AGRICULTURE AND RURAL DEVELOPMENT DISCUSSION PAPER 50

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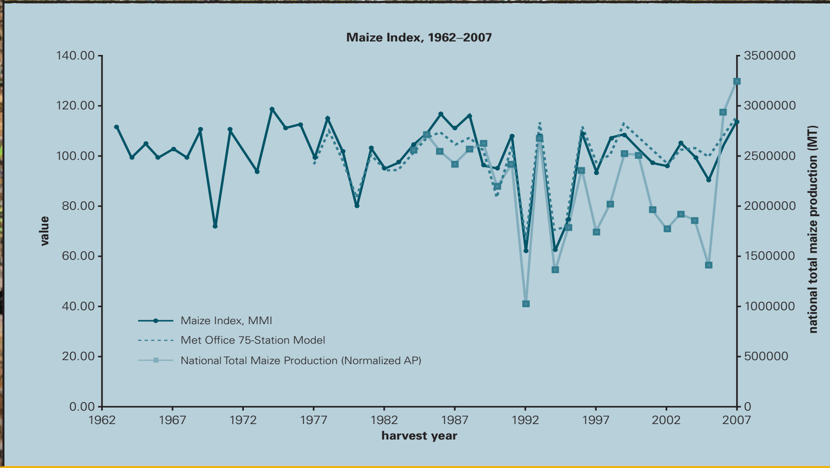
WEATHER INDEX INSURANCE FOR AGRICULTURE:

Guidance for Development Practitioners





THE WORLD BANK

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About the Authors

The authors are World Bank staff and consultants. The opinions expressed in this paper are solely those of the authors.

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The Authors—Maize Index vs National Production.

Table of CONTENTS

ACKNOWLEDGMENTS

This paper presents the findings of almost eight years of research and development into the topic of weather index insurance at the World Bank. It is the culmination of the efforts of a relatively small and dedicated team of individuals (both staff and consultants). It has been a challenging "voyage of discovery," addressing both technological and practical barriers to the development of weather index insurance products in a number of developing countries. This applied research was made possible largely through generous funding received from the Swiss and Dutch governments (SECO and Dutch Ministry of Foreign Affairs, respectively) and also from the European Union (largely under the All Agricultural Commodities Programme for the ACP Countries).

The core team working on this area consisted of (at various times) Erin Bryla-Tressler, Joanna Syroka, Julie Dana, Ornsaran Pomme Manuamorn, Alex Lotsch, William Dick, Andrea Stoppa, Sandro Calmanti, Erik Chavez, Xavi Gine, Panos Varangis, Ulrich Hess, Steve Jaffee, Carlos Arce, Jerry Skees, Mario Miranda, Richard Carpenter, Olivier Mahul, Ramiro Itturioz, David Rohrbach, Diego Arias, John Nash, Hector Ibarra, Pablo Valdivia, Roy Parizat, Vikas Choudhary, Marc Sadler, IRI Columbia, MicroEnsure, Swiss Re, the Rockefeller Foundation, Financial Sector Deepening Trust, the World Food Programme, FIDES, and Oxfam. In addition, a vast number of both private and public sector stakeholders in a number of developing countries have dedicated their time and efforts to collaborate with the team to endeavor to establish the necessary conditions for product development and distribution.

While the research and development phase at the World Bank is drawing largely to a close on this subject, it should be noted that there are a large number of other initiatives active in this field. Researchers, academics, insurance companies, reinsurers, donors, and development practitioners continue to seek new and innovative solutions to the challenges of scaling up index insurance and the development of products that effectively seek to transfer at least some of the risk that farmers face in developing countries on a daily basis.

ACRONYMS AND ABBREVIATIONS

AET	actual evapotranspiration
AICI	Agricultural Insurance Company of India
ARMT	Agricultural Risk Management Team
BAAC	Bank for Agriculture and Agriculture Cooperatives of Thailand
BIP	base insurance product
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CGMG	Gallagher Insurance Brokers Ltd
CV	contingent valuation
EOS	end-of-season
FAO	Food and Agriculture Organization
FEWS-NET	Famine Early Warning Network
FIDES	*Federación Interamericana de Empresas de Seguro*
GCC	government catastrophic cover
GIIF	Global Index Insurance Facility
GTF	GIIF Trust Fund
GIS	geographical information system
GSM	Global System for Mobile Communications
GTS	Global Telecommunication System
GUI	graphic user interface
IBRD	International Bank for Reconstruction and Development
IFAD	International Fund for Agricultural Development
IFC	International Financial Corporation
ILRI	International Livestock Research Institute
LGP	length of growing period
LRI	livestock risk insurance
MFI	microfinance institution
MOA	Ministry of Agriculture
MPCI	Multiple Peril Crop Insurance
NAIS	National Agricultural Insurance Scheme of India
NARR	North American Regional Reanalysis
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NDVI	normalized difference vegetation index
NGO	nongovernmental organization
NMO	National Meteorological Office
NOAA	National Oceanic and Atmospheric Administration
OTC	over-the-counter contract
PET	potential evapotranspiration (also known as ETo)
PKSF	Palli Karma Sahayak Foundation
Q&A	questions and answers
R&D	research and development
SOS	start-of-season
TTL	task team leader
TOR	terms of reference
VAR	value at risk
WBG	World Bank Group
WFP	World Food Programme
WII	Weather Index Insurance
WMO	World Meteorological Organization
WR	water requirement
WRM	weather risk management
WRSI	Water Requirement Satisfaction Index
WTP	willingness to pay

EXECUTIVE SUMMARY

Since the late 1990s, there has been a lot of discussion and debate about the promise and potential uses of index based agriculture insurance. As theoretical discussion of the advantages of index over traditional insurance turned to a need for practical examples, a plethora of pilot schemes began to emerge. A 2005 World Bank publication "Managing Agricultural Production Risk" set out, in some detail, the potential benefits of index insurance and some early examples of its application in developing countries. Since that time a large amount of research and piloting of the product has been undertaken both within and outside of the World Bank. However, despite this experience and effort, there have been few examples of successful scale-up at the farmer level, unless achieved through policy or financial tools by governments and/or heavy financial support from donors.

The following paper is a distillation of the findings of the work undertaken by the World Bank. It is deliberately not a collation of case studies, but rather a practical overview of the subject. The purpose of this paper is to introduce task managers and development professionals, who are not insurance sector specialists, to weather index insurance. We seek to place this relatively new insurance product in a broader context of agricultural risk management and more specifically within the context of agricultural insurance. Ultimately, the paper seeks to take the reader through the main decision points that would lead to a decision to embark upon a weather index insurance pilot and then assists them to understand the technical procedures and requirements that are involved with it. In addition, the paper seeks to advise the reader of the practical challenges and implications that are involved with a pilot of this nature and what they might expect to encounter during the initial stages of implementation.

As with the paper itself, this executive summary is a little unusual. Given the "guidelines" nature of the paper, it is not practical to produce an executive summary, as this will merely end up losing the richness of the practical content and end up as a list of what to do next. Instead, what follows are some of the main messages and findings of the World Bank in this area. While they may not flow directly from a subsequent reading of the text, this executive summary is, perhaps, the best place to flag some of the issues in what is not (by its very nature) a discussion paper.

While risk is a factor that affects all areas of human endeavour and activity, risk in agriculture is particularly problematic. Agriculture's reliance on natural conditions (rain, temperature, sunlight, etc.) and lack of ability to either control them or effectively mitigate when they are insufficient or too abundant means that things go wrong in agriculture on a very regular basis (high frequency). The fact that these phenomena tend to affect large areas invariably means that when things do go wrong, a lot of people are affected (covariance). Finally, due to the nature of farming systems in developing countries, when things go wrong it can often result in big losses (high impact). Most insurance products are able to provide you coverage from loss at attractive premiums because risks rarely materialize (low frequency), normally happen to only a very few of the insured (idiosyncratic) and oftentimes losses are low and below the threshold of the actual insurance (low impact).

Before managing agricultural risk, it must first be assessed and approaches identified that can be used to most efficiently and practically manage it. While insurance is generally the first thing that comes to mind for most people when they think of risk, it is important to understand that in agriculture (due to the above problems), it is often the least attractive or practical approach. Risk management mainly consists of 3 types of activity—mitigation, transfer, and coping. Mitigation covers a number of traditional activities. From irrigation to hybrid seeds, from vaccinations to pest control, many agricultural activities are really the application of risk management approaches. Many vets would not consider themselves to be risk managers, but in effect, that is a large part of what they do. Transfer is the simple act of passing one's financial risk to a third party, who is prepared to accept it because they charge a fee (or premium) for the service. Crop insurance and price hedging are the most common forms of transfer in agriculture, but they are often very expensive. Coping is often a residual activity, where a party is unable to either mitigate or transfer and therefore is forced to take either physical and/or financial measures to be able to cope with the impacts of a risk once it is realized. Before embarking on the use of a particular product, it is imperative to clearly identify the risk faced and to assess the potential to use one or a combination of the above risk management activities.

Based on a verifiable and independent measurement of a variable that impacts crop development, it is argued that index insurance can potentially reduce insurance premiums and make insurance accessible to more farmers. The cost of insurance is made up of two components. First, the underlying risk based on the frequency, severity, and extent of impact of loss (known as pure risk). Second, there are also large costs involved in administering and implementing insurance—mainly individual risk assessment and loss adjustment. Together, specifically in agriculture, these costs are very high and therefore premiums are excessive for most farmers (hence most agricultural insurance schemes are subsidized). Index based insurance, at least theoretically, can cover many farmers in a given area without the need for loss assessment and adjustment or the need for excessive paperwork and individual risk assessment when writing a policy. This can reduce some of the administrative and implementation costs, and also has the potential to reduce payouts where loss is due to factors other than natural factors (e.g., farmer malfeasance or poor farming practices).

Pre-feasibility work is important, as initiating index insurance schemes is often very challenging. For example, the need for accurate and reliable data for the establishment of the index creates major challenges in many developing countries. For years there has been underinvestment in meteorological services and infrastructure and very often data series are simply not available. There are a number of prerequisites that are necessary for the implementation of pilot or scheme and practitioners should seek to identify whether these are available at the very outset of the activity. In certain cases, where some prerequisites are missing, there may be alternative solutions and technology can play an important role in this regard. For example, where traditional weather data is missing, "synthetic weather" has been constructed using a number of data sources to backfill missing gaps.

The implementation of index insurance schemes is technically very challenging. This guide, while it seeks to assist the reader to understand the concepts and implications of indexes and parametrics, does not attempt to verse the reader in the intricacies of mathematical modeling, data manipulation and crop phenology. Until such time as local capacity in these and other areas is developed, there will be a heavy reliance on international technical assistance. Not only does the technical nature of the product make it expensive to develop indexes, it also makes it difficult to market to potential policyholders. There have been particularly innovative and interesting attempts to demystify the product at the marketing stage and to ensure that policyholders were cognizant of the nature of the coverage that they had. However, these capacity building and awareness activities come at a significant cost in terms of time and money, and few, if any, local insurers appear willing to make such investments.

The very nature of an index based product creates the chance that an insured party may not be paid when they suffer loss and/or that they may receive a payment when they have suffered no loss. Known as basis risk, this phenomenon is a particular problem for index products. It is frequently caused by the fact that the measured variable (e.g., rain) at the measurement site differs from that on the individual farmer's field or that the complex rainfall data and crop models calculation fail to accurately capture yield losses. Of course, there is also the problem that index products tend to only capture one variable and loss can be caused by a number of factors (e.g., a farmer is covered for drought, but lost his crops to disease). There is a "duality" to basis risk—insurers who have received premiums from farmers who have suffered losses, but are not paying due to a lack of a triggering of the index, face serious reputational problems. They run the real risk that such incidents can negatively impact other products that they sell in the market (e.g., auto insurance, life insurance, etc.). Arguably, part of the reason for the failure for scale-up on the index product by commercial insurers is directly linked to this duality of basis risk.

Practitioners should be aware that there are practical challenges to product roll out and establishment of a sustainable pilot. While creation of a viable index is challenging from a technical point of view, the roll out of the product and its sale to potential policyholders can be very time consuming and unsuccessful. Not only do such issues as willingness to purchase and availability of money to pay premiums emerge at this stage of implementation, but the strength and resolve of local partners (banks and insurers) is often tested. The amount of time required to market the product and effect sales should not be underestimated and note should be taken of the extra challenges posed by highly disaggregated and remote farming communities. A notable challenge to sustainability is the dropout rate of farmers who purchase insurance, but do not receive payouts either because of a good growing season or as victims of the basis risk. While retention rates and new policy sales are very positively impacted by early pay outs, clearly this is only possible when there are small numbers of insured and payouts are small relative to premiums. This approach to product branding and promotion will not be sustainable in the long term, while is clearly technically incorrect in the short term.

There is a lack of clarity as to the regulatory and legal status of index based products in nearly all jurisdictions. Clearly, index products do not align with the traditional definition of insurance, as they do not indemnify actual loss and a policyholder does not actually have to have an insurable interest before they purchase an index based contract. Certain commentators have referred to these products as amounting to little more than gaming or lottery type activities. This is important for a numbers of reasons, but chief among them is that, without strict regulation, buyers of these products will not have their interests protected by law. Equally, if not subject to the relevant financial regulations, sellers of these products may not make suitable financial provision for them and therefore be unable to make payments in the case of loss. To date, most pilots have been authorized by national regulators on the basis that they involve very few parties and that any losses will be covered by the implementing parties. Before any major scale up of index products is therefore envisaged, the legal and regulatory issues in the country will need to be addressed.

While experience with the product has been mixed, there still appear to be some promising applications of the product that can benefit farmers in developing countries. The original concentration on index products was to make them available for poor farmers and, while this approach has had limited success, there may still be approaches that might lead to some form of positive outcome, be that through enhanced use of technology, improved modeling, and so forth. In addition to this, there would also appear to be the potential to make the benefits of index products available to some farmers through risk aggregators such as banks or input suppliers. For those farmers who are not able to access these sorts of service providers, the use of index products as a source of contingent finance or revenues for the purposes of funding social protection and/or recovery type activities could potentially be very powerful, either at the macro or community level.

The reader should be aware that there is no single methodology in this field and this paper does not seek to prescribe one, but does describe an approach that has been used in a number of index pilot activities undertaken by the World Bank and its partners. Indeed, it should be noted that this field continues to develop and benefit from innovations in many technical areas. This paper also does not seek to delve deeply into the technical details and science that lie behind the "black box" that is at the heart of the index. For the more technical audience, we would suggest that they refer to resources such as "Designing Index Based Weather Risk Management Programs" (available at www.agrisktraining.org or in CD format upon request from the Agricultural Risk Management Team at the World Bank).

Chapter 1: AGRICULTURAL RISKS AND RISK MANAGEMENT

Risk and uncertainty are ubiquitous and varied within agriculture and agricultural supply chains. This stems from a range of factors including the vagaries of weather, the unpredictable nature of biological processes, the pronounced seasonality of production and market cycles, the geographical separation of production and end uses, and the unique and uncertain political economy of food and agriculture sectors, both domestic and international.[1]

The above statement represents the day-to-day realities of life for hundreds of millions of farmers in developed and developing countries around the world. However, the impacts of realized agricultural risks are not peculiar to farmers alone. The companies and service industries that supply the farmers, the processing and logistics companies that move the produce from farm to the markets (that is, the wider supply chain), and ultimately the consumer all suffer to one extent or another.

Agricultural risks can range from independent (for example, localized hail losses or an individual farmer's illness) to highly correlated (for example, market price risk or widespread drought). Managing risks in agriculture is particularly challenging, as many risks are highly correlated, resulting in whole communities being affected at the same time. Clearly, given the widespread nature of resultant loss, financial recovery is particularly difficult and challenging. For governments, the fiscal implications of social safety net payments or the rebuilding of damaged infrastructure can be serious. For insurers, sudden losses suffered by a large number of policyholders places a strain on their reserves and financial stability. For farming communities, there is often no other option than to sell assets, normally at distressed prices.

Although this paper addresses only a certain type of risk (weather) and a specific method of seeking to manage it (insurance) and a specific type of insurance product (weather index) and in a particular economic context (developing countries), we shall briefly discuss in this chapter the following:

- Risks prevalent at the farm level
- Risks prevalent within supply chains
- Assessment of risk
- What is entailed in risk management

1.1 FARM-LEVEL RISKS AND CONSTRAINTS

Risks faced by farmers are numerous and varied, and are specific to the country, climate, and local agricultural production systems. These risks and their impacts on farmers are widely researched and classified in the literature and therefore we will not seek to cover the issues here.[2] The key risks faced by farmers are shown in table 1.1.

Additionally, farmers face constraints that do not enable them to either improve or increase their production and revenues. Examples of such constraints are limited access to finance, dislocation from markets, poor access to inputs, lack of advisory services and information, and poor infrastructure (for example, irrigation or rural roads). These constraints are generally worse in low-income countries, where public goods and private sector service delivery are often poorly developed.

The importance of noting the difference between a risk and a constraint is that often the latter are a function of the former. For example, many argue (and it would seem logical) that access to finance (in terms of both cost and availability) for farmers in developing countries would improve if the potential financiers were able to be assured that the risks inherent with agricultural production had been managed, thereby reducing their repayment risk.

Of course, many constraints are often not driven by one underlying risk alone. Taking access to finance once more as

1 See Jaffee, S., Siegel, P., and Andrews, C. (2010). "Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework." The World Bank. Washington. D.C.

2 For a synthesis of risk management literature see Barnett, B., and K. Coble (2008). "Poverty Traps and Index-Based Risk Transfer Products." *World Development* 36:1766–1785.

TABLE 1.1: Key Risks Faced by Farmers

RISK	EXAMPLES/ FACTORS	EFFECTS
Weather risks	Rainfall or temperature variability or extreme events	Lower yields, loss of productive assets or income
Biological risks	Pests, disease, contamination	Lower yields, loss of income
Price risks	Low prices, market supply and demand, volatility	Lower prices, loss of income
Labor and health risks	Illness, death, injury	Loss of productivity, loss of income, increased costs
Policy and political risks	Regulatory changes, political upheaval, disruption of markets, unrest	Changes in costs, taxes, market access

Source: Authors.

an example, even if the underlying weather risk is managed through the purchase of an insurance product or installation of irrigation, this still leaves the financier running a number of risks. For example, the farmer may simply sell the product and not repay the bank, or prices may fall to such an extent at harvest that the revenue is insufficient to repay the loan amount, or perhaps the crop was destroyed by locusts and there was no crop left to sell at the due repayment date.

The issue of the existence of multiple risks in agriculture should be well noted. All too often, the apparent management of one major risk leaves stakeholders (although rarely the farmers) with the impression that the overall risk profile has been managed. However, this is often not the case; even when farmers and their partners have managed their own direct risks, indirect risks can cause losses. For example, an outbreak of aflatoxin in maize in a given country may lead to the imposition of an import ban by potential buyers. Even though farmers and the supply chain they are involved with may have well managed this risk and their maize is aflatoxin free, they will suffer from the country's market access restrictions.

Equally, even if a farmer has managed contamination risks in her own basket of goods, should the processor fail to control its crop collection or processing activities correctly, then the farmer may well suffer due to the exclusion of the processor from the market (there being no other buyer for the farmer's produce). Therefore, consideration of risk throughout a supply chain enables a more comprehensive assessment and management of risks.

1.2 SUPPLY CHAIN RISKS

Supply chains facilitate the flow of physical products, finance, and information. An agricultural supply chain encompasses all the input supply, production, postharvest, storage, processing, marketing and distribution, food service, and consumption functions along the "farm to fork" continuum for a given product (be it consumed fresh, processed, or from a food service provider), including the external enabling environment. These functions typically span other supply chains as well as geographic and political boundaries and often involve a wide range of public and private sector institutions and organizations.

The underlying objective of agricultural supply chain management is to provide the right products (quantity and quality), in the right amounts, to the right place, at the right time, and at a competitive cost—and to earn money doing so. Logistics and communications are embedded in all of these flows, and poor logistics and communications are often major constraints that can exacerbate underlying risks in many agricultural supply chains. For governments, there may be broader objectives involved, especially where the supply chain is especially strategic for trade or critical in the domestic food system. Risks within the supply chain are shown in table 1.2.

Given the complexities of agricultural supply chains and the products that they work with, there is little surprise as to the extent of the risks. One factor that complicates the situation and increases the number of risks within these supply chains is the perishability of the products involved and also the fact that many of them are intended for human consumption (which means that more controls are required in order to ensure human safety). Effective management of these risks generally requires the close cooperation of the various supply chain actors and a degree of sophistication and flexibility that is often not found in developing countries.

1.3 RISK ASSESSMENT

Although being aware of a risk is clearly important, before one can consider managing it, one must actually assess the risk being considered. Risks (and their impacts) are assessed by quantifying three main variables: hazard, vulnerability, and exposure.

- **Hazard** is the categorization of the type of risk being considered—for example, weather, price, pest, policy, or market. The quantification of the hazard is then undertaken by assessing three subvariables:
  - Frequency: How often or likely is the risk to occur?
  - Severity: What are the likely fiscal impacts of such a risk if it occurs?

TABLE 1.2: Major Risks in Agricultural Supply Chains

TYPE OF RISK	EXAMPLES
Weather	Periodic deficit or excess rainfall, varying temperatures, hail storms, strong winds
Natural disaster (including extreme weather events)	Major floods, droughts, hurricanes, cyclones, typhoons, earthquakes, volcanic activity
Biology and environment	Crop/livestock pests and diseases; contamination caused by poor sanitation, humans, or illnesses; contamination affecting food safety, natural resources/environment, or production and processing
Market	Changes in supply or demand that impact domestic or international prices of inputs or outputs; changes in demand for quantity or quality attributes, food safety requirements, or timing of product delivery; changes in enterprise or supply chain reputation and dependability
Logistics and infrastructure	Changes in transportation, communication, or energy costs; degraded or undependable transportation, communication, or energy infrastructure; physical destruction, conflicts, or labor disputes affecting transportation, communication, energy infrastructure, and services
Management and operations	Poor management decisions; poor quality control; forecast and planning errors; breakdowns in farm or farm equipment; use of outdated seeds; lack of preparation to change product, process, markets; inability to adapt to changes in cash and labor flows
Policy and institutions	Uncertain monetary, fiscal, and tax policies; uncertain regulatory and legal policies or enforcement; uncertain policies on trade, market, or land and tenure systems; governance-related uncertainty; weak institutional capacity to implement regulatory mandates
Politics	Security-related risks; uncertainty associated with sociopolitical instability within a country or in neighboring countries; interruption of trade due to disputes with other countries; nationalization or confiscation of assets

Source: Jaffee, S., Siegel, P., and Andrews, C. 2010. "Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework." The World Bank. Washington. D.C.

