both area-yield products, though only significantly for the *aman* area-yield product. Randomly changing the insurance premium across sessions did not affect the take-up of other agricultural insurance products, but it did increase demand for all of the insurance products that might complement flood and drought products when direct-yield insurance is not available. Specifically, the demand for insurance against own death, death of one's spouse, and disability increased, as did demand for individual and group savings (columns 9 and 10).

Table 5.3—Area-yield insurance price and demand for other types of insurance

	Boro **Area Yield**	***Boro*** **Dry Days**	**Loss Of Limb, Eye**	**Death Of Spouse**	**Death**	***Aman*** **Area Yield**	***Aman*** **Dry Days**	***Aman*** **Flood**	**Savings Individual**	**Savings Group**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Price	-0.03	0.22	0.43***	0.47***	0.46***	-0.10**	-0.11	0.22	0.03*	0.35**
	(0.03)	(0.13)	(0.12)	(0.13)	(0.13)	(0.03)	(0.11)	(0.11)	(0.02)	(0.12)
Age	0.02***	0	0	0.01	0	0.02***	0	0.01	0	0
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)
Education	0.01	-0.02	0	-0.01	0.01	0.02	0.01	-0.01	0	0
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Male	0.21	0.2	-0.18	-0.48***	0.06	0.1	0.25*	-0.03	0.02	0.16
(Yes = 1)	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)	(0.11)	(0.12)	(0.09)	(0.05)	(0.19)
Understan	-0.04	0.63*	-0.25	-0.33	-0.11	0.26	1.02***	-0.01	0.01	0.15
ding	(0.21)	(0.25)	(0.28)	(0.27)	(0.27)	(0.20)	(0.24)	(0.19)	(0.10)	(0.39)
Risk	0.02	-0.02	0.04	0.02	-0.01	0.03	0.01	-0.03	0.02	-0.01
aversion	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.04)
Order F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Round F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
R^2	0.4	0.42	0.45	0.59	0.6	0.35	0.39	0.29	0.38	0.58
N	614	614	614	614	614	614	614	614	614	307

Source: CIB survey (2011).
Notes: OLS regressions. The dependent variable is the number of segment of insurance purchased. Standard errors are clustered at respondents' level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Interestingly, controlling for other available participant characteristics, we find that male participants are more interested in the *aman* dry days insurance product than are female participants. In addition, female participants are more likely to purchase life insurance for their spouse to protect their consumption should the main income earner die. Older farmers are more interested in the area-yield products. These products likely have paid out several years ago, rather than in recent years; thus, older farmers could have remembered those years, which may have encouraged them to select area-yield insurance.

The degree of risk aversion, elicited through a selection of lotteries that were ranked by the degree of risk involved, does not appear to significantly determine the take-up of insurance overall. This finding could either reflect that we had a relatively poor measure of risk aversion (one question asked hypothetically in a short survey), or it could (for the index products) reflect that risk aversion is likely to have a nonlinear relationship with demand for index insurance products (Clarke 2011). Understanding of the insurance products is significantly, positively correlated with the purchase of dry days index insurance—more so for the *aman* season than for the irrigated *boro* season.

Interest in Group Savings

After life insurance, group savings was the most popular option: 58 percent of participants selected this option on their individual boards. Demand for group savings increased significantly to 77 percent when insurance decisions were made as a group. Table 5.4 presents regression results only for those insurance decisions in which the group savings option was included. Being offered group savings does not significantly affect the demand for other insurance options, except for own life insurance. This finding seems to imply that group savings may be viewed as a substitute for life insurance.

Table 5.4—Demand for other insurance options when group savings was offered

	Boro **Area Yield**	***Boro*** **Dry Days**	**Loss Of Limb, Eye**	**Death Of Spouse**	**Death**	***Aman*** **Area Yield**	***Aman*** **Dry Days**	***Aman*** **Flood**	**Savings Individu al**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Group savings	-0.11	-0.03	-0.13	-0.13	-0.21*	0.03	-0.12	-0.03	-0.03
	(0.09)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)	(0.09)	(0.09)	(0.04)
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Round F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.82	0.81	0.82	0.87	0.86	0.77	0.84	0.76	0.82
N	624	624	624	624	624	624	624	624	624

Source: CIB survey (2011).
Notes: OLS regression. The dependent variable is the number of segments of insurance purchased. Standard errors clustered at respondents' level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Interestingly we observe that when a group decision is being made about whether to invest in group insurance, group insurance is more likely to be selected (Tables 5.5). This finding could reflect that decisions in groups were made somewhat democratically (more individuals preferred group savings when asked individually). Or it could reflect that when the group was given the opportunity to discuss the insurance options, they were able to discuss how the group savings could be organized, and with a clearer idea of the rules in place, it became a more attractive option. The literature on group polarization processes (Isenberg 1986) would lend credence to the view that when acting as a group, individuals make decisions consistent with the majority in the group and thus appear more extreme. Gong, Baron, and Kunreuther (2009) showed specifically that this dynamic can make individuals appear more cooperative when making choices together under uncertainty.

Table 5.5—Demand for group savings when decision made as a group

	Proportion Selecting Group Savings Option
Individual decision	0.58
Group decision	0.77
Test of difference	1.92*

Source: CIB survey (2011).
Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

To test whether the group tended to make decisions democratically, we first regress the group choice on the average of the individual choices of those in the group (Table 5.6). The positive coefficients indicate that decisions made at the group level match the average individual allocation. In the case of group savings and *aman* dry days, the group decision almost converges to the average individual choice.