  - Spatial extent: How widespread would the impact of the risk be—one person? one village? one country?
- **Vulnerability** is an estimation of what the impact of the realized risk would be given the assets affected by the event and taking into account the current ability to manage the impact.
- **Exposure** is the identification of the location of crops, livestock, and farm holdings that may be directly impacted by the hazard. Interdependency in the supply chain leads to indirect exposure for other parties.

Clearly this process of risk assessment involves the use of a number of assumptions and variables, so risk modeling is increasingly used as a tool to allow the development of probability estimates for financial losses. It should be noted that agricultural risk assessment is particularly dependent on the relationship between the timing of the loss event and the agricultural calendar. This is largely due to the fact that crop or livestock vulnerability varies according to the growth stage and season. In addition, risk assessment in agriculture is further complicated by the fact that vulnerability is heavily influenced by many local variables, such as soil, crop varieties, cultural practices, irrigation, and drainage. The use of and access to local knowledge and information is therefore essential to the interpretation of agricultural risk within a given area.

1.4 AGRICULTURAL RISK MANAGEMENT

1.4.1 Approaches

Having first become aware of a risk and then having assessed it, the next issue is how the party (or parties) at risk can seek to manage that risk. It should first be noted that risk management should be planned on an ex-ante basis (that is, before realization of an event); this is what is considered in this paper. Some ex-ante plans provide (financially or otherwise) for actions on an ex-post basis (for example, insurance payouts and government relief programs). Managing realized risks on an ex-post basis only is not considered to be risk management—after all, if something has already happened, it is no longer a risk (although a future reoccurrence might be). There is a great deal of literature on the subject of risk management and a surprisingly large amount of differing terminology in use. For the purposes of this paper and for the work of the Agricultural Risk Management Team (ARMT) at the World Bank, three clear approaches to risk management are considered:

- **Mitigation** is the lessening or limitation of the adverse impacts of hazards and related disasters. Risk mitigation options are numerous and varied (for example, crop and livestock diversification, income diversification, soil drainage, mulching, use of resistant seeds, avoidance of risky practices, and crop calendars).
- **Transfer** refers to the transfer of the potential financial consequences of particular risks from one party to another. While insurance is the best-known form of risk transfer, in developing countries the use of informal risk transfer within families and communities is extremely important.
- **Coping** refers to improving the resilience to withstand and manage events, through ex-ante preparation and making use of informal and formal mechanisms in order to sustain production and livelihoods following an event. Although we have noted that coping is an ex-post activity, it is possible to plan and to prepare for coping activities on an ex-ante basis. This is often fiscally beneficial, as the ability to quickly respond to events often reduces losses.

A fourth approach is that of **risk avoidance** or **risk prevention**. However, this is rarely possible in agricultural production, especially in developing countries where there are very few alternative sources of nonfarm employment.

1.4.2 Approaches: Informal Versus Formal

Farmers and their associated supply chains in developing countries have developed a range of informal and formal approaches to manage risk, and these are evident at the household, community, market, and government levels (see table 1.3). At the producer end of the supply chain, there is generally more reliance on informal approaches, whereas the later links in the chain tend to rely on more formal (and financially based) risk management approaches.

Clearly, informal approaches at the household level are related to the key hazards faced. For example, livestock are an important form of savings for the many households where drought is a risk, although this is an imperfect approach, as there may well be no feed available for the animal due to the drought and therefore it will be necessary to undertake "distressed" sales. Savings, buffer stocks, off-farm income, family networks, and informal borrowing also play a role. Community-level approaches, such as mutualization and mutual help, are normally informal or semiformal, although they can develop more formal structures as they become larger and more established.

More market-based, formal approaches include such things as formal savings, formal lending, and also insurance. Unfortunately, partly due to the number of risks prevalent at the farm level, access to credit tends to be severely restricted for agricultural borrowers. This problem is compounded by the fact that the majority of farmers have very low levels of collateral availability. Where more formal market arrangements exist (particularly for cash crops), farmers can benefit from some formal approaches. For example, contractual arrangements can lead to a packaging of credit and insurance services. With such contracts there may be the potential for advance price agreements and collateral enhancement through warehouse receipts.

1.5 WHICH RISKS? AND MANAGED BY WHOM?

As we suggested in the beginning of this chapter, it is not only farmers who are affected by agricultural sector risks.

TABLE 1.3: Risk Management Tools

SEVERITY OF RISK	POTENTIAL RISK MANAGEMENT MECHANISMS: HOUSEHOLD/COMMUNITY	MARKETS	GOVERNMENTS
Nonspecific	Sharecropping Farmer self-help groups Water resource management	New technology Improved seed	Irrigation infrastructure Extension Agricultural research Weather data systems
Low	Crop diversification Savings in livestock Food buffer stocks	Formal savings	
Moderate	Labor diversification Risk pooling (peers, family members) Money lenders	Formal lending Risk sharing (input suppliers, wholesalers)	State-sponsored lending
High/ Catastrophic	Sale of assets Migration	Insurance	Disaster relief State-sponsored insurance

Source: Authors.

In addition, it is also clear that different levels of the supply chain, or agricultural sector, have varying capacities (both financial and technical) to manage risks and that these are partly dependent on the severity of any given risk. As a consequence, the actual tools that are available to or used by the different stakeholders tend to differ. In table 1.3 we have provided some examples of the different tools according to severity and stakeholder.

1.6 PUBLIC-BASED EX-POST VERSUS MARKET-BASED EX-ANTE RISK MANAGEMENT TOOLS

In agricultural risk management, a distinction is necessary between measures that aim to create and foster the management of risk by *markets* (particularly insurance, savings, and formal lending) on an ex-ante basis and the management of risks by *government* (particularly emergency humanitarian relief, compensation for catastrophic events, and reconstruction of public goods) normally on an ex-post basis. Facilitating the use of market-based approaches can reduce the needs and scope for government interventions and thereby decrease the costs incurred by government in ex-post coping activities. For this reason, many governments are active in the promotion of market-based risk management and insurance (although they are normally operated through public-private partnerships). Examples of such activity are government subsidies, information and extension, and legal and regulatory measures, including those for insurance.[3]

However, when disasters strike or when there are losses that were not managed by the agricultural sector stakeholders, government intervention will be necessary, partly because not all risks are insurable and partly because not all farmers or stakeholders can or want to access commercial insurance. This latter issue of severity and requirement for government intervention raises the last main issue for this chapter: risk layering.

1.7 RISK LAYERING

The process of risk assessment and identification of risk management options also requires segmentation of levels of risk that can or should be retained by the farmer, managed by informal or community means, or transferred by instruments such as insurance. Risk layering, as this strategy is known, considers the practical and viable roles that can be played by the different levels of the agriculture sector or supply chain: farmers (micro level); processors, retailers, financiers, and insurers (meso level); and government (macro level). The main determinant in the development of the strategy is the ability of each level to manage with the given risk (either physically or financially). In addition to enabling any given risk to be shared among a number of parties (and thereby reducing the fiscal burden on any one party), the retention of risk at the differing levels also seeks to ensure that the parties will continue to act in a manner that seeks to actively manage the risk. If one party were totally absolved of a risk, then they might act in a manner that actually increases the likelihood or negative impact of the realized risk (there being no incentive to do otherwise).

A good example of this risk layering and risk retention is traditional auto insurance, where the policyholder has a deductible and a no-claims bonus. The deductible and bonus serve two functions. First, policyholders remain liable for minor damages to their vehicles, which are the most frequent sources of loss. Second, the policyholder is provided an incentive to drive in a responsible manner, avoiding causing losses to others. The net effect of this is that insurers are seeking only to accept transfer of the second tier, larger (but much more infrequent) losses on which they are able to charge reasonable premiums and for which they are able to make sufficient financial provisioning.

A more detailed example of risk layering for weather risk insurance is considered in Chapter 2.

1.8 WEATHER RISKS IN AGRICULTURE

As we have mentioned, the risk that we are discussing in this paper is weather. Obviously, given the vast variety and complexities of global climates, it is difficult to generalize when discussing weather-related risks. The impacts of a given weather event differ according to the specific agricultural system, variable water balances, type of soil and crop, and availability of other risk management tools (such as irrigation). Additionally, the negative impacts of weather events can be aggravated by poor infrastructure (such as poor drainage) and mismanagement.

From a weather risk management standpoint, there are two main types of risk to consider. These relate to (1) sudden, unforeseen events (for example, windstorms or heavy rain) and (2) cumulative events that occur over an extended period (for example, drought). The impacts that either of these types of risk have vary widely according to crop type and variety and timing of occurrences. Key weather risks are shown in table 1.4.

3 See Mahul, O., and C.J. Stutley (2010). "Government Support to Agricultural Insurance." The World Bank. Washington, DC.

TABLE 1.4: Main Weather-Related Risks Affecting Agriculture

HAZARD	COMMENT
Drought (rainfall deficit)	• Crop varieties adapted to mean rainfall and water balance • Rain-fed agriculture predominates globally • Annual or multiannual • Key risk to livestock
Excess rainfall and flood	• Excess rainfall causes direct damage and indirect impacts • Riverine, flash, coastal floods • Watershed management, drainage, irrigation have impact on flood
High temperatures	• Impact on evapotranspiration and related to drought • Seasonality and vulnerability to crop stages
Low temperatures	• Frost (short-term low temperatures, early and late season damages) • Freeze (winterkill) • Growing degree days (lack of warmth during season)
Wind	• Cyclonic severe events (hurricane or typhoon) • Frontal windstorm • Local windstorm and tornado
Hail	• Localized, but may be severe

Source: Authors.

1.9 RELATIONSHIP BETWEEN WEATHER AND YIELDS

Short-duration extreme weather events (such as hail, windstorm, or heavy frost) can cause devastating direct damage to crops in the fields. Assessment of these damages can be undertaken immediately by physical inspection. On the other hand, while the final outcome of cumulative events can be devastatingly obvious, much of the damage already occurred earlier during a stage of crop development. However, correlations of the weather event and damage are often difficult to model, except for the most extreme events. In the case of cumulative rainfall deficit (drought), the best correlations exist for rain-fed crops grown in areas where there is a clear sensitivity of the crop to deficits in available water, and clearly defined rainy seasons. An example is maize production in southern African countries, such as Zambia and Malawi. Less-clear relationships are found in areas of higher and more regular rainfall or less-clear seasonality, or where other influences, such as pest and disease, are important causes of crop losses. If partial or full irrigation is in place, the relationships become much less strong. Rain-fed production in the tropics (where rainfall is higher and less seasonally marked) is an example where correlations may be less easy to establish. However, droughts are also a feature of tropical crop production, where both floods and droughts can occur in the same year. In sum, making generalizations is risky.

1.10 WEATHER RISK MANAGEMENT APPROACHES

As noted, risk mitigation, coping, and transfer are the key strategies in agricultural risk management. Also, as discussed, these strategies can be applied at the household, community, market, and government levels. Examples of how these strategies apply in weather risk management are given in box 1.1.

KEY POINTS

- Agriculture is associated with many types of risk that expose farmers, agribusiness entities, and governments to potential losses.
- Many approaches can be employed to manage agriculture-related risks, and often several need to be applied within an overall risk management framework.
- Risk management strategies involve risk mitigation, risk transfer, and risk coping.
- Formal (market-based) approaches (including agricultural finance and insurance) allow disciplined financial management of risks but are often challenging to implement in developing countries and may not be suitable for managing extreme risks or disasters.
- Informal approaches are much more frequently found at the farmer level in developing countries. They include savings, household buffer stocks, community savings, and nonformalized mutuals.

BOX 1.1: Weather Risk Management: Strategies and Levels of Operation

Because weather so strongly impacts their livelihoods, farm households and their communities are motivated to develop and improve strategies to cope with and manage weather risks. Risk management strategies available to households can be grouped into three categories.

1. **Households and communities** employ risk management strategies that include crop and labor (on and off farm) diversification, risk-pooling arrangements among peers or family members, sharecropping, investing in semiliquid assets such as livestock or buffer stocks, farmer self-help groups, and loans from moneylenders.
2. **Markets** create mechanisms to help farm households manage weather risks, including new technology; improved seed varieties; formal financial services, including savings, lending, and insurance; risk-sharing arrangements with input suppliers and wholesalers; and information technology tools.
3. **Governments** make investments to help farm households manage weather risks. Governments can provide state-sponsored lending and insurance services; infrastructure, including roads, electricity, and water; educational services; research and development funding to improve technology used in agriculture; weather data and information systems; and disaster relief. Yet, because government resources in lower-income countries are limited, many households will not have access to most of these services. For example, disaster relief is often slow in coming and may not reach the households most in need. Thus, government help can be useful when households receive it, but in many cases, may not be something on which households can rely.

While many of the strategies described above can help households cope with the impact of low and moderate weather risks, these strategies are likely to be ineffective in the case of larger weather shocks. Major disasters render household strategies inadequate for several reasons.

First, diversification strategies will not adequately protect households in a major disaster that affects all sources of farm incomes. Crop diversification strategies may fail as households are likely to experience losses to both cash crops and subsistence crops because of catastrophic weather. Labor diversification strategies can also fail because labor income may also be tied to a good crop. Laborers who earn income from harvesting, transporting, or processing local commodities will also suffer from a catastrophic event that affects farm production.

Second, catastrophic weather events affect whole communities, causing intracommunity risk-pooling arrangements to break down. Strategies of reciprocity and risk pooling among neighbors and family members will fail if everyone is suffering from the same catastrophic event. Moneylenders, input suppliers, and wholesalers are also likely to have losses from defaults as the entire community is suffering. As households cope with losses, certain savings strategies such as owning livestock are also likely to break down as many households attempt to sell livestock at the same time, depressing local prices.

Finally, the development of formal lending and insurance services for agricultural production is also constrained by, among others, the risk of weather shocks as local lenders and insurers who operate in a single geographic area are often unwilling to extend loans and insurance to farmers because their losses would be too great if a catastrophic weather event occurred. Weather shocks can create high rates of loan defaults for bankers or indemnity payouts for insurers. Thus, many farm households lack access to formal credit and weather insurance because catastrophic risks are too high for local financial service providers.

Source: World Bank Agricultural Risk Management Training Materials.

- Insurance is a small part of an array of approaches and instruments that are available to help the financial management of risks through transfer to a third party.
- The risk-layering concept is useful for planning and structuring of risk financing and transfer. Layering risk allows systematic decisions for more efficient risk retention, mitigation, and risk transfer.

Chapter 2: AGRICULTURAL INSURANCE: A BACKGROUND

In Chapter 1 we saw that insurance is one of the tools that farmers and other stakeholders can use to manage risks that are too large to manage on their own (risk layering). Part of that risk is transferred to another party, who takes it in return for a fee (or premium). Where available and affordable, agricultural insurance (crop or livestock) can provide great benefits to farm households:

1. Insurance can (and should) be used to complement other risk management approaches. Farmers can rely on informal household- and community-level strategies such as crop and labor diversification to manage small to moderate risks. In the event of a major weather shock, insurance can be designed to protect against revenue or consumption losses. This enables households to avoid selling livelihood assets or drawing on savings.
2. Insurance can assist farmers in accessing new opportunities by improving their ability to borrow either money or in-kind credits. In doing so, farm households may potentially experience safer and possibly higher returns.

Crop and livestock insurance are widely used in high-income countries. Markets are large, and there is a long experience in finding ways to insure agriculture with traditional insurance products. Given the focus of this paper on a particular type of crop insurance product for a specific set of risks, a wide discussion on agricultural insurance (including livestock insurance) will not be undertaken here.[4] In the following sections we will consider both traditional and nontraditional crop insurance products and review their differences.

2.1 AGRICULTURAL CROP INSURANCE PRODUCTS

Crop insurance products can broadly be classified into two major groups: indemnity-based insurance and index insurance.

4 For a detailed discussion of the development of agricultural insurance and the role of governments in it, see Mahul, O., and C.J. Stutley (2010). *Ibid.*

2.1.1 Indemnity-Based Crop Insurance

There are two main indemnity products:

- *Damage-based indemnity insurance* (or *named peril crop insurance*). Damage-based indemnity insurance is crop insurance in which the insurance claim is calculated by measuring the percentage damage in the field soon after the damage occurs. The damage measured in the field, less a deductible expressed as a percentage, is applied to the pre-agreed sum insured. The sum insured may be based on production costs or on the expected revenue. Where damage cannot be measured accurately immediately after the loss, the assessment may be deferred until later in the crop season. Damage-based indemnity insurance is best known for hail, but is also used for other named peril insurance products (such as frost and excessive rainfall).
- *Yield-based crop insurance* (or *Multiple Peril Crop Insurance, MPCI*). Yield-based crop insurance is coverage in which an insured yield (for example, tons/ha) is established as a percentage of the farmer's historical average yield. The insured yield is typically between 50 percent and 70 percent of the average yield on the farm. If the realized yield is less than the insured yield, an indemnity is paid equal to the difference between the actual yield and the insured yield, multiplied by a pre-agreed value. Yield-based crop insurance typically protects against multiple perils, meaning that it covers many different causes of yield loss (often because it is generally difficult to determine the exact cause of loss).

2.1.2 Index-Based Crop Insurance

Currently there are two types of index product:

- *Area yield index insurance*. Here the indemnity is based on the realized average yield of an area such as a county or district, not the actual yield of the insured party. The insured yield is established as a percentage of the average yield for the area. An indemnity is paid if the realized yield for the area is less than the insured yield regardless of the actual yield on a policyholder's

TABLE 2.1: Features of Crop Insurance Products

	PRODUCT	SUMMARY	PERILS	BENEFITS	CHALLENGES
TRADITIONAL PRODUCTS	Named peril crop insurance	• Specific perils • Damage-based policy • Measure % damage in field • Agreed sums insured • Operated in private sector • Generally unsubsidized • Experience in private sector	• Main: hail, fire • Other: frost, freeze, wind • Suited to localized, independently occurring, sudden perils • May include quality loss	• Simple policy • Limited farmer details needed at point of sale • Transparent loss assessment • Product experience • Manageable adverse selection and moral hazard (especially for hail)	• Individual farmer loss assessment • Loss assessment cost in small farmer systems • Not suited to complex perils, especially drought and pest
	Multiple Peril Crop Insurance (MPCI)	• All perils, few exclusions • Yield-based policy • Measure harvested yield • Compare to a % of average yield • High cost, often requires subsidy • Problematic for small farms • Concentrated in a few countries (USA, Canada, South Africa, Argentina) • Many failed attempts	• A wide list of perils • Difficult to exclude perils, as causes of loss cannot be identified • Includes management influences • May include quality loss • Occasionally includes some price risk	• More easily made into a "universal" product type • Limited technical adaptation required for different crops • Guarantees farmer production and income • Type of insurance farmers typically want and understand • Indemnifies each farmer according to yield	• Individual farmer loss assessment, major loss adjustment task, impartial loss adjustment difficult • Adverse selection (worst farmers benefit) • Moral hazard (exploitation of policy) • Major work to set up yield history for each farmer, poor data • High premium and administrative cost • Not suited where farms are small
INDEX-BASED PRODUCTS	Area yield index insurance	• Farmers grouped into assigned areas (e.g., district, county) • MPCI but on area average yield • All farmers in area treated equally • Effective where similar exposures affect whole districts • Largest program is NAIS (India)	• A wide list of perils • Difficult to exclude perils, as causes of loss cannot be identified • Includes management influences • May include quality loss • Occasionally includes some price risk	• No adverse selection, moral hazard, individual farmer loss adjustment • Low administrative costs • Can address catastrophe perils affecting group • Enrollment of farmers is easy • Captures all causes of yield loss	• Local perils (e.g., hail) will not result in payout • Yield history at local district level often not available or reliable • Basis risk at local level depending on district area and peril
	Weather Index Insurance (WII)	• Payouts based on weather station measurement • Index trigger, exit, increments set to expected loss of yield • Can be complex to design • Limited experience to date	• Main: rainfall deficit and excess; high, low, or prolonged temperatures • Other: high wind, sun • Combinations of above • Basis risk minimized for gradual events	• No adverse selection, moral hazard, individual farmer loss adjustment • Can address catastrophe perils affecting group • Transparent, objective Meteorological Service Data (MET) • Easier to reinsure	• Basis risk is key challenge • Setting up the index parameters is technically complex • Need good meteorological and agronomic data, crop modeling • Difficult to correlate damage for sudden-impact weather

Source: World Bank Agricultural Risk Management Training Materials.

farm. This type of index insurance requires historical area yield data.

- *Weather Index Insurance (WII)*. Here the indemnity is based on realizations of a specific weather parameter measured over a prespecified period of time at a particular weather station. The insurance can be structured to protect against index realizations that are either so high or so low that they are expected to cause crop losses. For example, the insurance can be structured to protect against either too much rainfall or too little. An indemnity is paid whenever the realized value of the index exceeds a prespecified threshold (for example, when protecting against too much rainfall) or when the index is less than the threshold (for example, when protecting against too little rainfall). The indemnity is calculated based on a pre-agreed sum insured per unit of the index.

Table 2.1 summarizes the main features, benefits, and challenges of these crop insurance products.

2.2 AGRICULTURAL INSURANCE IN DEVELOPING COUNTRIES

Access to agricultural insurance is generally very limited in developing countries. Quite simply, providing this type of insurance is challenging for insurers, resulting in costs that are normally prohibitive for farmers. Insurers have tended to concentrate on urban and industrial risks and therefore often do not have networks in rural areas. Where agricultural insurance can be provided, risks (weather, pest, disease, and so on) are often highly spatially correlated and therefore financially difficult for insurers to manage. In addition, there is arguably a hesitation among the international reinsurance market to become involved with local insurance companies to enable them to transfer offshore some of their own risk, although this has been less of a constraint in recent years.

Additionally, for farmers, insurance works best where and when other services are in place, such as access to credit, improved seeds and inputs, markets and functioning supply chains, and advisory services. Insurance often cannot add value to a farmer's livelihood unless her income can be enhanced through availability of other services. All too often, many of these services are absent in developing countries, so the usefulness or attractiveness of insurance is not present for farmers.

Although there is a relatively low penetration of agricultural insurance in developing countries, the experience gained over the past century or more of crop insurance development in a number of countries provides a number of lessons learned and pointers. Some of these are captured in box 2.1.

2.3 RISK LAYERING IN WEATHER-RELATED AGRICULTURAL INSURANCE

In the previous chapter we introduced the concept of risk layering. For risk transfer products, this is a vital part of the risk management task, as it helps to determine who carries which part and how much of a risk. This enables equitable risk sharing and also ensures that correct levels of cover are taken out by the right parties (especially based on ability to pay). Let us not forget, insurance is not a panacea that can cover 100 percent of risks at premium levels that will be attractive to agricultural sector stakeholders. Insurance has a role to play as part of the solution, not as the solution itself.

Figure 2.1 presents a simple risk-layering example in relation to excess rainfall and the application of risk transfer products.

2.3.1 Self-Retention Layer

Risk retention (by the farmer) is needed for manageable, smaller, frequent risks that have to be either mitigated by the farmer using standard farming practices or coped with by the farmer, household, or local community mechanisms. This self-help and community approach is the first layer for managing risks. Additionally, where inputs or credits are concerned, arrangements may be needed to agree to delayed repayment for inputs or rescheduling of interest or principal of loans. These arrangements are quite similar to insurance, in that the financing of negative impacts of risks are spread over time.

2.3.2 Market Risk Transfer Layer

Insurance is best suited to infrequent but severe events. At an aggregated level, layering risk means that the financial sector stakeholders may decide to retain or transfer risks depending on their financial capacity and appetite for risk. When insurers decide to transfer part of their risk to another party, they generally rely on reinsurance companies to achieve this. The existence of the reinsurance agreement effectively boosts the insurer's capital and enables them to underwrite more risk than their own capital would otherwise enable them to do. In addition to traditional insurance companies, other agriculture sector stakeholders do become involved in risk transfer operations. They can be financial institutions lending to agriculture, processors, or those dependent on agricultural production for their turnover.

BOX 2.1: Lessons Learned and Pointers for Crop Insurance in Developing Countries

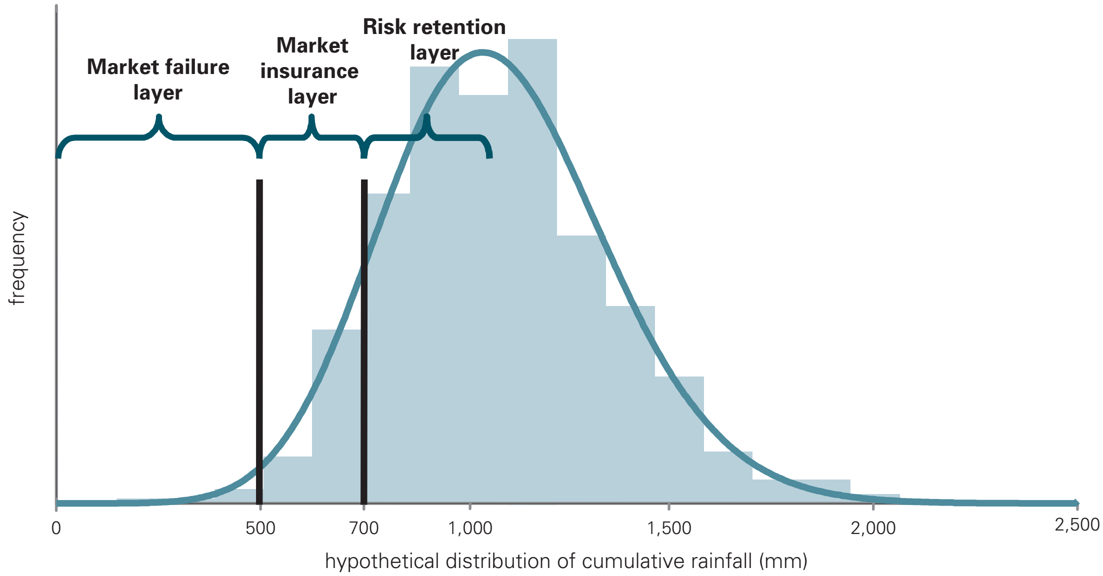
- Named peril crop insurance (mainly hail and fire) has operated as a financially sustainable, market-based insurance for more than a century, generally without subsidy or government intervention.
- MPCI has generally needed subsidies (except in South Africa). It does have the advantage of being a relatively standardized policy, irrespective of crop type. Governments have been attracted to yield-based crop insurance and the uniform nature of the product, but MPCI has some major issues in terms of loss adjustment, moral hazard, adverse selection, and high operational costs (hence the subsidies).
- Area yield index insurance is a relatively well established product, although not widespread. India has operated a (subsidized) area yield insurance, National Agricultural Insurance Scheme of India (NAIS), for 20 years.
- Weather index insurance is a relatively new development for agricultural applications. Many pilot projects have been started, but scaling up of weather index has happened only in a few countries (notably India).
- Index insurance is uncommon in high-income countries, which are dominated by markets with high uptake of named peril and MPCI insurance.
- The most common government intervention is through premium subsidy, often around 50 percent of premium but up to 80 percent in some countries. High levels of subsidy expenditure may not be sustainable in fiscally constrained economies or desirable, since subsidies tend to compromise commercial sustainability of agricultural insurance products by distorting risk-taking behavior and crowding out more efficient risk management mechanisms. Rent-seeking behavior can quickly add significant inefficiencies in delivery of agricultural insurance when subsidies are used.
- Other important government interventions are legal and regulatory frameworks and provision of public goods, such as data services and weather networks.
- The success or failure of crop insurance programs is related to the political economy of the country, the developmental status of agriculture, the complexity of the risks causing losses, and the management capability and leadership of the insurance organization.
- Transparency of products and of loss adjustment processes (leading to trust by farmers in the insurer and delivery or loss adjustment channels) is critical, irrespective of product type.
- Viability, integrity, and costs of loss adjustment procedures and operations are a critical test of the feasibility of agricultural insurance.
- The challenges of undertaking infield loss adjustment in small farmer agricultural systems for traditional indemnity products contribute to the attraction of index insurance.
- Grouping farmers in homogeneous risk areas, where they do not require individual loss adjustment, can make insurance feasible for small-farmer communities and reduce costs. However, this does increase the spatial correlation of the risk.

Source: Authors.

2.3.3 Market "Failure" Layer

Extreme losses from extremely rare, highly catastrophic events are not suitable for commercial insurance. For these types of losses governments or the broader international community may be needed to aggregate and transfer this risk layer out of the domestic economy to the international markets. This is also known as the "government intervention layer," as the fiscal responsibilities for reconstruction or such interventions as social safety nets lie with the affected government. Due to the risk that a government may decide to withdraw support for budgetary or political reasons, it is important to maintain a distinct segregation between the commercial layer described above and the social layer reserved for extremely rare and highly catastrophic events. This safeguards the commercial product from political whim, by allowing it to continue even if the market failure layer is no longer funded (as in Mongolia Index-Based Livestock Insurance [IBLI]).

FIGURE 2.1: Sample Rainfall Distribution Showing Layering of Deficit Rainfall Risk by Rainfall Levels



Source: Authors.

KEY POINTS

- There is no "one size fits all" insurance option. Index-based insurance is not the only alternative to traditional MPCI (in fact, it is not an alternative). In reality, there are different agricultural insurance products that are appropriate for different cases.
- Insuring against agricultural production risks is challenging. Many preconditions for successful implementation do not exist in developing countries. Index insurance, prima facie, offers a number of solutions that might overcome the lack of preconditions.
- Agricultural insurance often has social and policy objectives.
- Many governments give a high priority to development of agricultural insurance and can play an important role in insurance promotion through the provision of public goods (such as data and meteorological services) and legal and regulatory frameworks.
- Before deciding on promoting insurance for farmers as individual policyholders, a risk-layering exercise and consideration of the roles of the different stakeholders is imperative. It is important to define the role of the private and public sectors, taking into consideration the social and commercial objectives of insurance and the fact that they may be inconsistent.

Chapter 3: INTRODUCTION TO WEATHER INDEX INSURANCE

3.1 OVERVIEW

Having undertaken a risk assessment, identified a particular risk (weather), chosen a management strategy (transfer), considered the relevant risk-layering arrangements, and decided that perhaps a traditional agricultural insurance product may not be the most suitable solution, we find ourselves at the juncture of needing to discuss in more detail what exactly WII is and, equally important, what it is not.

Index insurance is a simplified form of insurance in which indemnity payments are based on values obtained from an index that serves as a proxy for losses rather than upon the assessed losses of each individual policyholder. The sum insured is normally based on production cost on an agreed value basis (fixed in the policy in advance), and payouts are made based on a pre-established scale set out in the insurance policy (discussed below).

The origins of WII come from the international weather derivative market, where major corporations hedge weather risks. The interest in WII applications for agriculture grew from a belief that traditional insurance products (especially MPCI) were not viable for developing countries, where limited commercialization and small average farm sizes are a major hindrance to the sustainable development of commercial agricultural insurance products.

In order for the underlying index to be a sound proxy for loss, it has to be based upon an objective measure (for example, rainfall, wind speed, temperature) that exhibits a strong correlation with the variable of interest (in this case, crop yield). Additionally, the weather variable that can form an index must satisfy the following properties:

- Observable and easily measured
- Objective
- Transparent
- Independently verifiable
- Reported in a timely manner
- Consistent over time
- Experienced over a wide area

Given the above requirements, weather indexation is most applicable to highly correlated risks, such as drought and temperature. Localized (independently occurring) risks, such as hail or fire, do not lend themselves to index insurance.

As mentioned above, indemnity payouts are made in accordance with a schedule laid out in the policy itself. An example of a payout structure for rainfall deficit coverage is shown in figure 3.1. In this instance the index payout threshold is 100 mm of rainfall, falling during a specified period, and the payout (maximum) limit is reached when rainfall falls to or below 50 mm.

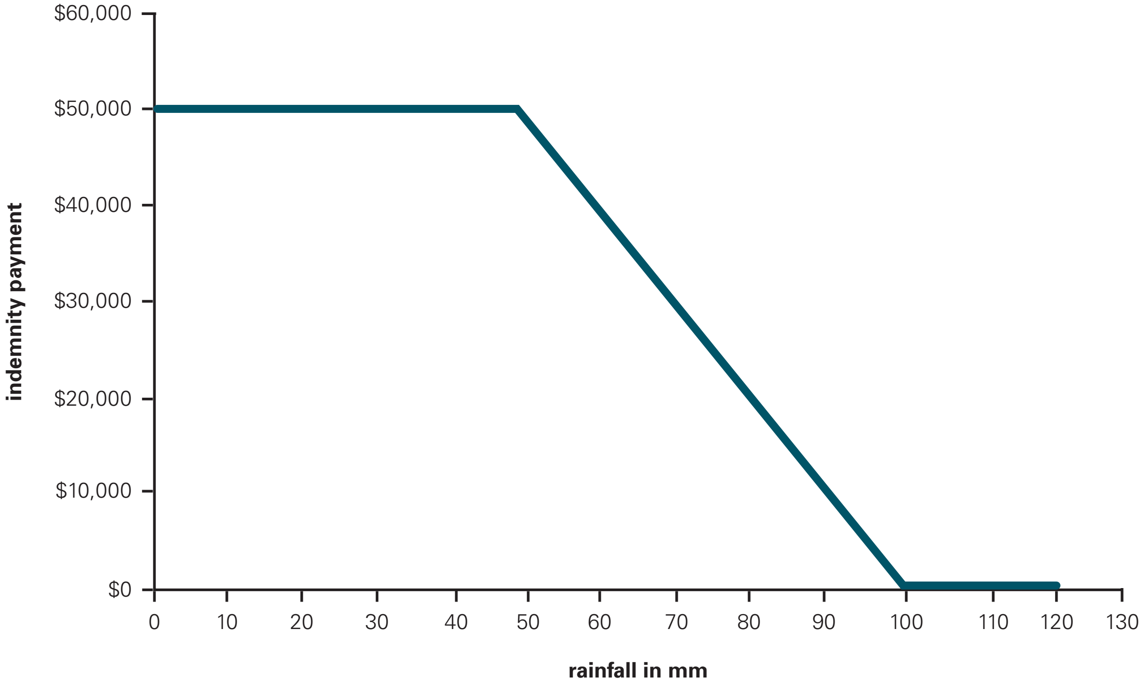
In reality, the payout structure in figure 3.1 is too simplified to capture the true correlation between rainfall and crop yield loss. The timing, not just the amount of rainfall during the various growth phases of a plant, is very important for satisfying the soil water balance and therefore the ultimate yield. Dry spells, or deficits over the main phases of crop growth, can cause yield loss, even if cumulative season rainfall is adequate. Commonly, index product designs use several phases of measurement during the crop season (typically three phases for grain crops), each with their own thresholds and limits of the weather parameter. These options are described later in this paper.

3.2 WEATHER RISKS, CLIMATIC CONDITIONS, AND INDEX INSURANCE

To date, most practical experiences with the development of WII have been with deficit and excess rainfall and have relied on data collection with terrestrial-based monitoring systems (weather stations). However, a wide range of weather risks are indexable, and table 3.1 draws out the main features of insuring different weather risks using index products. Additionally, and especially given the lack of weather monitoring systems in many developing countries, there is growing research on the use of alternative data sources and risk modeling (see box 3.1).

The scientific community has taken much interest in the design and adaptation of innovative models to simulate crop

FIGURE 3.1: Payout Structure for a Hypothetical Rainfall Contract



Source: Authors.

behavior and to overcome some of the limitations related to reliable access to rainfall data in developing countries. Box 3.1 illustrates some of those efforts.

3.3 ILLUSTRATIVE APPLICATIONS OF WII: MICRO, MESO, AND MACRO LEVELS

An advantage of WII is that it can be designed for different client types.

At the **micro level**, local WII for drought and excess rainfall is being sold to farmers through the Indian microfinance institution BASIX. Since its inception in 2003, the product has undergone a number of changes. Currently the contract is not tied to specific crops but offers a generic contract for three phases of the growing season for specific rainfall thresholds. The success of the BASIX–ICICI Lombard product sparked broad interest from other insurers, including the state-owned Agricultural Insurance Company of India (AICI) to enter this market. Swiss Re estimates that more than 539,000 Indian farmers have purchased weather index insurance to date. The Indian experience has also given rise to similar pilots and feasibility studies that target individual farmers in many countries around the world, including Thailand, Indonesia, Malawi, Kenya, and Nicaragua.

At the **meso level**, an index insurance product has been developed for a pilot project in northern Peru. The product will be sold to rural microfinance institutions to help offset loan defaults and liquidity problems caused by El Niño–induced excess rainfall (Skees and Collier, 2010).[5] The index is based on Pacific Ocean surface temperatures measured by the National Oceanic and Atmospheric Administration. Increases in the sea surface temperatures are a good indication of an El Niño weather pattern that brings torrential rain and catastrophic flooding to parts of northern Peru. These extreme rainfall events destroy crops and infrastructure, which in turn affects the ability of some borrowers to repay their loans. With the ability to insure against financial losses resultant from this weather phenomenon, microfinance institutions (MFIs) will be encouraged to increase agricultural lending and rural financial services.

At the **macro level,** an example of a macro application of index insurance is the Caribbean Catastrophe Risk Insurance

5 Skees, J.R., and B. Collier. "New Approaches for Index Insurance: ENSO Insurance in Peru." *2020 Vision for Food, Agriculture, and the Environment, Focus 18 Innovations in Rural and Agriculture Finance.* Kloeppinger-Todd, R., and M. Sharma, eds. Washington, DC: International Food Policy Research Institute, July 2010.

TABLE 3.1: Weather Parameter and WII Applications

WEATHER PARAMETER	IMPORTANCE FOR INDEX	KEY FEATURES AND EXAMPLES
Rainfall deficit	High	• Rainfall is the main, but not only, contributor to low yields from drought • Drought is difficult to insure by traditional insurance (MPCI or named peril), especially for small farmer systems • Most frequently used parameter for weather index for agriculture • Not possible to index rainfall for irrigated crops • Other variables (especially soils and temperature) affect transpiration and water balance, but drought indexes have so far been limited to rainfall as a single peril • Key period of risk: crop establishment and crop flowering, but also vegetative stage
Rainfall excess	Medium	• Causes problems of inability to harvest or loss of mature crops • Complex effects influenced by soils and drainage • Impact may be flood • Not widely developed as weather index peril • Key period of risk: maturing and harvest
High temperature	Medium	• Most important impact is in combination with lack of rainfall and high evapotranspiration during drought • Drought indexes so far have been limited to rainfall deficit and do not incorporate temperature • Key period of risk: high temperature can impact any growth stage, but particularly crop establishment and flowering

Low temperature	Medium	• Complex effects according to season:
		  • winter freeze (medium-length event)
		  • autumn and spring frost (sudden event)
		  • insufficient growing degree days (long-length event)
		• Short-term frost events difficult to index (heavy dependence on exact growth stage)
		• Local basis risk from microclimate and topography
		• Yield loss from spring frost (lack of flowering) or quality loss in autumn (fruit)
		• Winter freeze damage can depend on snow cover
		• Growing degree days important in some crops, such as cotton, especially if growing season limited
		• Key period of risk: spring frost in flowering in fruit and nuts, autumn frost in fruit, cool temperatures in maturation, mid-winter freeze in cereals

High wind speed, wind direction	High (macro index) and low (micro index)	• Impact of high wind (especially cyclones) is very complex at local level (high basis risk) • Cyclones associated with variable amounts of rainfall, high rainfall can occur under low category cyclones • Impact is very widespread • Currently macro indexes have been developed for cyclone winds, feasibility for micro application are now being researched
Sunshine hours	Low	• Some vegetable crops require combination of sunshine and high temperature to mature • Low sunshine hours (overcast) can lead to lack of maturity • May be difficult to index

Source: Authors.

Facility (CCRIF). CCRIF is a risk-pooling facility owned, operated, and registered in the Caribbean for Caribbean governments. It is designed to mitigate the financial impact of catastrophic hurricanes and earthquakes to Caribbean governments by quickly providing short-term liquidity when a policy is triggered. It is the world's first regional fund utilizing parametric insurance, giving Caribbean governments the unique opportunity to purchase earthquake and hurricane catastrophe coverage with lowest-possible pricing. CCRIF represents a paradigm shift in the way governments treat risk, with Caribbean governments leading the way in pre-disaster planning.

3.4 IS WII ACTUALLY INSURANCE?

Although these index products are referred to as insurance, there remains a question as to whether they might more accurately be called financial derivative products (the value being derived from the index). The simple answer is that this decision is one that has to be based on the structure of the product and the regulations prevalent in the jurisdiction in which the product is being sold (this will be discussed more in the section on legal and regulatory issues). In box 3.2, we discuss the two types of product and the markets they are traded in.

BOX 3.1: Innovations: Cheaper Weather Stations, Use of Satellites and Flood Indexes

Innovations in low-cost automated weather stations are providing increased opportunities for deficit and excess rainfall coverage, as the costs of denser networks are reducing.

Other data sources, such as satellite imagery coupled with computer models, also have the potential to measure risks in new regions. For instance, the normalized difference vegetation index (NDVI), which uses satellites to measure a plant's ability to absorb sunlight, can be used to proxy major droughts in certain parts of the world. NDVI is already being used in indexation of pasture growth for insurance in Spain and North America, and is under development in Kenya.

Specialized satellite imagery and computer models can be used both to model flood risk and to show areas that have been inundated by water (and also to monitor inundation periods). The type of flood strongly impacts the feasibility of flood index insurance. Index may be more applicable to river inundation flooding affecting large geographic areas, more challenging coastal flood, and not possible for flash flood. Flood index insurance would be very challenging to implement but may be technically feasible at the macro/meso levels.[6] The postfactual inundation information can also be used for more precise loss estimation.

Source: Authors.

3.5 WHERE CAN WII BE MOST USEFUL?

Arguably (and from ARMT experience) WII is most useful when it is used to augment an existing value proposition. WII (and agricultural insurance in general) is a tool option to manage risk in extreme cases. WII cannot solve or seriously address other agricultural constraints (unless, perhaps, there is an underlying and indexable weather risk). If farmers have no access to finance or markets, WII is unlikely to be able to solve these constraints as a standalone intervention. WII (or other agricultural insurance products) should be grafted onto a system where other vital parts are already reasonably functioning. The role of the coverage is to improve efficiency or unlock further potential.

Ideally, WII should be integrated within coordinated supply chains, where there are established linkages between

6 World Bank 2010. "Assessment of Innovative Approaches for Flood Risk Management and Financing in Agriculture." Agriculture and Rural Development Discussion Paper 46. Washington, DC.

BOX 3.2: Derivative and Insurance Index Markets

In the context of the weather market, weather risk is defined as the financial exposure that an entity (an individual, government, or corporation) has to an observable weather event or to variability in a measurable weather index that causes losses to either property or profits. As this risk can be measured through either an observable weather event or a weather index, it is possible to transfer this risk from a client to an organization interested in taking on that risk in the form of a weather risk management product. More specifically, a weather risk management product can be an insurance product or a derivative-based product. While the two instruments feature different regulatory, accounting, tax, and legal issues, the risk transfer characteristics and benefits are similar.

Derivative contracts derive their value by looking at an underlying index. They are not necessarily associated with any physical loss and simply base their payouts on the performance of the index. Currently, the majority of weather trading is in the derivative market. The Weather Risk Management Association monitors transactions in the derivative market, which may be considered as the weather wholesale market. There are two different types of derivative products, exchange-traded contracts (ETCs) and over-the-counter contracts (OTCs). Only OTC contracts are applicable for developing country clients and clients in the agricultural sector.

Insurance is the transfer of risk by a client (the insured) to a third party (normally an insurer). In exchange for a "consideration" (premium paid by the insured to the insurer), the insurer agrees to pay valid claims that occur during the period of the policy, in accordance with the terms and conditions of the insurance policy. Indemnity payments are paid in accordance with the contract and settled as compensation for suffered, assessed losses.

In most cases, weather risk transactions involving developing country producers will be structured as insurance, while derivatives more often serve large-scale buyers of weather insurance, such as large corporations or major national macro-level transactions. They may also have a role behind the scenes in allowing reinsurers to offset weather risk that they accept by passing some risk on to derivative markets. It should also be noted that there is a major international market for the reinsurance of traditional agricultural insurances, for which weather risk is a main, but not exclusive, exposure.

Source: Authors.

input provision, commodity sales, extension services, technical advice, finance, and so on. Contract farming is a good example of such a situation. Introducing insurance products within such integrated systems can also facilitate simpler contract design, as other mechanisms will more efficiently address other, nonindexable risks within the supply chain.

Finally, a key linkage that should be emphasized is the potential one with agricultural finance. Without linking these insurance programs explicitly to finance (such as bundling the insurance with agricultural production loans or inputs), a WII initiative will often find that many farmers lack both the capital to pay the insurance premium and sufficient incentive to use scarce resources on risk management.