Table 5.6—Group and individual choices

	***Boro* Area Yield**	***Boro* Dry Days**	**Loss Of Limb, Eye**	**Death Of Spouse**	**Death**	***Aman* Area Yield**	***Aman* Dry Days**	***Aman* Flood**	**Savings Individual**	**Savings Group**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Average individual segments	0.36*	0.36*	0.59***	0.51**	0.67***	0.46**	0.94***	0.65***	0.25	1.01***
	(0.20)	(0.20)	(0.19)	(0.21)	(0.21)	(0.21)	(0.13)	(0.16)	(0.16)	(0.14)
R^2	0.06	0.06	0.16	0.1	0.16	0.09	0.51	0.23	0.05	0.52
N	54	54	54	54	54	54	54	54	54	54

Source: CIB survey (2011).
Notes: OLS regressions. The dependent variable is the number of segments of insurance purchased in the group decision. Standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We then examine whose purchase decisions are more likely to differ from the decision made as a group. We may anticipate that those with more power in the group are better able to enforce their preferences. As such, we would expect the difference to be smaller for these individuals. From the short survey that was conducted, a good measure of power is difficult to find; so instead we use age, education, and gender as proxies. Table 5.7 presents results from regressions in which the dependent variable is the absolute difference between the number of segments purchased in the individual decision and the group decision. We find that individual and group allocations differ less for group savings when individuals are more educated, suggesting that individuals who are more educated are better able to influence the outcome of the decision on this insurance product (see column 10). For most of the other insurance products, we do not find that the more educated, older, or male members are more likely to exert their preferences on the group. We do find, however, that the difference between individual demand and group choice is larger for individuals who were more different from the average in their choice to begin with. For example, we find that older participants are more likely to prefer area-yield insurance; as such, we find that their individual choice on area-yield insurance is different from the group average. We observe a similar finding for understanding and drought insurance. Although there are some additional differences, they are not systematic, and the significance is weak.

Table 5.7—Demand for insurance, absolute value difference (individual-group decisions)

	Boro Area Yield	*Boro* Dry Days	Loss Of Limb, Eye	Death Of Spouse	Death	*Aman* Area Yield	*Aman* Dry Days	*Aman* Flood	Savings Individual	Savings Group
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Price	-0.19***	0.19	0.57***	0.45**	0.53**	-0.19***	-0.08	0.19	0.02	0.33*
	(0.04)	(0.19)	(0.15)	(0.16)	(0.17)	(0.04)	(0.15)	(0.13)	(0.02)	(0.14)
Age	0	0	0	0	-0.01	0.01**	0	0	0	-0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
Education	0	-0.02	0	0.03	0.02	0.04*	0.02	0	-0.01	-0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Male (Yes = 1)	0.09	0.27*	-0.23*	-0.16	-0.17	-0.23	-0.01	-0.16	0.04	0.49**
	(0.12)	(0.12)	(0.10)	(0.13)	(0.13)	(0.12)	(0.11)	(0.11)	(0.05)	(0.18)
Understanding	0.42*	0.45	-0.46*	-0.29	-0.35	0.16	0.78***	0.22	-0.02	-0.08
	(0.21)	(0.26)	(0.20)	(0.25)	(0.27)	(0.20)	(0.20)	(0.21)	(0.10)	(0.39)
Risk aversion	0.01	-0.03	-0.03	-0.07*	-0.02	0.01	0.03	0.01	0.02**	-0.07*
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.04)
Members in group	0.19***	0.04	0.02	0.06	0.03	0.16***	-0.02	-0.03	0.01	0.11
	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)	(0.03)	(0.04)	(0.04)	(0.02)	(0.07)
R^2	0.57	0.52	0.6	0.55	0.56	0.5	0.35	0.36	0.41	0.55
N	307	307	307	307	307	307	307	307	307	307

Source: CIB survey (2011).

Notes: OLS regressions. The dependent variable is the absolute value of the difference in segment of insurance purchased between individual and group decisions. Standard errors clustered at respondents' level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Price has a significant impact on the difference between individual and group decisions. Specifically, when the price of area-yield insurance is high, there is convergence between individual and group decisions on how much area-yield cover to purchase, but there is divergence on how much to purchase of other products that were found to have significant positive cross-price elasticities (own life, life of spouse and disability insurance, and group savings).

6. CONCLUSIONS

By combining multiple sources of data, we first describe the perceived and actual risks faced by farmers in rural Bangladesh, as well as the risk-coping mechanisms adopted in the absence of well-developed insurance markets. After identifying these major risks, we then design insurance products to offer coverage against those risks.

We test the appeal of the agricultural index insurance products and the life and disability insurance products through an incentive-compatible demand-elicitation exercise. Consistent with economic theory, farmers buy more of the insurance products that cover the risks they primarily face. However, because they are subject to a variety of risks, they do not focus on only one type of insurance; this study shows how farmers evenly split their endowment between life and disability insurance and agricultural insurance, which suggests that farmers care about both covariant and individual shocks.

Moreover, we find that when the price of area-yield insurance is randomly increased, the demand for area-yield insurance falls. Important cross-price elasticities are also found. As the price of area-yield insurance increases, demand for nonindex insurance products and individual savings rises, confirming that farmers substitute away from the more expensive product and suggesting that they do so in ways that would complement other index products. Demand for other index products does not change with area-yield insurance.

Farmers showed a strong interest in the group savings option as a useful addition to their comprehensive insurance package to cover major covariant and idiosyncratic shocks; however, the presence of group savings does not affect demand for other insurance products offered. Group savings was particularly popular when decisions about its purchase were made as a group, which could reflect the general democratic tendencies observed in group decision making over insurance purchases. However, we also find evidence consistent with increased encouragement from more educated individuals for others to do as they did.

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