To illustrate the value of such linkages, box 3.3 provides an example of a project in Malawi that integrates WII with access to finance and supply chain development. In this case, WII played a vital role in unlocking credit for small holders, which enabled farmers to access new productivity enhancing technologies and high value markets.

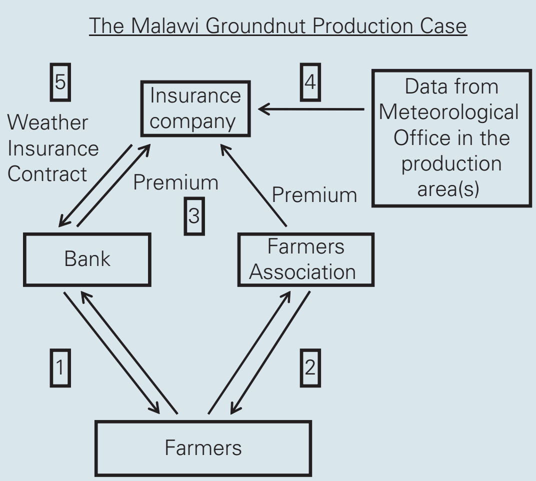
This program started insuring 900 farmers in 2005, insured 1710 farmers in 2006, and was discontinued in 2007. The reason for canceling the program was widespread default by farmers to the bank due to side-selling of groundnuts outside the contract farming structure. This was a counterparty risk that was not properly assessed at program launching since the financing scheme relied solely on index insurance to protect against weather risk only. There were no other mechanisms to manage other risks.

3.6 ADVANTAGES OF INDEX INSURANCE

Although the development and application of WII is still in its early stages, there are a number of theoretical advantages of the product. The degree to which these theoretical advantages may be realized through implementation and further development of the product remains to be seen.

- *Reduced risk of adverse selection*. Adverse selection can occur in agricultural insurance because farmers are more likely to buy insurance if they are a higher risk. Underlying this is an asymmetry of information, which places the insurer at risk (one that they need to manage through detailed, individual risk appraisal prior to premium pricing). An advantage of index insurance is that farmers subscribe based on the terms, conditions, and payout scale for all farmers in their defined area, virtually eliminating the adverse selection problem for insurers.
- *Reduced moral hazard*. In traditional insurance farmers may be able to influence the claim (by exacerbating physical losses) through their behavior, a phenomenon referred to as moral hazard. With index insurance, farmers have no ability or incentive to influence the claim, since payout is based on an independent and exogenous weather parameter, independent of farmers' behavior.

BOX 3.3: Linkages Between Access to Finance, Supply Chain Development, and Weather Risk Management in Malawi



1. Bank lends to farmers growing groundnuts under contract farming.
2. Contract farming company distributes inputs, provides extension services, and purchases produce at guaranteed price.
3. Bank takes out insurance for its loan portfolio. Bank and contract farming company pay most of the premium.
4. Insurance payout is indexed to weather stations in groundnut production areas.
5. In case of drought, payout goes to bank, while farmers are given loan relief benefits.

Source: Authors.

- *Field loss assessment is eliminated.* Loss assessment is a challenge for any traditional crop insurance program, because of the need to mobilize large numbers of skilled or semiskilled assessors who possess some agronomic knowledge. The ability of index insurance to make payouts without field assessment clearly reduces administrative costs by eliminating the need for assessors.
- *Reduced information requirements and bureaucracy*. Traditional insurance products require considerable work to collect data to establish yields and to classify farmers according to their individual risk exposures. Because of the use of the index, it is not necessary to collect such detailed data, nor to differentiate between individual farmers. This can be particularly useful in countries in which there is limited access to detailed data.
- *Facilitation of reinsurance.* Experience suggests that international reinsurers are likely to reduce the portion of the premium charged for uncertainty ("loading") when the insurance is based on independently measured weather events.
- *Transparency*. The assessment process in traditional products often leads to disputes between farmers and assessors due to the partly subjective nature of the loss adjustment process. Weather index contracts are based on the measurement of weather at defined weather stations and are therefore extremely objective and theoretically less likely to lead to disputes (although basis risk becomes the real driver for dispute).
- *Facilitating access to financial services*. By removing the most catastrophic, spatially correlated risk from vulnerable communities, successful index insurance markets have the potential to facilitate other financial instruments that are important for poverty alleviation and economic development.

3.7 CHALLENGES OF INDEX INSURANCE

Despite the apparent advantages of the weather index product, practical implementation through pilots and feasibility studies has shown that there are a number of challenges or disadvantages inherent with index products.

- *Basis risk*. Basis risk is the most problematic feature of index insurance. It is the difference between the payout as measured by the index and the actual loss incurred by the farmer. Because no field loss assessment is made under index insurance, the payout is based entirely on the index measurement and may be either higher or lower than the actual loss. The level of basis risk is influenced by several issues. First, basis risk is lower when the insured risk is correlated—that is, affecting a large geographical area relatively to the same extent and simultaneously. Poorly correlated risks are hail and localized frost. Better correlated risks are drought, temperature, and winds. Second, basis risk is higher where there are local microclimates, different management practices, and different crop varieties—that is, the weather risk may be correlated, but its impact is highly variable.
- *Data availability*. Despite simpler data requirements, accurate and complete data sets are still required for index insurance. This applies to the historical record of the chosen weather parameter(s) for underwriting and pricing purposes and for the recording of the parameter(s) for payout calculations during the period of insurance, as well as historical yield data to assess risk, design, and price the product, if the weather index is to serve as an accurate proxy for loss. For weather index insurance, a long and high-quality time series of meteorological data are required (circa 30 years of daily data).
- *Integrity of weather stations*. Weather stations used for index insurance must be sufficiently secure to prevent tampering. Additionally, they should have automatic, as opposed to manual, recording of data. Preferably, data will also be collected from the weather stations using automatic reporting systems such as Global System for Mobile Communications (GSM) devices. Not only do these provisions increase the quality of the data, but they also reduce the potential for human error or data manipulation. The degree of integrity has a direct impact on the cost of the uncertainty loading that goes into the insurance premium.
- *Need for farmer/insurer/regulator capacity building and education.* Index insurance is a new concept for farmers, and therefore any rollout of the product requires intense education programs to help them to understand the principle of the payout system and also the fact that it covers only one risk variable. To date, experience with this education requirement has provided mixed results.[7] For insurers, this is a new type of insurance product, so they require substantial technical assistance in designing contracts and indexes and extensive capacity building to enable them to undertake product development on a sustainable basis.

7 Gine, X. 2010. "The Promise of Index Insurance." The World Bank. Washington, DC.

BOX 3.4: Collaboration between IFC and IBRD under the Global Index Insurance Facility (GIIF)

The objective of the GIIF is to promote the development of effective and sustainable markets for indexed weather and catastrophic risk insurance in developing countries.

The GIIF program was launched by the WBG in December 2009 and is jointly implemented by IFC and International Bank for Reconstruction and Development (IBRD). In this collaboration, IFC works with the private sector to develop local capacity, while IBRD assists with public sector regulatory and policy reform work.

The European Commission and the Africa, Caribbean, Pacific (ACP) Secretariat are the primary donors to the GIIF Trust Fund (GTF) and have committed €24.5 million to facilitate reaching the objectives of the facility. The GTF is also supported by Japan's Ministry of Finance with an initial grant of $2 million, and the Dutch Ministry of Foreign Affairs, which provided $500,000 to establish the facility. The GTF is a broad-based facility and is open to a plurality of donors. The activities supported under the GTF are (1) local capacity building, (2) financial assistance to partner financial institutions, (3) performance-based premium support, and (4) regulatory policy and capacity building.

Since its formal launch, a total of seven grants have been conferred under the GIIF initiative. It is expected that these grants in Kenya, Rwanda, Mozambique, and the francophone West Africa will help expand access to index insurance in Africa. While GIIF sustains its growth in Africa, it has commenced expanding to other regions including Latin America and the Caribbean, South Asia, East Asia, and the Pacific. For the expansion projects in target regions, the GIIF program management unit is liaising with IFC regional offices to inform them about the program, and also with IBRD to develop a framework to address regulatory and policy issues.

GIIF has also entered into a technical partnership with Swiss Reinsurance Corporate Solutions, which will provide technical services to GIIF projects and will support GIIF's strategic objectives through its long-standing experience in developing innovative risk transfer solutions for emerging markets. As a technical partner, Swiss Re will support the implementation of approved projects and the rollout of the regional expansion strategy by:

- Providing secondary markets development support
- Undertaking capacity development of local partners (local insurance partners and other aggregators)
- Ensuring that projects meet minimum reinsurance requirements to find support in the reinsurance arena
- Enabling GIIF to be effective in standardizing, reviewing, and implementing projects and to initiate new projects in new areas including those where there is documented demand but no interested insurance parties

Major GIIF projects currently under implementation include:

- **Syngenta Foundation/UAP Insurance** aims to develop the technology for SMS-based mobile applications and assist in scaling up of drought or excessive rainfall insurance product in Kenya.
- **PlaNet Guarantee** aims to develop and implement an index-based insurance product in Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal, and Togo.
- **MicroEnsure** aims to develop local capacity and a favorable environment to reach low-income people with flexible, affordable and responsive weather index insurance in Rwanda.
- **Index-based livestock insurance (ILRI)** has designed and developed an index-based insurance products to protect Kenyan pastoralists from drought-related asset losses.
- **Guy Carpenter** aims to help develop index-based micro insurance for flood and drought risk in Mozambique.
- **SANASA Insurance** aims to help develop a simple, flexible, affordable weather index–based crop insurance product for different food crops in Sri Lanka.

In collaboration with IBRD, GIIF supports the regulatory and policy reforms for index-based agricultural insurance. Projects are ongoing in Nigeria and in the Inter-African Conference on Insurance Markets (CIMA) region of West Africa. Additionally, efforts in capacity building to develop an appropriate policy and regulatory framework for index-based agricultural insurance in 14 countries across Africa, the Caribbean, the Pacific, and Latin America are progressing through the involvement of IBRD.

Source: IFC.

Experience in this area has shown that transferring sufficient capacity is extremely challenging. Likewise, index insurance will be a novel concept for many insurance and other regulatory authorities that have jurisdiction over index insurance. Involving these regulatory authorities from the outset helps ensure their support, legal guidance, and favorable legal classification, all of which are critical to the product success.

- *Currently limited product options for different weather risks.* The majority of WII products have been designed for rainfall risk, which is not necessarily the most serious or prominent weather risk in many areas. Experience insuring other weather risks with new indexes is needed. In many regions farm losses often result from a complex interaction of perils—for example, increased temperature that leads to pest problems. A "simple" WII product is not suitable for this and thus would need to consist of more than one index rolled into a single product or would require the farmer to take out a different type of insurance product for the other risks.
- *Research, local adaptation and scalability.* The process of designing an index involves the analysis of weather data and interpretation of it in relation to the specifics of the crop to be insured. Correlations need to be carried out between the weather data and historical yield data in order to find good index parameters. Once the product is designed, trigger levels have to be adapted to each weather station. Where new automatic weather stations are needed, they need to be calibrated based on interpolation between stations. Further, ongoing annual reviews of the trigger levels are advisable, especially in the first years of a program. All of this technical work limits the speed at which the scaling up of a pilot program to a regional or national program can be carried out. It should be remembered that any given index needs to be reviewed and recalibrated every time it is moved to a new weather station, and a totally new index designed every time a new crop or even a new variety is introduced.
- *WII does not have universal application*. WII can be an effective instrument, but not for all crop types, cropping systems, or hazards. Where crop type or climate show complex and multiple factors affecting crop damage or loss, as may occur in humid climates or where pest and disease are dominant causes of loss, indexation with WII may be problematic. In such circumstances, an area yield index product may be more applicable.

In order to address these challenges and to promote effective and sustainable markets for WII and catastrophic insurance in developing countries, the World Bank Group (WBG) launched in 2009 the Global Index Insurance Facility (GIIF), administered by the International Financial Corporation (IFC). The GIIF is meant to be a comprehensive insurance-based program to address the scarcity of affordable insurance protection against weather and natural disasters in developing countries (see box 3.4).

Chapter 4: PREFEASIBILITY ASSESSMENT: "TO WII OR NOT TO WII?"

In the previous chapters we have sought to arm the reader with a rapid overview of agricultural risk management, where insurance can play a role in that, and some of the main issues that relate to the WII product. In addition, we have sought to highlight where WII is best suited within the bundle of risk transfer options for weather risk and what are some of the initial advantages and disadvantages or limitations of the product.

In this and the following chapters we seek to take the reader through the practical steps that are required before one would be in a position to actually have a structured and delivered WII product in a developing country. From practical experience, three distinct steps are required:

1. **Prefeasibility assessment**: desk-based and limited field work to assess the risk, assess the suitability of the product, and determine whether necessary preconditions are in place.
2. **Technical feasibility**: the collection and manipulation of data, construction of the index, and design of the product.
3. **Field implementation**: the distribution and sale of the product to policyholders, management of the index, data flows, and establishment of sustainability.

Before we embark on tackling these challenging steps, we should make a quick remark in the spirit of caveat emptor. From a development perspective (as opposed to a commercial insurance approach), it is highly undesirable to promote WII in isolation. It is highly unlikely that there will be a single vulnerability (crop variety and area), with a single problem (single weather risk), with a single solution (WII). In order to address the normal type of multiple vulnerability, multiple problem situations, development practitioners will likely need to employ a programmatic approach. In addition, creation and promotion of a suitable enabling environment from a government, regulatory, and policy point of view is equally important and more the ambit of development practitioners than the commercial sector.

4.1 EMBARKING ON THE PREFEASIBILITY ASSESSMENT

Strictly speaking, any risk management activity should "start from the beginning." It should consider all perils and risks (for example, pests, diseases, price risk, and so on), not only weather. Equally, it should run through a review of all the various mitigation, transfer, and coping options, not just consider insurance. For the purposes of this discussion paper, however, we will be looking at a situation in which there already appears to be a weather risk and the main thrust of the effort is to determine whether WII may be an optimal solution. On this basis, prefeasibility assessment should initially seek to answer six interrelated questions:

1. **What is the overall problem that the project is trying to address?** Is it a problem of low agricultural income, volatile productivity, limited access to finance, or vulnerability to disaster leading to a poverty trap? Invariably there will already be an answer, be it from a well-articulated demand that has given rise to a project itself (for example, a bank demands that farmers are insured before accessing crop loans), or well-established knowledge that has led to a consideration of weather risk transfer products (for example, certain areas in country A are drought-prone, thus having low agricultural productivity). Which leads to the next question:
2. **How does weather risk play a role?** In some cases, exposure to adverse weather is the predominant cause, while in others it is only a marginal factor. The answer to the second question largely relies in a simple analysis of available data. If the role of weather is significant, then:
3. **What other risk management activities are there?** Before seeking to launch a pilot, it is necessary to evaluate what other provisions have been made previously in the case of the weather risk, as this will have an impact on the success of the pilot. For example, if governments regularly cancel farmers'

debts in the case of drought, this will negatively impact both farmer and bank willingness to purchase WII in the case of drought.

4. **Are the objectives commercial insurance or social protection, or both?** The answer will lie partly in policy objectives, the issue of ability to pay, and the level of risk to be managed—the interplay between private and public goods. This issue must be addressed and resolved before making any progress toward technical feasibility, as the answer will fundamentally affect the design and structure of any WII product. In either situation:
5. **Is WII an objectively practical option?** This question involves a review of prerequisites and conditions and making a "value judgment" based on both qualitative and quantitative factors assessed through desk review and field work. If it is:
6. **Is there demand for WII, or more generally agricultural insurance?** While all the technical and even practical conditions may have been met, with no demand for the product, there will be no premiums and therefore the initiative will be at high risk of failure. Unfortunately, demand assessment is far from a precise issue and presents a number of challenges.

4.2 HOW DOES WEATHER RISK PLAY A ROLE? WEATHER RISK MAPPING

A preliminary and important step would be to conduct a "simple" weather risk mapping exercise. This can be done for the agricultural sector as a whole, at the regional level, or simply at specific locations, depending on the task at hand. The key objective is to identify:

- Weather risks (wind, temperature, rainfall, hail, and so on) that are indexable
- Type of crops subject to those risks (oil seed crops, vegetables, trees, and so on)
- Number and type of producers that grow those crops
- Location of weather stations
- Agro-climatic zones
- Altitude

As an example of this activity, consider the case of a project that has an overall objective of providing drought-affected farmers with access to insurance. At the basic level, a crude weather risk map can be constructed by overlaying a country's (or a region's) map with information on the distribution of key weather risks, the location and type of crop production and farmers, agro-ecological zones, crop yield levels, irrigated zones, and location of weather stations. Notably, the map should also illustrate the overlap of different problems if they exist in the same area (which would highlight multi-peril scenarios in which WII may not be suitable).

As the term "simple" suggests, the exercise is supposed to be a hands-on, rapid assessment. It should be sufficient to base the exercise on synthesizing information that already exists, rather than conducting new studies or analyzing raw data.[8] This information is general publicly available from organizations including the Ministry of Agriculture, the National Meteorological Service, and the National Statistical Bureau. In some cases, the biggest challenge will be to make use of these existing data and present them in a new and integrated geographical information system (GIS) format.

For a more informative version of the map, additional layers of information could be added—for example, areas of concentration of poverty incidents, poverty maps, network of rural roads, coverage of financial institutions, coverage of existing development programs (if available), and so on. The integrated picture from these data will be invaluable to identify the most appropriate areas for the project intervention. For an example of terms of reference for a risk mapping in agriculture, see Annex 2.

Figure 4.1 gives examples of existing information and maps that have been used in a weather risk mapping exercise in Jamaica.

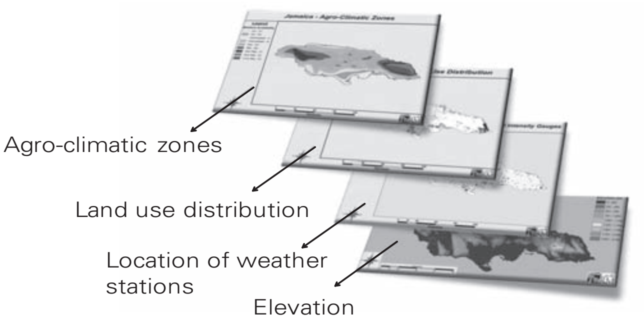
4.3 ARE THE OBJECTIVES COMMERCIAL INSURANCE OR SOCIAL PROTECTION, OR BOTH?

WII development can be guided by commercial or social objectives, or both. These objectives have a fundamental impact on how the insurance product is constructed, financed, and delivered. At the outset, a fundamental distinction needs to be made between insurance designed to help poor people protect their livelihoods and assets, and insurance designed to help households with viable farm businesses manage their risks.[9] Having a clear social objective, insurance that protects

8 For an example of a weather risk management strategy design based on such information see: World Bank (2010), Jamaica: Towards a Strategy for Financial Weather Risk Management in Agriculture at http://www.worldbank.org/agrm.

9 These two types of insurance are called *protection* and *promotion* (or *development*) insurance in the paper "Sustainability and Scalability of Index Based Risk Transfer for Agriculture and Rural Livelihoods," developed by World Food Programme and International Fund for Agricultural Development (WFP-IFAD).

FIGURE 4.1: Maps Used for a Prefeasibility Report in Jamaica



Source: Jamaica: Towards a Strategy for Financial Weather Risk Management.

BOX 4.1: Mongolia: A Public-Private Index Insurance Partnership

The insurance program under this project combines self-insurance, market-based insurance, and social insurance. Herders retain small losses that should not affect the viability of their business, while larger losses are transferred to the private insurance industry, and only the final layer of catastrophic losses is borne by the government.

The livestock risk insurance (LRI) is a commercial risk product, sold and serviced by insurance companies. Herders pay a fully loaded premium rate for this product. Insurance companies pool these risks and use both global reinsurers and the Government of Mongolia (GoM) to protect extreme losses in the pool. This product pays out when the sum mortality rates exceed specified "trigger" percentages (6 percent). The LRI premium rates are developed using historical livestock mortality data. Payouts are made based upon a mid-year estimate of mortality by area and species. The maximum payment for the LRI is set once the estimate of mortality reaches a specified "exhaustion point" of 30 percent. Losses beyond that point are paid by the GoM with the government catastrophic cover (GCC). This safety net represents the subsidy for the Index-Based Livestock Insurance Program (IBLIP). The intent is for the GoM to pool these risk and obtain global reinsurance on the pool. It has been demonstrated that this is a more efficient way to provide subsidy. Additionally, should the GoM decide that it can no longer provide this subsidy, the LRI program can remain as a commercial insurance product. This design is unique and may have significant value for using subsidy to "crowd in" an insurance market.

Source: Mahul, Oliver & J. Skees (2006). Piloting Index-Based Livestock Insurance in Mongolia. The World Bank and personal communication with Jerry Skees, July 27, 2011.

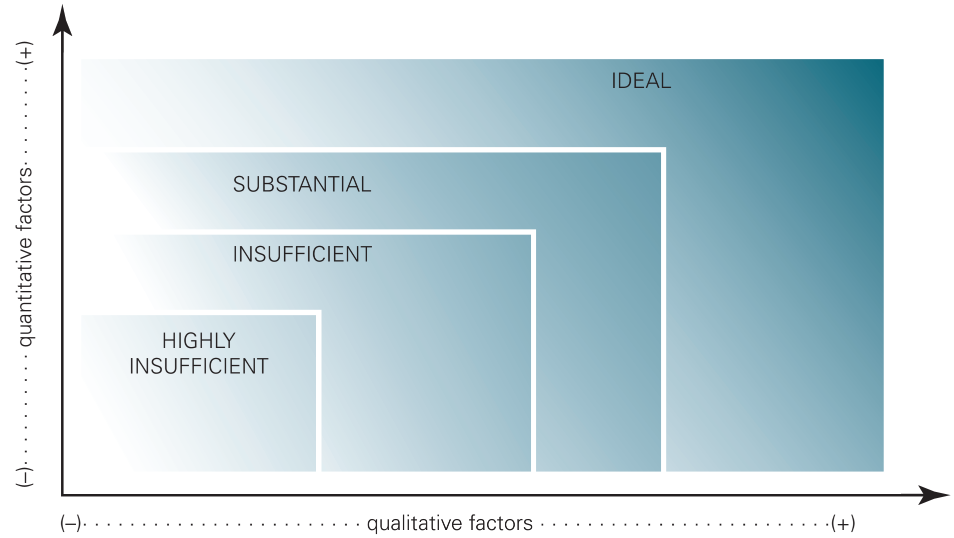
lives and assets from catastrophic losses inevitably has to be subsidized and requires special delivery channels that should be aligned with relief or social safety net interventions. On the other hand, insurance that promotes agricultural development should take into account long-term commercial sustainability and be channeled through private intermediaries. However, even with commercially viable farmers, it is still unlikely to sell insurance on an unsubsidized basis, unless it is linked to a value proposition.

Often, situations require a balance of both social and commercial objectives. This may be due to the need to address many strata of beneficiaries, or the inherent mixed nature of a project (for instance, agricultural insurance development for smallholders), or mainly as a precondition to make the project sustainable in the long run. Considering a framework for a public-private partnership will be very important for these cases. Box 4.1 illustrates a public-private partnership in index insurance in the livestock sector.

4.4 IS WII AN OBJECTIVELY PRACTICAL OPTION? A PRELIMINARY DESK STUDY

The crude weather risk mapping exercise should identify whether, prima facie, WII may be a potential option (hopefully among a bundle of other measures). However, given the technical complexities and data requirements of WII, the next step is to assess whether a number of preconditions to create a conducive environment for WII are available. Of course, this is not necessarily a "go or not go" situation; there will rarely be an ideal situation, just as it would be rare for there to be absolutely no basis for WII application (at least theoretically). It is therefore important to understand the necessary and sufficient conditions for weather index insurance in a country and also to appreciate how one can diagnose a given case as an "ideal," "substantial," "insufficient," or "highly insufficient" proposition. Judging the circumstance in a country is certainly a nebulous process, arguably based more on art than science. For example, while 30 years of weather data are preferred, it may still be possible to proceed if other positive and mitigating conditions are in place. Additionally, steps can be taken to improve a situation. For example, if initial project champions are absent, one could design and implement an education campaign to drive the process.

FIGURE 4.2: Degrees of Acceptability of a WII Proposition



Source: Authors.

As we will see in the following section, the prerequisites and conditions are a mixture of both qualitative and quantitative factors. When considering the conduciveness of any particular situation, it is useful to consider how these two types of factors interrelate. Figure 4.2 highlights the interaction of the factors and their relationship to the issue of "go or not go."

4.5 PREREQUISITES AND CONDITIONS

In the following section we have highlighted six main areas in which data or information is required and can normally be ascertained through a desk review or through the use of remotely accessed local knowledge.

4.5.1 Weather Data and Monitoring

Clearly, given the reliance of an index on sound data, any data that is to be used must adhere to strict quality requirements. A long, "cleaned,"[10] and internally consistent historical records are needed for a proper actuarial analysis of the weather risk—ideally at least 30 years of daily data. In addition, WII contracts require a dense, secure, and high-quality weather station network, especially if it is planned to try and scale up an initial pilot to surrounding areas. Ideally such a network would consist of automated stations that report daily to the World Meteorological Organization (WMO) Global Telecommunication System (GTS) and undergo standard WMO-established quality control procedures. In box 4.2 we have sought to provide a provisional checklist that may be useful when assessing weather data and infrastructure.[11]

4.5.2 Agronomic Data

Under a WII contract, sound data is needed to assess crop vulnerability. In order to be able to design an index that will truly be representative of loss, crop data should be available in relation to the specific variety being planted in the given area, as opposed to more general data that might not represent the crop development characteristics of the actual farmers' crops. Linked with this, detailed information is required on the variety's crop cycle, as this will be an important input to the crop model that will be used for estimating the index. Obviously, multicrop production systems are particularly challenging, with different crops and varieties being grown. In such a case, data should be collected on the most important crops. Once the information is analyzed, a decision will have to be made whether the whole crop system is indexable. Normally this is not the case because of basis risk. In this situation it may be more practical to design a catastrophic product that provides for compensation but does not seek to compensate for actual loss.

10 "Cleaned" means replacing missing and erroneous data before it can be used.

11 For an example of terms of reference for the creation of gridded weather data ("synthetic"), see Annex 3.

BOX 4.2: Checklist for Assessing Weather Data and Infrastructure

To make the assessment, the relevant National Meteorological Office (NMO) will need to share its data. Many NMOs provide data catalogs, which can be requested online, usually at a cost. It will only be practicable to request data from a sample of weather stations in a few potential pilot areas. This, however, will give a sense of the overall quality, as well as consistency, of the data. Additional questions can also be asked at this stage. Usually, the following should be determined:

- Weather parameters being recorded (rainfall, temperature, solar hours, wind speed, and so on)
- Type of equipment used (automated versus manual stations)
- Availability of historical time series (approximately 30 years are needed)
- Missing data per weather station
- Sufficient quality standard of data and access (data cleaning, reporting etc.)
- Location of stations and radius of coverage, plus whether they were relocated during the period.
- Are the weather stations reasonably close to potential customers?
- Are the weather stations secure from tampering?

Key issues to be borne in mind:

- **There is no standard radius of insurable area around a weather station**. The degree to which a station truly represents weather for a given radius depends on topography and existence of micro climates (the latter being partly a function of the former). In many cases the actual assessment of radius will depend on site visits and local interviews.
- **Most NMOs are severely resource constrained and seek to charge for data**. In some countries agreements have been signed between the NMO and the Insurers Association (or individual insurer) that details the fees, provision of data for contract pricing and data monitoring for determining potential payouts. This is a beneficial situation, adding to transparency, accountability and sustainability and should be encouraged.
- **Some NMOs have analytical capacity in agro-meteorology and may ask to assist in contract modeling**. A practical approach to this is to propose a partnership between the NMO and an agricultural college and the provision to them of training contract design. This inclusive approach will ensure data provision and aid sustainability, especially though the development of local contract design capacity.

Source: Authors.

4.5.3 Financial Data

If a WII contract is seeking to indemnify for actual loss, then a decision as to the loss to be covered will need to be made. In any event, data will be needed to calculate the level of loss per farmer across the whole area to be covered by the index. There are three main types of potential loss that a WII product could seek to cover. First, input costs are based on input usage and unit cost for those inputs. Second, credit amount is a factor of input costs plus any additional financing that the farmer required. Third, loss of income is based on the lost production and a set value per unit of production. Therefore, data will be required on input costs, costs of labor, interest rates, and so on.

4.5.4 Status of the Local Insurance Industry

In many developing countries, the local insurance industry has little experience of or capacity to underwrite traditional and index agricultural policies. An initial assessment of the industry will inform future approaches in terms of consultations, capacity building, and technical assistance that may be required, as well as highlighting potential interest in offering such products.

4.5.5 Existence of a "Champion"

Although not strictly a desk-based activity, it is very important to establish, as soon as possible, who or what will be the local driver in country for the activity. The implementation of a WII product requires coordination of a large number of stakeholders and a larger number of activities to be undertaken. It is imperative that the lead on these activities is taken by a local stakeholder, otherwise sustainability will be at risk from the very outset.

4.5.6 Prospective Delivery Channels

Identification of the primary product delivery channel at an early stage is preferable. Depending on the legal framework, product design, institutional capacity, and interest in any given country, the delivery channels for WII could be:

- Ministry of Agriculture
- Insurance companies
- Insurer intermediary
- Commodity Board
- Financial institutions
- NGOs

4.6 IS WII A SUBJECTIVELY PRACTICAL SOLUTION? THE INITIAL FIELD WORK AND CONSULTATIONS

The goal of this step in the process is mainly to assess the "qualitative" aspect of the conducive environment and also to clarify any outstanding issues highlighted during the desk review process. For example, while one can see how dense the network of weather stations is in a country from a map found online, one cannot assess the willingness of the NMO to continuously supply data for an insurance project. Likewise, while insurance law does not prohibit index instruments, it is not a given that the insurance regulator will automatically support a WII pilot. This qualitative assessment is more about the art than the science, but is a critical step in making decisions. The key qualitative issues that need to be assessed generally cover the following:

1. **Definition of insurable interest and objectives**
   - What are the objectives of the government or champion for agricultural insurance?
   - What level of cover is intended? Catastrophic events, extreme events, or more frequent, lower impact?
   - Type of coverage? Crop or enterprise specific or consequential in nature? Loss of assets, income, costs of production, credit amount or compensation not linked to actual loss, lost opportunities for income generation (for example, farm labor tied to affected crop, inability to access to markets), business interruption, damage to infrastructure, costs of disaster relief, and so on.
2. **Defining the insurance beneficiary (or target group)**
   - Who might be the policyholder? Individual farmer, cooperative, bank with aggregated portfolio, a regional government or even central government?
3. **Defining the crops, risks and areas to insure**
   - Food crops or cash crops? Annual or perennial?
   - Risks to be covered?
   - What districts, provinces, departments?
   - Coverage: named perils, multi-perils, or indexed risks?
4. **NMO**
   - Is the NMO cooperative and interested? What are they requiring for their services?
   - Are there at least pockets of high-quality weather data, not only in terms of the historical records, but also of how data cleaning and transmission are routinely handled?
   - Where are the "usable" weather stations in relation to the potential farms insured? What does the local topography look like?
5. **Mechanisms to reach farmers**
   - Which channels will be used for payouts?
   - Which channels will be used to collect premiums?
   - What financial institutions, regulators, agribusiness companies are present? Anyone with keen business interest in supporting the product?
6. **Institutional assessment**
   - Which institutions will operate the insurance?
   - Who will subscribe the risks and what is the capacity?
   - What is the operational capacity of various players?
   - What information systems are in place?
   - What are the attitudes and perspectives of the insurance regulator?
   - Is the legal and regulatory framework conducive to index insurance?
   - Are government policies consistent with the objective of the index insurance product?

This qualitative assessment can be conducted within a one- to two-week time frame. It involves meeting with key stakeholders including insurers, banks, farmers or farmer organizations, NMO, insurance regulators, and so on. In order to cover the varied topics and technicalities, it is advisable to include an expert in agriculture or agro-meteorology and another person with a financial background (preferably in insurance or agricultural finance). In order to ascertain the realities at the farmer level and as a provisional step to consider the potential of basis risk, it is extremely useful to hold farmer focal group meetings using a structured questionnaire.

These prefeasibility stakeholder consultations are usually the first face-to-face encounter between a project team and key stakeholders. Apart from enabling a first-hand understanding of the conditions on the ground, the consultations often present the first opportunity to introduce the concept and application of WII. However, given that most stakeholders will not have encountered the product before, care needs to be taken to avoid raising expectations by advertently or inadvertently "overselling" the product at this stage. As we have mentioned, while WII has the potential to provide a risk management solution in many contexts, it is not a universal product that is suitable to all crops, problems, and beneficiaries. Overselling the product at this early stage may create much needed enthusiasm to implement a pilot (the all-important champion issue), but the trade-off is likely to be an expectation that is unrealistic and unmanaged. Such overexpectations can become a source of reputational risk for a project team, as well as for donors (if the project is externally supported).

4.7 IS THERE DEMAND FOR WII—OR MORE GENERALLY FOR AGRICULTURAL INSURANCE?

Arguably, demand assessment is the most challenging task of the prefeasibility process. While the project team can assess the initial practicalities and availability of a "conducive environment," demand is the aspect that cannot be answered definitively before a project is actually initiated. However, some groundwork on demand assessment should still be done as part of a comprehensive prefeasibility assessment. After all, if no one wants or considers that they need the product, then it will be a short-lived initiative.

There is no established methodology used for demand assessment for WII or for agricultural insurance products more generally. Understanding what drives demand for insurance, especially for farm households, is a subject that has drawn the attention of the academic, commercial, and development communities alike. As a result, a number of different approaches (both formal and informal) have been developed to assess demand. The basic outline of the three main approaches is discussed briefly below.

4.7.1 The Academic Approach: "Willingness to Pay" Assessment

The "willingness to pay" (WTP) concept has been widely considered in the literature on rural risk management. When farm households cannot manage weather risks on their own or within their community, there is a prima facie hypothesis that there should be demand for insurance. Economic studies that examine how rural households manage risks demonstrate that they already pay high opportunity costs for the risk-averse choices they make. In other words, the working poor already pay for the risks they face by making suboptimal choices and therefore there should be a WTP for insurance.

The academic approach can be interpreted in many ways and developed with different variants, depending on where the emphasis of the research is. It often includes formulae to capture the impact of crop insurance on the producer's expected income and variance of income. These impacts are evaluated in the context of a model of producer welfare, which features both price and yield uncertainty, as well as risk aversion on the part of the producer. Though these methods have been amply applied for crop insurance in developed economies, it is a complex exercise for developing country rural households, given their income diversification patterns, multicropping systems, and informal methods of managing risks. Box 4.3 illustrates one particular example of a WTP exercise in the context of an index insurance product in Tanzania.

BOX 4.3: Examples of WTP Analysis for Weather Index Insurance

Sarris, Karfakis and Christiaensen (2006) applied the WTP approach to study rainfall insurance in Tanzania. The paper explores empirically the issue of the demand, namely the WTP, for rainfall-based insurance, in the context of a poor agrarian economy, with rural households significantly dependent on agricultural commodity risks. Using data from household surveys in the Kilimanjaro and Ruvuma regions of Tanzania, the paper ascertains the nature of the weather-related risks faced by smallholder growers in the context of their overall risk environment. It then estimates their desirability for weather-based income insurance as well as their demand for it by utilizing contingent valuation (CV) techniques. The results indicate that producer households are affected by a variety of shocks, of which weather-related ones are very important. The paper estimates the demand for weather-based crop insurance in each of the two regions and indicates that there seem to be considerable welfare benefits (net of costs) for such insurance, but differentiated according to regional rainfall instability, as well as producer incomes.

Source: http://www.fao.org/es/esc/en/378/444/highlight_451.html.

The academic nature of this analysis requires extensive data collection and interviews, and this has notable implications for the costs of an initiative and also the length of time taken to undertake such a study. For these reasons, a WTP study would more normally be conducted as part of a formal feasibility study for WII.

4.7.2 The Commercial Market Assessment Approach

This approach applies a market demand assessment technique similar to that used by commercial insurers. The key question is whether there is a business case for the product. This can be assessed by pursuing some or a combination of all the following analyses:

- Past and existing levels of insurance coverage
- Farm structure: how many farmers, distribution of land holding sizes, subsistence versus commercial farming, and so on
- Credit coverage and gaps where insurance may help unlock more credit
- Interest from agribusinesses and agricultural banks

The crude weather risk mapping exercise (discussed above) can be adapted to highlight potential demand using the commercial market assessment approach. However, while some of the questions can be answered by the weather risk map and the desk review, many still require a qualitative, on-the-ground assessment. During field visits it is often found that what looks good on paper can be much more complicated in reality. Interviews with farmers and local staff of agricultural banks or agricompanies are extremely valuable. Apart from understanding the nature of risk that potential clients face, a field visit enables a demand assessment team to understand current local risk management practices that might reduce demand for insurance. Equally, it can lead to ideas on how to package and deliver the insurance product in a way that will attract potential clients. An example of this approach is the Indonesia Weather Index Insurance Study for Maize Production conducted by the IFC (2009), (see box 4.4).[12]

As in the case of the academic approach, this can form a key section of a formal feasibility study. However, due to its more rapid and less resource demanding nature, this form of assessment is more apt for the prefeasibility stage.

4.7.3 The Development Organization's Approach: "Dry Running and Pilot Testing"

While the above approaches can provide valuable clues to a potential take-up of WII, it is often felt that effectively assessing demand cannot be done as a hypothetical exercise. For most recent WII projects in developing countries, the act of "dry running" or "piloting" itself is treated an empirical demand assessment. This entails:

- Farmers being provided with real prototype insurance products
- Provision of educational and marketing sessions
- Real purchasing decisions being made

As there are real transactions taking place, it is arguable that demand assessment through pilot implementation provides the most tangible evidence of how farmers take up WII and what are the key factors that contribute to it. However, these are clear disadvantages to this approach. This pilot exercise does require organizations to commit resources to an operation without a certainty of the project's result. In the case of insurance companies, participating in a pilot is risky in terms of financial returns.

If the decision is taken to use a piloting approach, then the demand assessment will not be part of the desk review and consultative activities, but will be integral to the implementation phase of the weather index insurance project itself. Chapter 7 will discuss the dry run and pilot implementation issues in further detail.

BOX 4.4: Story of Maize Farmers in Lombok, Indonesia

The Perigi village has a population of 10,000 people that farm around 6,000 hectares of irrigated land and 400 hectares of dry land on which maize cultivation is carried out. The main production risk is drought. Pests and diseases seem not be a relevant threat to maize production in this area. According to maize producers, if dry spells of three to five weeks are experienced around establishment and flowering, the crop is likely to fail.

Maize farmers in the Perigi village are cash constrained and finance their production activities through informal credit at an interest rate of 50 percent every four months. They do not approach local financial institutions for credit because they would not be considered eligible as they don't have land titles to serve as collateral.

Perigi farmers clearly stated that they would be ready to pay an insurance premium of over 10 percent if this enabled them to access the formal credit channels that charge an annual interest rate of 15 percent.

So, farmers are interested in insurance, if it can help unlock formal credit and lead to interest savings.

Source: Authors.

12 IFC (2009). "Weather Index Insurance for Maize Production in Eastern Indonesia." International Financial Corporation. The World Bank. Washington, DC.

Regardless of the approach one takes, a caveat should be made on demand assessments. Demand for insurance cannot be generalized. While a demand assessment may suggest a potential take-up in the area(s) studied, it does not necessarily imply broader take-up. In other words, demand in one area is not a good indicator of general scalability.

4.8 SUMMARY: A DECISION TREE

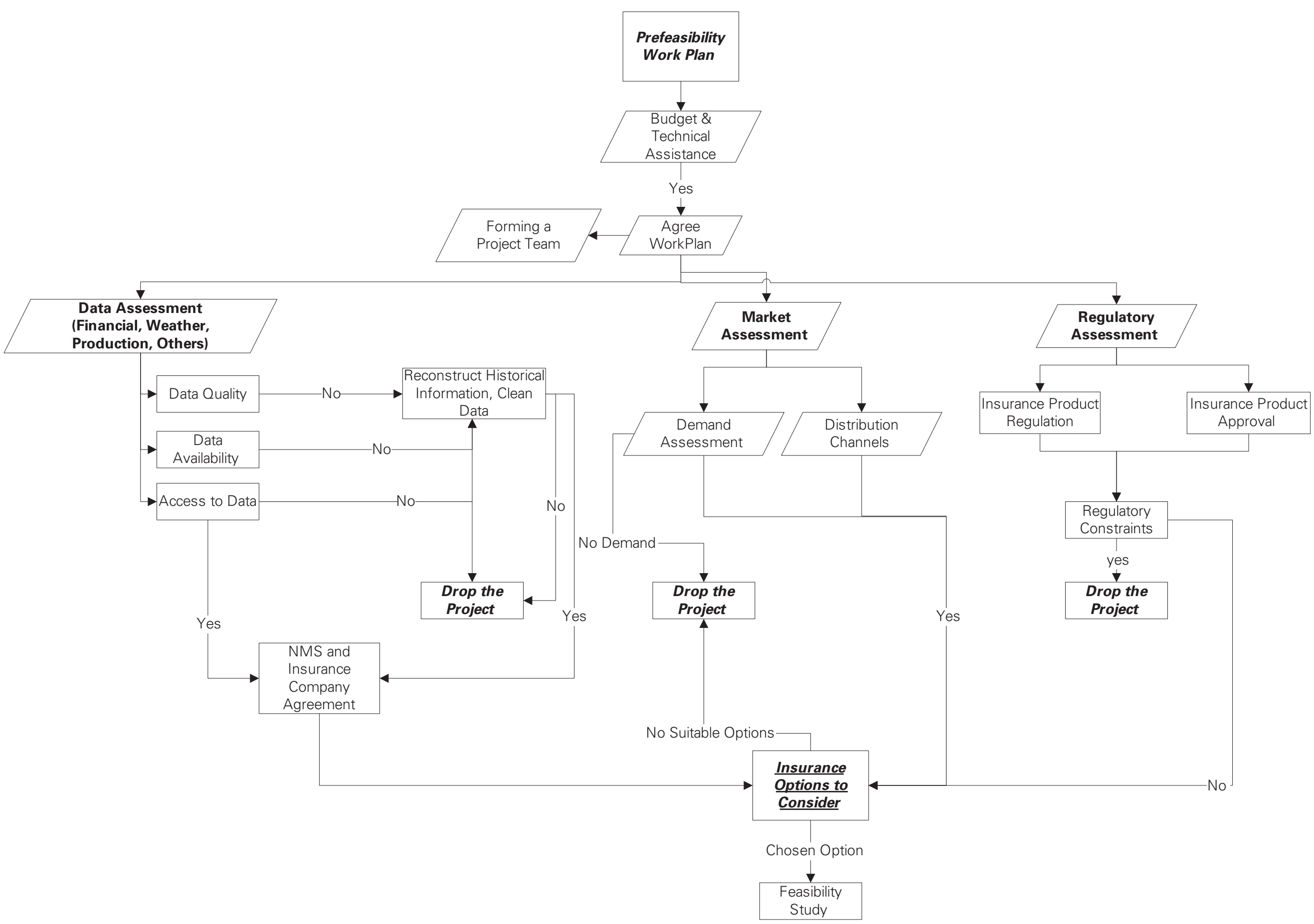
As one can see from the foregoing, the process of prefeasibility involves the consideration of multiple factors, both qualitative and quantitative. It requires the application of art as well as science. It requires decisions on trade-offs and "less than best" propositions. It is, in effect, a challenging exercise, but one that is crucial before embarking on an activity that will require serious financial resources and dedication of a specialist team for an extended time period. In order to assist parties considering embarking on such an activity, figure 4.3 presents a simplified decision tree to try and formalize the prefeasibility procedure.

While the decision tree is merely illustrative, it seeks to show the main decision points when a project can encounter unsolvable constraints and when a proposed WII project may need to be reconsidered. However, as mentioned previously, there are no clear-cut rules on decision points, and each of the above components or steps needs to be analyzed and judgments made at various stages of the process on the viability of progressing with any project. Annex 4 contains a suggested step-by-step checklist for conducting a prefeasibility pilot project.

KEY POINTS

- This chapter is not a "cookbook," but rather a pointer as to some of the key elements that need to be considered during a process of assessing the prefeasibility of any proposed WII project.
- Prefeasibility assessment should be a concise, but informative and flexible process. The overall objective is for a project team to understand necessary and

FIGURE 4.3: Decision Tree for a Prefeasibility Study



Source: Authors.

sufficient conditions for WII in a country, not finalize every issue.

- The prerequisites and conditions mentioned are a mixture of technical and practical issues. Some of them are objective and some subjective in nature.
- There are three main phases to a prefeasibility assessment: desk-based objective assessment, field work subjective assessment, and demand assessment.
- Finding the answers or making decisions about trade-offs can sometimes require the application of more art than science.
- It should be possible to categorize the level of suitability of WII. Ideally, one should be able to diagnose the operating environment as an "ideal," "substantial," "insufficient," or "highly insufficient" situation based on a given set of preconditions. However, it is also important to recognize that there is no standard set of preconditions, and the key is to understand the range of acceptability when something is less than ideal.
- Prefeasibility assessment is also about identifying the appropriate product. The exercise will highlight the options available for the intended developmental or commercial project purpose. By the end of the exercise, the team will have a set of options (with pros and cons) and can decide which option to push for the feasibility phase.
- It should be noted that prefeasibility assessment does not always have to lead to "doing something." One of the options could be "doing nothing" if the team finds no grounds for it.

Chapter 5: TECHNICAL FEASIBILITY: CREATION OF THE BLACK BOX

Having successfully completed the prefeasibility stage and made the decision to progress with a WII approach, the next step is to actually create the index—the "black box" and the prototype insurance contract. Given the novelty and technical complexities of designing weather-indexed contracts for agriculture, it is strongly advised that professional experts in agro-meteorology and agricultural insurance are hired to assist a project team. The experts will assess the various insurance options, create the black box, and subsequently adjust the contract parameters to best reflect the desired protection that will meet the stated project objective.

This chapter will not seek to explain in detail the technical steps that need to be taken by the experts, but rather illustrate what they will be doing, what answers they will be looking for, and what general challenges they will face. This illustration is provided for the target audience of this discussion paper: task managers, donors, and various other forms of WII promoters. Specific details on the technicalities and a modular-based training tool can be found at http://www.agrisktraining.org. This training tool is aimed at insurance industry professionals, academics familiar with the modeling systems, and generalists who already have a relatively in-depth knowledge of WII.

At the outset it should be noted that various methodologies can be used for designing WII contracts. In addition, and as in the prefeasibility stage, the technical feasibility also requires the application of "art" and science. The science is required for building a mathematical model that will serve as a proxy for losses. The art is the application of technical knowledge and qualitative information obtained from farmers and experts to adapt the model so that it responds to the specific context (thereby addressing or minimizing basis risk). As there is no unique way to conduct this process, this chapter is merely illustrative of the major steps required to develop the prototype contract.

In essence, the first step will be undertaking three pieces of interrelated analysis:

- Exposure assessment
- Hazard (or risk) assessment
- Vulnerability assessment

The output of these analyses will be:

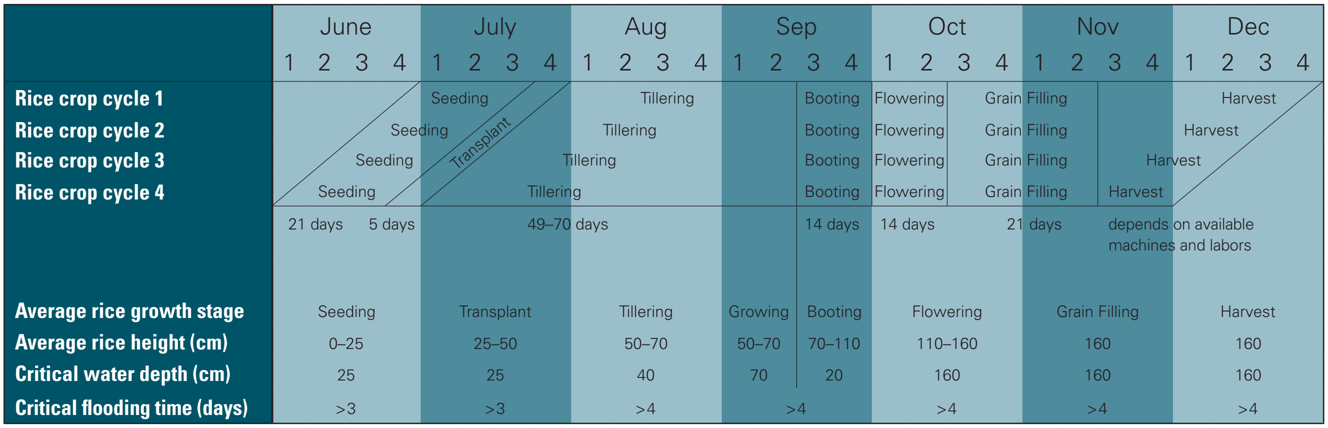
- The mathematical probability of an occurrence of a given weather risk
- The potential intensity of that weather risk
- The potential level of damages caused given the intensities assessed

Depending on the model used and the professionals who are engaged, these pieces can be explicit or implicit in their step-by-step activities to design an index insurance contract. The descriptions of these interrelated activities in this chapter are shown more for illustrative purposes and do not necessarily reflect a particular process of designing contracts. A detailed technical explanation and process of developing index weather insurance, as ARMT has mainly done in piloting projects, can be found in Annex 6.

It is thus important for task team leaders (TTLs) to know that there is no one single way to design an index, and that indexes can vary significantly. An appropriate index for a client will predict loss events and their magnitude with a sufficient level of accuracy. In some cases simple indexes such as the amount of total cumulative rainfall in a season will be appropriate, while in other cases much more complicated indexes such as dynamic crop models will be appropriate. In all cases once a robust index that accurately captures the losses faced by clients is determined, one can go on to design and structure an appropriate index-based weather insurance contract or simply analyze the weather exposure of a client, thereby guiding investment decisions, business plans, and actions for various entities exposed to weather risk.

These three pieces of information will provide the basic quantitative elements for designing an index and structuring and pricing a WII contract.

FIGURE 5.1: Example of Rice Crop Cycles



Source: ASDECON 2008.

5.1 EXPOSURE ASSESSMENT: HOW THE CROP BEHAVES

The objective of this work is to quantify potential yield losses that are associated with particular weather risks at various stages of the crop cycle. Although this exposure analysis uses the same principles as that used for property insurance, in agriculture there is an additional need to understand how a crop behaves in response to changes in weather variables at different stages of plant development. In essence, a building will react to a weather variable in the same manner throughout a given period. A plant, on the other hand, will react differently depending on what stage of growth it has reached. The experts will need to quantify potential losses or reductions in yields at various phases of the crop cycle. Therefore, an agronomist who knows the phenology of the identified crop, and who can divide the crop production cycle into various phases, will be needed during this stage of the assessment.

Figure 5.1 provides an example of rice crop cycles from seeding in June until harvest in December in a rice-producing district in Thailand. This is the initial information that will serve as the basis not just for identifying the various risk phases, but more importantly for identifying the critical periods for any given level of weather hazards. This information is also useful for estimating the increasing accumulated production costs where the insured amount is defined in terms of production costs.

Figure 5.2 shows a maize crop cycle from planting in April until harvest in November, with the identification of critical periods of rainfall at various phases in a particular location.

Information on crop phases and identification of critical water needs during the crop cycle enable experts to design a rainfall index that differentiates between timing of rainfall, as opposed to merely being based on accumulated rainfall. This differentiation is captured in the model through weighting of rainfall. Most WII experts divide crop cycles into periods of 10 days (*dekadal*) to capture the water needs of a crop at close intervals and allow for this weighting. Additionally, a number of other variables are used in the crop models that lie behind an index (for example, soil type, evapotranspiration rates, and temperature), which improves the ability of the model to mirror the actual behavior of the plant. Crop models, in many cases, can be used as the underlying index. Crop models can be simple water-balanced crop models, such as the Water Requirement Satisfaction Index (WRSI) originally designed by the Food and Agriculture Organization (FAO).[13]

Putting the technicalities aside for a moment, the important things to note at this stage are that the exposure assessment is seeking to:

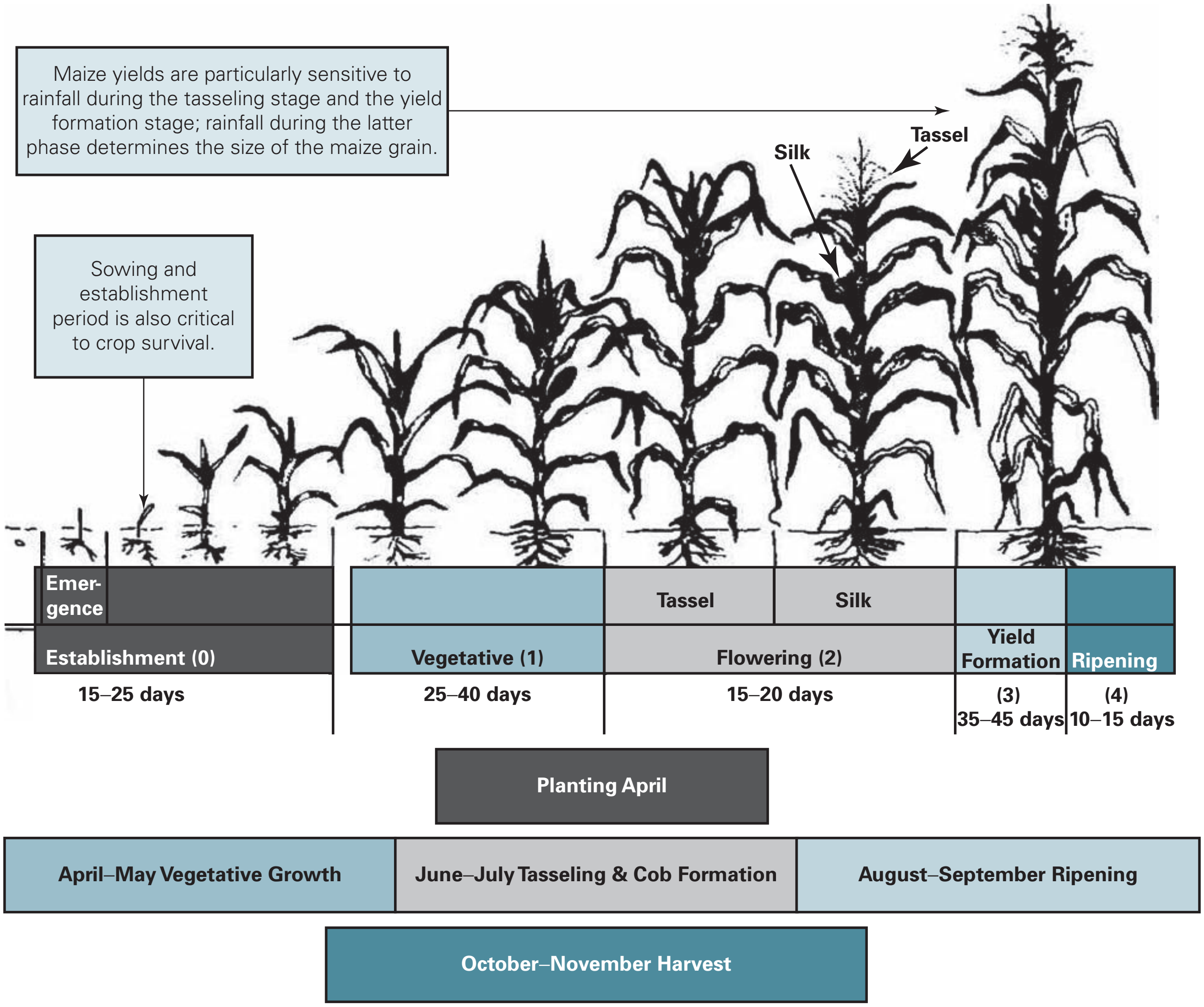
- More precisely identify the critical weather risks at various stages of the crop cycle
- Quantify the value of exposure to weather risks at different phases during cycle
- Provide information for assigning weights to given weather risks
- Quantify the farmer's weather exposure per unit of the defined index
- Quantify the yield volume lost per unit index

In order to achieve this, the experts are seeking answers to the following questions:

- What weather risks are critical in causing yield variability?

13 For a more detailed technical explanation of WRSI, see Annex 7.

FIGURE 5.2: Example of Maize Farmer Cropping Calendar



Source: FAO.

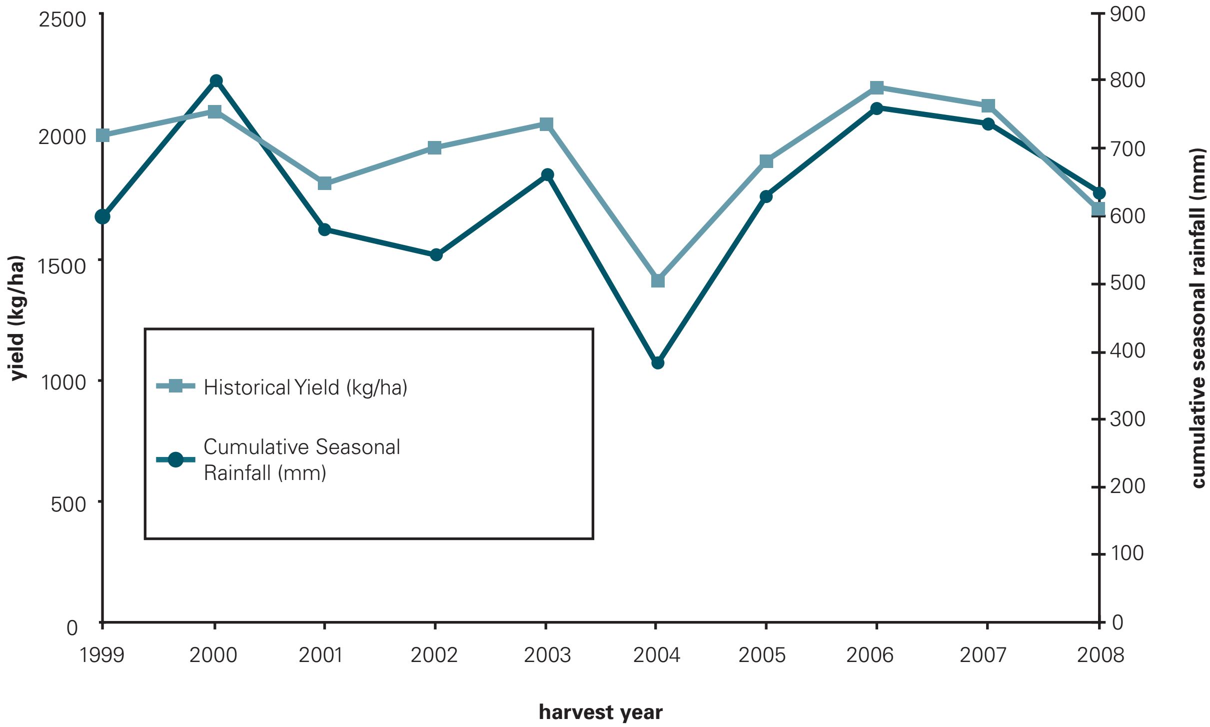
- Which are the critical periods for the crop in terms of weather risks?
- Is there sufficient scientific research on the crop cycle and resilience of the crop to weather risks to be able to design an index that can proxy with sufficient accuracy?
- What is the right weight to assign to critical and non-critical phases for the index?
- What are the exposed values at various phases of the crop cycle?
- Does the proposed index capture the risk in question?

5.2 CORRELATION OF THE INDEX WITH "REALITY"

The final decision as to the acceptability of the crop model and the derived index will obviously lie with the task manager or developer of the WII initiative. While the experts will be hired to provide their input, they will not be taking responsibility for the final product. This is a challenging situation, as most task managers will not have sufficient technical knowledge to enable them to assess the accuracy of the index. However, for assessment of the index's performance in terms of assessing yield, the simple method to test this is to ask the specialists to compare the index with actual, historical crop yield data. The degree to which they match or correlate will demonstrate how efficient the index is at providing a proxy for yield. An example of this correlation exercise is shown in figure 5.3.

As can be seen, the index in this situation does appear to provide a relatively close correlation between the index and the actual yields. If the correlations in an exercise of this kind do not come up very strong, then the first option may be

FIGURE 5.3: Alaba Wereda Maize Yields Versus Farmer's Maize Rainfall Index



Source: Authors.

to revisit the proposed weightings in the index to assess whether they need to be adjusted. While this may increase the correlation, care needs to be taken to avoid a phenomenon known as "overfitting." This occurs when an index is weighted in a certain way and variables are then constructed to ensure a high level of correlation. Unfortunately, while this approach may be used to adapt to historical data, it may result in the index performing in a manner that does not serve as a useful proxy in the future. In simple terms, while mathematical "fitting" can be used to achieve correlations, unless there is a clear understanding that the cause of the lack of correlation is mathematical and not some other physical variable, then mathematical fitting may well not capture further physical variables in the future.

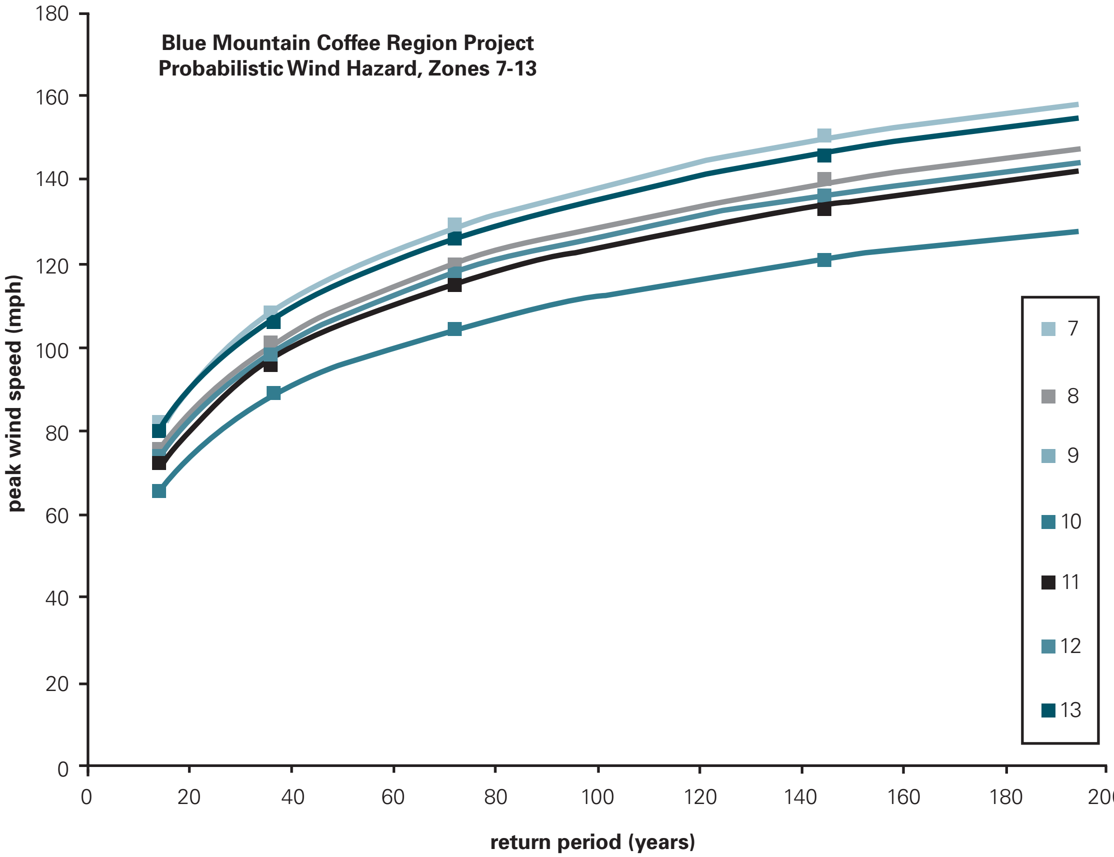
5.2.1 Farmer and Local Expert Interviews

A complementary approach to selecting a weather index is to utilize farmer or local expert recollections of difficult years. It is particularly valuable if these actors can recall the growing seasons when the crop faced particular difficulties in a certain year due to weather or some other risk. Such interviews can also be very useful for verifying other sources of data, such as historical yield data, and understanding the underlying causes for and ramifications of the variations in such composite data sources. As with the historic yields data, this information is likely to be noisy, and it can be difficult to discern the impact of specific events. However, it also provides important information that could distinguish a robustly performing index from one that is inappropriately designed. In some cases, this may be the only information one may have to identify an appropriate index.

5.3 HAZARD ASSESSMENT: HOW WEATHER BEHAVES

The objective of this work is to generate models of expected hazard frequencies for weather variables (such as rainfall, temperature, and wind speed). These weather models also need to be designed with enough spatial resolution to enable them to capture field level variations. In simple terms, the experts will be trying to construct the whole range of probabilities, based on historical weather data sets, for various intensities or magnitudes of weather events. This is known by insurers as the "return period" (for example, wind speeds of 90 miles/hour will hit the pilot area once every 40 years). The outputs from this modeling are called exceedance frequency curves. In figure 5.4 we have given an example taken from simulations done in Jamaica, showing the probabilistic wind hazard exceedance frequency curves for seven zones in the Blue Mountain area.

FIGURE 5.4: Example of Wind Hazard Exceedance Curves



Source: Carib RM 2010.

Given the highly technical nature of this modeling work, it is advisable to have the historical probabilistic models generated by the experts peer reviewed by an independent party (with similar technical expertise). The TTL will find that this hazard analysis is at times implicit in a mathematical model or spreadsheet calculations for WII contracts, and it is not so obvious that this analysis is being done at varying levels of rigor. It is, however, mentioned here to illustrate this technical component of contract design. Underwriters in insurance and reinsurance companies rely heavily on this information in the process of pricing a contract.

During the hazard assessment, the experts will be seeking to answer the following questions:

- Is there sufficient historical, quality weather data to model the curves?
- Is the data of sufficient spatial resolution to capture identified risks in the pilot zones?
- What is the level of confidence that basis risk under the curve has been minimized?
- Do the hazard curves accurately represent the return periods perceived by farmers?

5.4 VULNERABILITY ASSESSMENT: HOW BIG MIGHT THE LOSSES BE—AND FOR WHOM?

This assessment aims to quantify the immediate fiscal impact of the weather risk on farmers. The outcome of the assessment assists definition of the main contract parameters (for example, insured amount, risk retention levels, and the triggers per phase for the insurance contract). This exercise will provide the contract designer with the elements to tailor the insurance contract to the risk profile and needs of the beneficiaries. Box 5.1 provides a summary of illustrative steps that are usually taken when conducting a vulnerability assessment.

Both qualitative and quantitative analysis of risk perception should be conducted through interviews, secondary literature reviews, focus groups, surveys or questionnaires, and discussions with stakeholders and experts.

BOX 5.1: Basic Questions to Answer in a Vulnerability Assessment

1. **Identification of vulnerable groups.** A vulnerability profile should be generated to understand a group's exposures to both spatial and temporal risks. This is to identify a group's main characteristics within the homogenous zone.
   a) How many groups, districts, and farmers are vulnerable? How are these groups affected by risks?
   b) Which are the most vulnerable households? (for example, small landholding, highland areas, nondiversified income individuals)
   c) Who are the most vulnerable individuals?
   d) Are groups affected (quantitatively) differently? Why?
   e) What is the production average over the last 10 years?
   f) What are the factors most highly associated with groups' vulnerabilities?
   g) When do they face these hazards?
   h) What is the seasonality of income activity?
2. **Cataloging assets in a system.**
   a) How have groups' income levels been affected by weather events?
   b) What is the crop planted area for each weather homogenous zone?
   c) What is the average production harvested per month/season?
   d) What is the farm gate price received?
3. **Mitigating or eliminating the most serious vulnerabilities.**
   a) After a disaster, do farmers have access to financial services that contribute in minimizing vulnerability?
   b) Which coping strategies could be identified?

Source: Authors.

The outputs of a vulnerability assessment normally include:

- A description and analysis of present vulnerability, including representative vulnerable groups (for example, specific livelihoods at risk by weather hazard)
- Vulnerability indicators, including impact on investment, income, debt, employment, and export earnings due to weather risks
- Vulnerability maps and profiles for districts, groups, and growing production areas
- Comparison of groups' vulnerabilities under different types of risks and location
- Potential crop production losses for different weather events

5.5 STRUCTURING THE CONTRACT

Based on the qualitative and quantitative outputs generated in each of the three assessments mentioned above (exposure, hazard, and vulnerability), an agricultural insurance specialist should be in a position to structure an insurance contract. Basically, three main issues need to be resolved in the process of contract structuring:

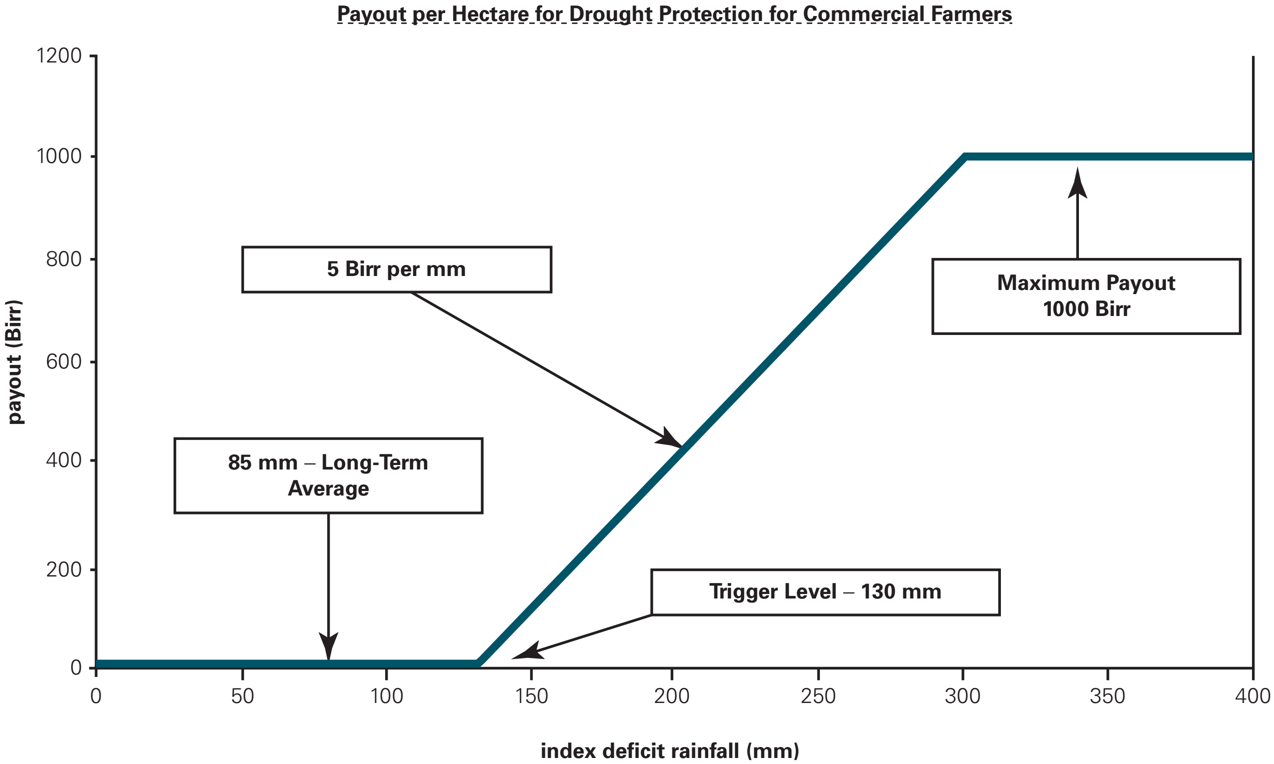
- **Trigger payout levels.** In a traditional contract, the insurer will price the contract based mainly on probabilistic models, and payouts will be made in accordance to an ex-post loss assessment. For index-based contracts, however, it is necessary to agree to an ex-ante payout scale that will determine how much the contract will pay for each unit of weather variable. This scale is measured in ticks and is expressed in terms of intensity of the event (for example, millimeters of rainfall, degrees of temperature, miles per hour of wind speed, and so on).
- **Pricing of the contract premium.**
- **Ensuring that the payout level is sufficient.** The prototype contract must be carefully reviewed to ensure that it offers the level of protection required by the insured, depending on the project objective.

The contract selected must perform an insurance function for the buyer (that is, the index must capture the risk in question and perform well from an agro-meteorological point of view), thereby satisfying both client and regulatory requirements. The specific details, values, and combinations of these features (and the resulting contract) depend on the risk profile and demands of the clients, and the context in which the insurance contract is being introduced to manage weather risk.

In order to address these issues, the specialists will be seeking to answer the following list of questions:

- Does the contract capture local conditions and environment as well as crop specific agro-meteorological risk?
- Does the contract adequately cover the major identified risks?
- Is the risk retention fixed in the contract acceptable to farmers?
- How often and how much will the prototype contract be paying out?
- Do various levels of payouts respond to farmers preferences?

FIGURE 5.5: Contract Parameters in an Indexed Drought Contract



Source: Authors.

- What is the cost-benefit of such a contract versus other alternatives to manage risks (for example, irrigation)?
- Will farmers be paying too much premium for too little coverage?
- Does the prototype contract meet the project stated objective?

Figure 5.5 shows a simple illustration of the results obtained while structuring an index contract for a project in Ethiopia. This simple graphic can be very useful for a project team to share the results of the exercise with various stakeholders.

This hypothetical contract will start paying when there is a rainfall deficit of 130 mm and will continue paying 5 Birr per each millimeter of rainfall deficit until accumulating the total payout in the contract of 300 mm of rainfall deficit for a maximum payout of 1000 Birr. Any yield losses due to rainfall deficit below 130 mm will be assumed by the farmer.[14]

14 ARMT has developed a contract optimization tool that can be very useful for changing initial contract parameters to optimize farmers' coverage. This can be found in the WII training module at http://www.agrisktraining.org.

Another illustration of a simple payout structure for flood damage (from a World Bank study done for index flood insurance) is shown in table 5.1. The advantage of presenting the contract parameters in a table format like this is that it is easier for nonspecialists to understand and explain to farmers. In the end, what farmers want to know is how much their payout will be based on certain levels of either weather excess or deficit. In the example in the table, there are agreed percentages of production costs the contract will pay out for four given levels of inundation over 60 cm of flood.

TABLE 5.1: Flood Index Insurance Structure with Total Production Costs as Sum Insured

DAYS OF INUNDATION OF 60 cm FLOOD	YIELD DAMAGE	INSURANCE PAYOUT
3 days	No damage	No payout
4 days	20% loss	20% of total production cost
5 days	60% loss	60% of total production cost
6 days	80% loss	80% of total production cost
7 days	100% loss	100% of total production cost

Source: Authors.

BOX 5.2: Complexity in Product Design in Bangladesh

Three study areas were selected for the technical feasibility assessment for WII in Bangladesh. Initial activities included the selection of crop and study areas, and rice was proposed as the crop to be insured under the pilot. Dinajpur, Pabna, and Bogra were selected because of:

1. The large number of rice farmers
2. A preliminary risk assessment based on national-level risk maps
3. The existence of many MFIs providing crop loans
4. The existence of weather stations with historical records

Investigating the technical feasibility of WII involved:

1. Analysis of meteorological and yield data
2. Assessment of trigger level and payout scale
3. Pricing of contract for insurance purposes

The results of the analyses highlighted the complexity of designing rainfall-related WII contracts for the chosen areas. While the districts were situated in drought-prone areas, and the national-level yield assessment demonstrated that rainfall variability plays a key role in the rice yield variability, for the purpose of designing a simple rainfall index insurance product applicable to a whole district, the study did not find weather indicator-yield correlations at a systemic (district-wide) level in the three study areas.

Data constraints play a key role in the findings. It became evident that the historical yield data series were not useful for the purpose of contract design given the large area (covering two to three districts) from which the data were aggregated. Additionally, the distances of the study areas from meteorological stations became clear during the field visits.

There were existing risk management practices prevalent in the study areas. Interviews with farmers highlighted the importance of existing mitigation practices such as irrigation and the use of pumped ground water.

Data problems, plus alternate mitigation actions, make WII complicated. In an environment of farming systems and rural water management as complex as in Bangladesh, determining the value of a WII product requires an elevated level of intensive research work.

Source: Authors.

BOX 5.3: Contract Pricing

When establishing a price for a weather risk management instrument, providers will take into consideration their own risk appetite, business imperatives, and operational costs. While there are a variety of methodologies for pricing, in general the pricing for all contracts will contain an element of expected loss, plus some loading or risk margin that corresponds to a capital reserve charge required to underwrite the risk at a target level for the business, as well as administrative costs. Therefore in general the premium charge for a contract can be broken down as follows:

$$\textit{Premium} = \textit{Expected Loss} + \textit{Risk Margin} + \textit{Administrative Costs}$$

Expected loss is the average payout of the contract in any given season. The risk margin is charged by the providers because in some years, when extreme events happen, payouts in excess of this average can occur, and the risk taker must be compensated for this uncertainty. The values of the expected loss and the risk margin must be established from historical weather data. These values may include an adjustment to compensate for uncertainties in the data such as trends or missing values. The approach for determining the loading over the expected loss differs from insurer to insurer, and many use a combination of methods to determine the risk margin included. A sensible pricing methodology uses a risk measure such as the value at risk (VaR) of the contract to determine the risk margin. A VaR calculation is aimed at determining the loss that will not be exceeded at some specified level of confidence, often set at 99 percent. Administrative costs are essentially the costs for the provider to run the business, including charges for data, office costs, taxes, and reinsurance and brokerage charges if necessary.

Source: Authors.

The project team will need to adopt a great degree of flexibility and innovative approach while going through the process of structuring an index contract in agriculture, and be prepared to admit that the complexities at times are so overwhelming that there is no confidence on behalf of the project team about delivering an adequate response to transfer risks for farmers in a particular situation. Box 5.2 illustrates such complexities in a real case scenario in Bangladesh.

5.6 PRICING THE INDEX CONTRACT

In effect, the "price" of the contract, or rather the cost of the premium, will ultimately be set by the insurer. The process that an insurer undertakes to determine the premium is known as underwriting. The role of the task manager or WII promoter will be to ensure that a potential insurer has the required level of information and possesses the suitable level of confidence in it. Underwriting is basically evaluation by the insurer of the risk and exposures of potential clients in order to determine an acceptable risk (eligibility) and level of coverage, and thereby premium. Insurers use their own methods to appraise risks and price contracts, and therefore different insurers price the same contract at different premium levels for the same risks. However, box 5.3 provides a simple overview of the elements involved in pricing.

Insurers seeking to introduce WII in lower-income countries typically have at most 25 to 30 years of weather data. Within such short time frames, significant catastrophes and existing trends may fail to emerge from the data. Thus, when calculating expected losses, insurers take the pure risk (according to the data) and then add an ambiguity load—effectively a margin to account for inaccuracies or uncertainties. Ambiguity loads can also be used to account for changing weather risk—for example, related to climate change. An insurer attempting to price pure risk is unable to tell if future trends will be the same, worse, or better, and often ambiguity loads can be significant.

Insurers can and do adjust pure risk estimates and ambiguity loads over time, although new information does not always provide clarity or lead to reduced pricing. When insurers have access to very little data, it may be difficult to tell if new data fit into the same pattern or represent a fundamental change. For instance, a series of weather shocks may be an example of a low frequency, high severity risk within the same central tendency or it may suggest a shift in the central tendency and overall climate.

Chapter 6: INITIAL IMPLEMENTATION: THE DEVIL IN THE DETAIL

Despite having discovered that the product is technically feasible, the task manager should be aware that reaching this stage successfully does not always mean that ultimately a product can be developed (see box 6.1). This chapter will attempt to present some of the areas that can cause complications during implementation.

Technical feasibility is only one facet of program development, and any successful program must address and overcome a number of challenges associated with expanding a new financial product into a market. Notably, when considering farmer-level WII, we are considering financial products targeted toward clients who have limited financial literacy and whose experience with insurance products is, in most cases, almost nonexistent.

BOX 6.1: Where Does Feasibility Stop and Implementation Begin?

Chapter 5 discussed how to carry out a feasibility assessment. While this activity will give a good indication if and how a WII program could be implemented, it cannot predict or determine all the challenges that may lie ahead. In reality, the only true test of feasibility is trying to implement a program and offering the product to clients. There is a significant overlap between determining feasibility and the beginnings of the operational program. The steps involved in implementing a WII program are outlined in this chapter, and while some of these things have been completed in the feasibility work, in other cases they may not have been completed. The depth of the feasibility report carried out will determine how much work remains to be done in order to implement a pilot program. In many cases, feasibility will cover the general aspects of program development, while in other cases feasibility goes into much more detail outlining specific operational activities and potential partner arrangements.

Source: Authors.

With these limitations in mind, it is clear that the success of WII program development will be heavily dependent on the actual demand for the product and the completion of the business processes and operational arrangements that will give clients access to them. In order to see more clearly how these factors run throughout the implementation process, we have broken the process down into two distinct phases:

- Meeting the preconditions
- Implementation

6.1 MEETING THE PRECONDITIONS

A number of preconditions must be met for implementation of a WII pilot, and they will influence the ease of program implementation. While there are numerous factors, two basic preconditions must be satisfied in order to move forward: ability to identify and reach clients and data availability and access.

6.1.1 Ability to Identify and Reach the Client

Before a program can be developed, the specific use of indexing should be established and client need identified so that an appropriate product can be designed. Client needs must dictate contract design and program development, otherwise the product will suffer from lack of demand or will fail to meet the expectations of all involved parties. In general, clients fall into one of two groups in agriculture. Either they are farmers ("micro" clients) or they are operators in agricultural supply chains (banks, input/service suppliers—"meso" clients). When deciding whether to market products to farmers or to institutions, it is important to consider the tradeoffs between the two; these are considered in table 6.1.

Providing financial services to rural clients is more challenging than to urban for a variety of reasons (poor infrastructure, lack of formal financial sector, small or geographically dispersed land holdings, and so on). To access potential clients, insurance providers must develop a cost-effective way to offer and provide information on new products. In the case of meso-level clients, this can often be done fairly directly and at relatively low cost. Farmers, on the other hand, are poorly

TABLE 6.1: Comparison of Micro- and Meso-Level Products

	FARMER-LEVEL INSURANCE	INSTITUTIONAL-LEVEL INSURANCE
Program planning and implementation	• Farmer outreach critical—can require co-ordination with farmers' organizations or other rural service providers • Services need to be farmer focused • Implementation complicated by number of clients and their dispersal	• Smaller number of potential stakeholders • Outreach not as relevant • Programmatic decisions can be made relatively by the financial institution or portfolio client
Contract design	• Contracts must meet needs of specific farmers or groups of farmers, while also being generic enough to be scalable • Designing a contract that acts as an accurate proxy for the risk of each farmer is critical for take-up and program efficacy	• Products can be tailored to meet the specific need of a single client rather than a large number of clients • Determining average weather risk of a large group of farmers rather than the risk to a specific farm can simplify index design
Basis risk*	• Only small levels of basis risk will be accepted by farmers • Weather at the stations must match the weather on the farmer fields with a high degree of confidence • Basis risk and its management are a major challenge, especially to sustainability	• Portfolio clients are interested in average payout, which minimizes basis risk • Portfolio clients are risk aggregators, with many clients and areas, and are therefore more capable of absorbing basis risk events than individuals
Communication and education	• Education and training for farmers are critical marketing components and enable farmer understanding of basis risk • Given numbers of individuals involved, fact that insurance is a new concept to many, and that WII is technically complicated, resource investment in education and training can be significant	• Education and training limited to a much smaller group of individuals, many of whom already have a higher understanding and awareness of financial products • Given the foregoing, costs involved with these clients are invariably much lower

* Basic risk is the potential that the weather at the station used in the index can differ from the weather on the farmer's fields.

Source: Authors.

connected to markets, and reaching them can be challenging and expensive.

Unless a commercial partner can be found who is willing to invest the time and financial resources to engage in sufficient outreach to potential clients, any program is unlikely to succeed in an initial product offering and will certainly be at high risk of low sustainability.

6.1.2 Data Availability and Access During the Contract Period

Historical data from weather stations is critical for deriving the indexes that underlie the products. In addition, accessing data on a real-time or semi-real-time basis is critical for settling the contract, guaranteeing that insurers and reinsurers want to participate in the contract, and providing transparency in contract administration. The challenges associated with accessing both historical and real-time data to support the project should not be underestimated.

Getting agreement from the National Meteorological Service (NMS) to provide data to clients can prove challenging. In many cases, state institutions are either unwilling or unable to share it. Use of weather data for commercial purposes is rare in many countries, and therefore there is no set system for sale of data or provision of services from the NMS. Many pilot programs have been delayed by months simply because access to data (even though it existed) could not be gained. Box 6.2 illustrates some challenges you might encounter trying to access weather data to be utilized for designing agricultural index insurance for most countries.

6.2 IMPLEMENTATION

If the above preconditions (and other previous steps, such as prefeasibility) can be met, then there may be potential for a program to move forward. At this stage of program development, activities move from being largely technical to much more practical, requiring extended work in country with the local program partners. These activities will vary from program to program, but here we group them into eight general activities.

6.2.1 Establishing a Work Plan

Program implementation usually requires 6 months or more to sufficiently prepare to offer policies to clients, and it is important to coordinate the work planning with the cropping cycle. Because WII programs have to be coordinated with preseasonal activities, it is important to ensure that all activities in the work plan take this into consideration.

For a work plan to be effective, it must be supported by the diverse stakeholders who will be required to move the program forward, all of whom have differing roles and responsibilities for program success (see table 6.2). This often requires careful coordination of activities and stakeholders,

BOX 6.2: Why Data Access Is a Complicated "Business"

"Publically available" does not mean free... although sometimes it does. Some NMSs require purchase of data, while others share data freely; when it is for sale, prices can vary significantly. While initial payment for data may not be significant, the terms for payment should be considered carefully, since additional data will be required to scale up the program to additional stations.

Data that is purchased must be sharable. It is important that the terms of any data purchase or release permit the data to be shared with all parties involved in the pilot (including international reinsurers and local insurers). Failure to ensure this will make it very challenging to underwrite the program.

Daily data is preferred. Often NMSs are willing to share weekly or dekadal data. While this is helpful and can provide a basic overview, accurate analysis of the weather risk and, specifically, design and underwriting of any insurance product require daily data.

"Missing" data may not be missing. Summaries of available weather data from NMSs are often misleading. Invariably, NMSs only provide summaries of data that has been cleaned and digitized. In reality there is commonly much more data available that has not been cleaned or is held in other formats (for example, records kept at weather stations, logs and reporting cards held by the NMS, and so on). This data is often in handwritten form and yet to be digitized. Harvesting this data and digitizing it significantly increases the scope for access to weather data.

Ongoing access to data is just as important as access to historical data. During the insured crop season, the NMS will need to provide data at an agreed-upon frequency. This data is essential to determine when and if there is a payout from the contract. Any gaps in data provision must be monitored and remedied.

Automated stations are preferable. Automatic weather stations are preferred because of their heightened ability to provide source data without the potential for physical interference and also to provide more timely data provision. Manual stations can act as backup stations. Where only manual stations are available, these are acceptable for the purposes of insurance as long as they have the appropriate security. However, it should be noted that automatic stations do need maintenance and regular recharging of mobile phone cards if they are reporting via mobile networks.

Source: Authors.

TABLE 6.2: Stakeholders in WII Programs

CATEGORY	POTENTIAL STAKEHOLDERS	ROLE
Insurer	Insurance companies, insurance association	Underwrite risk, contract design, marketing
Reinsurer	Reinsurance companies, hedge funds	Risk transfer capacity
Agribusinesses and financial partners	Agricultural banks, rural service organizations, nongovernmental organizations (NGOs), MFIs, input suppliers, agribusiness companies	Clients, agents for marketing and education, collecting policies and premiums
Farmers	Farmer association, cooperatives	Clients
Government departments	Meteorological service, insurance regulator, Ministry of Finance, Ministry of Agriculture, planning ministries, research and specialist institutes	Provide data, agronomic information, and research; assist in contract design; maintain weather infrastructure; regulate product
Donors	Technical assistance, financing key investments	Research and development (R&D), weather infrastructure

Source: Authors.

which may necessitate the appointment of a local project manager or a team tasked with pushing the work forward. It is vital that the roles and responsibilities of the various stakeholders are set out from the beginning; this is often best achieved through the signing of a memorandum of understanding by the stakeholders. An example of a work plan can be found in Annex 10.

6.2.2 Identify the Potential Pilot Areas and Complete Risk Assessment

Generally, the feasibility work will identify some preliminary target areas. These areas should now be vetted to determine the best location to launch the program. When WII is first discussed, most people consider areas that are frequently affected by extreme weather. However, these areas are actually the least suitable for a weather risk transfer product. WII (like all insurance products) is most suited to areas where payouts are not regularly required. Similarly, in those areas where risks are extremely infrequent, it will be challenging to market a product to farmers whose perceived risk is extremely low.

For pilot programs it is often best to start with a large pool of diverse areas and clientele. This will both allow the best areas for the program to be selected and also offer various options for the approach being piloted (for example, working with an MFI or retailing directly to farmers). Of course, the final area selection will be dictated by both the technical and operational realities.

In the preconditions we discussed above, we noted the importance of identifying clients and the ability to reach them. While a partner may have indicated their willingness and ability to work on the program, their ability to do so should be reconfirmed during the process of area identification. There should be a thorough determination of the planned delivery channels for reaching end users, through institutions such as a bank, financial intermediary, or farmer organization, and clarification that they can efficiently and cost effectively deliver the product to farmers (or other intended beneficiaries). The institution must have both sufficient outreach to provide marketing and education to clients and the organizational capacity to handle a new financial product.

6.2.3 Contract Design and Establishing a Premium

Contract design is a core activity of any WII program and requires considerable attention in both staff time and financial investment. Primarily, it involves the design of prototype contracts and ultimately the design of a contract that provides the most accurate proxy for clients' risks, while establishing a premium that a client is willing to pay.

Prototypes are simply generalized contracts with the basic terms determined purely by agronomic modeling and input from clients. Determining premiums is a relatively straightforward process, and initial quotes can be obtained to ascertain how inexpensive or expensive the contract will be. Prototypes provide the basis for discussion with clients and will provide clearer indications of client commitment to the program. This discussion also provides feedback on the terms of the contract and initial reactions to the premium level. In addition, if there are any serious design constraints, prototyping will identify these and allow for testing of other contract designs or approaches to indexing the risk.

Contracts to be retailed directly to farmers must be designed to balance simplicity of contract structure with ability to capture the complex dynamics that the index seeks to mirror. The contract must provide effective insurance for the buyer, by faithfully capturing the identified risk. It must compensate a farmer for losses and thereby satisfy client needs and insurance regulatory requirements. A contract that achieves a balance of agro-meteorological and practical considerations is most likely to facilitate a farmer's acceptance and the marketing process.

A key consideration in contract design is to ensure that the product offers adequate protection to a farmer, who may often have more than one crop or income stream. To ascertain this, the team should consider whether a payout based on a weather index would effectively compensate a farmer for the worst potential economic loss the farmer might experience. This overall vulnerability of a farmer to external shocks is often better managed by simpler index contracts that focus on more extreme events.[15] The same consideration also holds for intermediaries like banks and MFIs, who are concerned about the aggregate risk of many farmers, rather than the specific risks of individual farmers.

6.2.4 Test the Contracts, Determine Marketability, and Finalize the Product

Once the contracts have been designed, they should be discussed in detail with the program stakeholders. They need to be evaluated both for technical accuracy and to determine actual client demand.

While contract design is a detailed and lengthy process, the sooner a prototype can be developed for testing and sharing with stakeholders, the better, as this can add significant clarity to project development and allows contract refinement based on field conditions. Testing contracts can be executed through focus groups with farmers, clients, and industry leaders. Simple strategies that demonstrate the years a contract would have paid, the triggers for payout, and the overall terms of the contract can provide good illustrations of how well a contract matches the farmers' risks.

Finally, the terms of the contract need to be set. These include the trigger levels for the contract, payout levels and amounts, and start and end dates for the contract. Finalizing these will require agreement among the insurers and reinsurers as well as the clients.

These terms will have a significant impact on the cost of the premium. While initial pricing can be done on a provisional basis (see above), the final cost of the product is ultimately determined by these terms and by loadings selected by the insurance company offering the product. The insurance company will combine a number of different costs to come up with the overall price. The primary components of the premium are the pure risk and administrative costs, but insurers will also load contracts to account for catastrophic payouts

15 Hess, U. "Innovative Financial Services for Rural India: Monsoon-Indexed Lending and Insurance for Smallholders." Agriculture and Rural Development (ARD) Working Paper 9, The World Bank, 2003. Hartell, J., H. Ibarra, J.R. Skees, and J. Syroka. Risk Management in Agriculture for Natural Hazards. Rome: ISMEA, 2006.

(which is a largely subjective process). Before a program can be launched, the insurance company has to decide and communicate in writing to stakeholders and clients the final terms and premiums for the contract. This information then needs to be shared with potential clients.

6.2.5 Identify and Carry Out the Business Processes

In parallel to the technical work, it is critical to commence the business processes that will also drive the program. While the contract design work underpins the contract, the operational work is equally as critical for a fully functional operational program and ultimately drives the transaction.

These business processes are some of the areas in which WII programs face their biggest obstacles. Of course, most of the challenges are not unique to WII and are common in the rollout of many new financial products. The actual challenges or difficulties that a program will face in this area differ according to the particular situation and stakeholders involved. However, in general terms, these are the main areas that need to be addressed or considered:

- Determine how and when the product will be marketed
- Determine how premiums will be collected and payouts distributed
- Develop policy documents
- Finalize agreements between stakeholders
- Prepare marketing material
- Adapt internal Management Information System (MIS) and accounting systems

6.2.6 Obtaining Clearance from the Insurance Regulator

Clearly, it is important to work within the existing insurance laws and regulations of the program country. This can be a complicated issue with WII, as its definition as insurance will be dependent on laws and regulations applicable in each country. In Chapter 7 we will discuss this issue in more detail. From an operational point of view, obtaining the clearance will normally require presenting a draft contract to the regulator for approval. In some cases it will simply require providing information on the terms of the contract to the regulator. In all cases it is necessary to make sure that the regulator has approved the product and any associated documentation as is mandated by the jurisdiction in which the pilot will operate.

6.2.7 Sourcing Insurance and Reinsurance

One of the potential advantages of index-based products is the ease with which they can be underwritten by insurers and reinsurers. However, in most developing countries, these products are new, so many insurers are hesitant to expand their business with this product too quickly. Additionally, the capacity of domestic insurers' staff to understand, design, process, and administer WII contracts is low, and this presents an obstacle to increasing the volumes of business transacted. However, this is an area in which the program can seek to provide dedicated "hands on" capacity building as the pilot proceeds.

While many pilots have low total values at risk and could therefore be conducted without transferring any risk to the international reinsurance market, there are a number of reasons why reinsurance should be considered. First, while the exposures may be small, the product is new and untested for many insurers, and they are therefore cautious about underwriting on their own. Second, as the insurance program expands, management of catastrophe exposures through reinsurance will be necessary. Third, there are clear benefits to establishing relationships between national and international reinsurers.

Fortunately there is an active reinsurance market for WII. This interest is based on a desire to engage in new markets and diversification of risks. It is generally based on the belief, or at least hope, that there will be a growing market for weather risk in a country. However, it should be noted that reinsurers' interest in pilot programs (which are generally quite small) is likely to be high only if they see the prospect of significant market expansion. For small pilot deals, international reinsurers have little or no financial incentive to participate. In most cases proportional reinsurance is used for new programs, as the insurer and the reinsurer are involved in taking risk in a contractually proportional manner, and this may be converted to a nonproportional program as exposures grow. Clearly, the retention capacity of the national insurer(s) involved with WII in a given country will dictate the levels of necessary reinsurance purchase.

If the product is going to be reinsured, obtaining a commitment from a reinsurer should be completed before the program is launched. It is advisable to obtain quotes from a number of reinsurers to get the most competitive terms for the contract, including both price for the deal and length of the contract (single year versus multiyear). These terms should also include the type of reinsurance agreement that will be utilized (stop-loss, proportional, and so on), the terms of that agreement, and the costs. In many cases these agreements will be made by reinsurers verbally, but it is advisable to try to obtain a formal written offer in advance of sales. It is important to discuss with the reinsurer the size of the deal and to establish in advance whether the offer of reinsurance is contingent on the particular volume of business. In many

BOX 6.3: Some Considerations When Providing WII Education and Marketing to Farmers

Client/product characteristics. For micro, unbundled, or standalone products, a long window should be allowed for marketing and education. For meso or bundled products, less time may be necessary. For the first group there should be repeated information sessions, question and answer (Q&A) sessions, peer consultations among the potential buyers, and retraining of sales staff.

Deadlines. The sales period for index insurance must close before the insurance coverage period actually begins. For weather insurance this means before farmers are able to predict how weather will impact their crop. A grace period between contract purchase and coverage is meant to control "antiselection" (also known as "adverse selection"), whereby farmers buy insurance only in bad years.

Integration with seasonal activities. In case of a loan-linked program, marketing and education are often more efficient when linked to existing orientation or training programs that banks provide to borrowers and potential borrowers.

Key messages. Marketing and education must focus on reminding farmers that they are vulnerable to weather risks and that they are likely to be worse off unless the risks are properly managed. It is important to demonstrate clearly how the insurance product could help them. This can be done by (1) asking the farmers to recall big weather events that affected their lives in recent years, (2) analyzing what would have been historical payouts had the index insurance contract been bought, and (3) comparing the index insurance product with the existing coping strategies in order to highlight the product's effectiveness and complementarities with existing measures.

Local delivery, local staff, local language. Marketing and education need to be brought to the client. Marketing sessions conducted in the local villages are generally most effective. It is critical that they be carried out by local staff in local languages, as this makes farmers feel more comfortable and increases understanding. Building trust with clients is a key component that will encourage take-up.

Preconceptions about insurance. It is not uncommon that the target clients will have negative preconceptions about insurance. This may be related to previous experience with agricultural or other types of insurance. It is important to anticipate these reactions from clients and prepare to address them effectively.

Cash availability. It is critical to consider clients' cash flow when marketing the product. Many clients will have access to cash only immediately following harvest. In those cases it may be necessary to sell policies well before the season or to make arrangements to finance the cost of the premium.

Source: Authors.

cases reinsurers will offer capacity only if business volumes meet a particular threshold.

6.2.8 Market the Product

The marketing of the product can be relatively straightforward or extremely challenging, largely dependent on the targeted clients. Client selection—micro versus meso—will dictate whether marketing needs to be done at the individual level to a large network of small farmers, or if it can be done to a smaller group that has greater outreach.

In those cases in which the identified client is an institution, an agribusiness, or a larger farmer, the resources required for marketing and education can be relatively minimal and will require only a limited number of meetings and interactions. On the other hand, if the clients are individual, smaller farmers, a relatively large amount of resources should be dedicated to marketing and development of delivery channels. This is one of the areas in which costs of a pilot program can increase significantly, with implications for financial sustainability. It is critical to strike a balance between the need to educate clients and the demands of running a financially sustainable program.

Where WII is being offered bundled into a loan or input package, the education and marketing requirements do change. Since clients ultimately are making decisions based on the entire package (for example, loan and insurance) and the insurance is usually a secondary element of the package, marketing will require a less detailed education program for the insurance component. This can lower the costs of marketing and may increase take-up of the product. However, care must be taken to ensure regulatory compliance and true client understanding of their coverage.

If products are being offered to farmers, education and marketing are generally best carried out by stakeholders who regularly work with the farmers (for example, banks or input providers). Often these stakeholders will have previously provided education on new products, and that experience can provide valuable inputs for WII marketing. Product marketing and education are heavily influenced by the education level of clients, cultural considerations, and previous experience with insurance products. Box 6.3 summarizes a list of issues to be addressed when designing an education or marketing strategy for farmers who are not acquainted with agricultural insurance.

6.2.9 Finalize the Operational Aspects and Monitor the Program

The operational partners carrying out sales of the product will need to complete sales in sufficient time to enable them to provide policy and premium schedules to insurers and reinsurers. This is simply a list of the number of policies sold and the associated premiums. This requires communication from the client level to the insurer and, depending upon the operational arrangements in place, could involve a number of different institutions. In addition to recording the sales, maintaining the appropriate records, and transferring this information among the different parties, premiums will also need to be transferred from the clients to the insurers and reinsurers. This will need to be done relatively quickly and will require that transfer arrangements and the necessary business relationships for transferring the funds are established in advance.

6.2.10 Monitoring and Evaluation

The program development process is not completed once the policies have been issued. In fact, one of the benefits of WII is that the contract can be measured throughout the season. This allows underwriters and policyholders to monitor the situation as the season develops, which provides greater transparency for the clients, hopefully leading to greater trust between the parties.

Under the project the NMS should provide daily weather data on agreed dates. In cases in which a few days are missed due technical or other problems, parties need to have a previously agreed procedure to fill in the data gaps (for instance, by relying on a backup station or historical data). In cases in which equipment fails altogether and is missing for an extended period of time, the parties should consider including a termination clause for the contract.

BOX 6.4: Carrying Out a Dry Run

A dry run of a WII program might be a suitable option in various cases:

- When stakeholders are uncomfortable with a full operational pilot in the first year of operation
- When there is insufficient time to get the pilot running for the season

Starting a program prematurely can undermine future opportunities for implementing weather insurance. Therefore, even when there is sufficient time to run a full pilot, a dry run can be helpful for testing how a pilot will work and also for providing hands-on education and training to stakeholders and partners.

A dry run was carried out in Thailand (2006) with the Bank for Agriculture and Agriculture Cooperatives (BAAC). BAAC was interested in piloting a WII program in Nakhon Ratchasrima Province (a major maize area susceptible to drought). BAAC began collecting rainfall, yield, and other key agro-meteorological data, interviewing farmers, and designing a prototype rainfall WII contract. The stakeholders then decided to implement a dry run instead of a full pilot.

The reasons for this were twofold. First, the stakeholders wanted to test the marketing of noncompulsory and unsubsidized WII insurance to farmers to enable them to better assess the potential demand for the product. Second, the dry run allowed stakeholders to practice product marketing and customer enrollment and to develop a robust rainfall monitoring system.

Apart from operational insights, the dry-run provided the pilot team with the following:

- Input from farmers, which improved the prototype rainfall index
- A better understanding of the risk environment by BAAC and the farmers in the pilot area
- A clearer understanding of the role of the WII product within existing risk management measures

Source: Authors.

Basic contract monitoring sheets should be developed that can indicate whether there might be a payout under the contract. It is important that the insurer develops a contract monitoring sheet to be shared with project partners. Each time records of the weather parameter are received, the project manager in each organization should use that data to update the sheet. The sheet should reflect how the contract payouts are developing as more and more data is fed into the model (index), a procedure called "marking to model." This information is important for all parties concerned. It helps the insurer set up his outstanding loss reserves and update it as more data is received. If communicated well to the farmers, it helps them gauge the extent of basis risk between their fields and the weather station, a piece of information that helps in refining contract design and any likely payouts.

In addition to contract monitoring, the project should be monitored by the stakeholders to detect any unanticipated outcomes, determine if all participating stakeholders are meeting their commitments, and evaluate the performance of the program in relationship to client's expectations.

6.3 DRY RUNS: A CHANCE TO EXPERIMENT

Experience has shown that many pilots are often implemented in situations that are less than optimal. This is hardly surprising when one considers the technical and innovative nature of WII and the relatively low sophistication of financial markets in many developing countries. An alternative to a full-blown pilot (and the inherent risk of failure) is to hold a dry run. This is effectively the same as a pilot, except that the clients will not have paid premiums and will not be holding real policies. Effectively it gives project implementers, insurers, reinsurers, and clients the opportunity to see how a WII contract performs without having any fiscal exposure should there be technical or practical problems incurred during implementation. An example of such a dry run is described in box 6.4.

Chapter 7: REGULATORY ISSUES

The goal of this chapter is assist practitioners in determining how legal and regulatory risks can be best addressed and the importance of addressing these issues at the outset of program. Legal and regulatory systems vary across countries, making it impossible to have a one-size-fits-all approach to addressing these issues. There are important differences, particularly between countries with a common-law legal system versus a civil-law legal system. Furthermore, insurance markets in developing countries are at very different stages of development, and there are significant differences in regulatory and supervisory capacity. Given that laws, legal systems, regulatory systems, and frameworks differ, it is not possible to provide specific country advice without further study of each country. So instead, this chapter will consider legal and regulatory risks in general and the possible consequences of these risks.

7.1 LEGAL RISK

Since insurance by definition establishes the rules that govern the relationship between the parties to the contract (the contract between the insurer and insured) and any beneficiaries under the contract (the effect of the contract on third parties), this raises legal risks. Legal risk for an insurance contract has been described as "a failure in the legal framework, documentation or counterparty that results in the increased probability of risk and loss." Risks can be generic in nature or entity (contract) specific.[16]

Practitioners will primarily be concerned with generic legal risk, such as the risk that a contract does not fall within the legal definition of insurance or a contract does not adequately provide for an insurable interest (if needed in the country), resulting in a lack of enforceability. However, entity-specific (or contract-specific) risk may also be important. Entity-specific legal risks are those legal risks that relate, for example, to a party's capacity to contract or problems with the contract documentation. For example, the contract may adequately provide for insurance interest required in the country eliminating generic legal risk, but there remains a specific contract risk that a person who does not have an insurable interest purchases the insurance. Entity-specific risk may also be important if the project selects one or more specific insurance companies to participate in the pilot.

Legal risk can be difficult to mitigate. It is not possible to seek a declaration from the court as to the legal status of an index insurance contract in advance. Therefore, the principal way to reduce legal risk is by thoroughly analyzing local legislation and obtaining local legal advice. If the advice is to be worthwhile, it is imperative that the local legal adviser fully understands the legal issues involved, which may require additional briefing on index insurance generally and the legal issues common to index products. It is also important to carry this review out at the outset of the program so that any potential legal risks can be anticipated and potentially mitigated. While there are a variety of different potential challenges, such as a dispute over tax treatment, the most obvious legal challenge would be one brought by a policyholder who feels that a payout from the contract does not match the losses suffered. Unfortunately, even with a thorough legal review, the prospect of future adverse court decisions resulting in a legal challenge to an index insurance contract cannot be eliminated completely. Like a latent design defect in a building, legal risk can materialize many years after the product was first designed and fully implemented.

7.1.1 Legal Issues

Differences between common law and civil law legal frameworks. There are substantial differences between common-law and civil-law legal systems. Countries with a common-law system have a legal system based on the English system of law, derived in part from statutory law and in part from judicial decisions. In common law, jurisdiction-specific legislation on insurance contracts is still relatively uncommon, although legislation concerning contracts may apply (such as legislation on unfair contract terms). In the absence of specific legislation on insurance contracts in a

16 http://www.GlobalAgRisk.com.

country and without established local legal precedents, common-law principles will usually apply, and the courts will consider, and may apply, cases decided in other established common-law countries. This may result in some uncertainty as to the likely legal position. However, in the absence of specific insurance contracts legislation, there are less likely to be specific detailed requirements concerning the form of an insurance contract and the matters that must be included.

A civil-law system is one that has a codified set of laws, usually based on the European continental system of law. Civil-law countries will invariably have specific legislation on insurance contracts. The requirements on insurance contracts may be contained in the Civil Code, or an equivalent law (for example, Commercial Code), or it may be contained in separate insurance contracts legislation. Unfortunately, civil-law countries with a less developed insurance market may have laws that, although based on the laws of a more developed civil-law country, are much less sophisticated. In particular, the law may contain very specific requirements relating to the matters that must be covered in an insurance contract, without any exemptions. These may be inconsistent, or even incompatible, with index insurance. For example, insurance contracts legislation may prohibit an insured from receiving a payment under an insurance contract that exceeds the loss or damage that the insured has sustained.[17]

Insurable Interest. Insurable interest is a requirement in most countries for all types of insurance contract—both indemnity and nonindemnity contracts. The concept of insurable interest is complex, and the definition varies from country to country, including differences in the rules that apply to insurable interest under indemnity and nonindemnity insurance contracts. While no specific definition can be provided in general, insurable interest is defined as the need for the insured to possess the interest being covered. Defining an insurable interest is not as straightforward in an index insurance contract as it is in a traditional indemnity insurance contract, where the requirement to establish loss will usually also establish an insurable interest.[18]

Where the insurance law requires an insurable interest, a number of matters will need to be considered by practitioners, with the assistance of local legal advice:

- What is required for an insurable interest? Must the interest be financial or is the definition broader, including a wider economic interest?
- Are there special rules relating to insurable interest in the case of property, and if so, is the index insurance properly regarded as form of property insurance?
- When does the law require the insurable interest to be held? Under an indemnity contract, an insurable interest is always required to be held at the time of the loss, but in some countries an insurable interest is also required when the contract is entered into.
- Does the contract design adequately provide for insurable interest?
- Will any effort be taken to ensure that only persons with an insurable interest are able to purchase the contract, and if so, how will this be achieved?

Loss or Damage. Indemnity insurance is intended to precisely indemnify the insured for a particular insured loss. There is, therefore, a significant risk in both common-law and civil-law countries that, if the indemnity principle is not observed, an index contract would fall outside the definition of insurance. In many civil-law countries, the law contains very clear and inflexible wording that prohibits the insured recovering more than his actual loss. Given the nature of an index insurance contract, where the index can never be more than a proxy for loss, if there is an express provision such as this in the law, the legal risks associated with index insurance are significant.

For this reason, index insurance has often been categorized in the pilots as a special type of indemnity insurance contract, known as a valued policy. A valued policy is an insurance contract in which the parties agree in advance on the value to be placed on the insured property in the event of its total loss. In the event of a partial loss, the insured is entitled to recover that percentage of the total loss value that is equal to the percentage loss of the property insured. Not all civil-law countries in Europe permit valued policies[19] (although most do). There is a risk, therefore, that if a developing country has modeled its laws on a country that does not permit valued policies, this argument will not be permitted. However, even among those countries that permit valued policies, different rules may apply.

17 This is discussed in more detail later in this chapter.

18 The case studies suggest that all the pilot contracts were written as indemnity contracts (valued policies being a special form of indemnity insurance).

19 This summary of the law in different European countries is taken from Principles of European Insurance Contract Law. See http://www.sellier.de/pages/en/buecher_s_elp/europarecht/672.htm.

Other Legal Issues. Many other legal issues may arise in offering an index insurance contract, particularly in civil-law countries, where there may be less flexibility:

- Rights to cancel the contract on notice, for a partial return of the premium, which is clearly inappropriate for an index insurance contract
- A lack of clarity on the purchase of insurance by groups of farmers not organized as a legal entity, such as a cooperative
- A requirement for formal notice of claim to be submitted by the insured, which again is not appropriate for an index insurance contract where the knowledge is vested in the insurer

7.2 REGULATORY RISK

Regulatory issues relate to the regulation and supervision by an insurance regulator of entities that provide services in the insurance market. The insurance regulatory framework of a country will always cover insurers—those companies that offer and write direct insurance business in the market—and will usually cover certain insurance intermediaries such as insurance agents and brokers. In some countries, providers of other insurance-related services, such as loss adjusters, are also regulated and supervised.

Regulatory risk can be described as the risk that the implementation of the regulatory framework by the regulator, or future changes to the regulatory framework, will result in the product being categorized as other than insurance, or will have some other significant impact on the ability of the product to achieve its objectives. The principal regulatory risk is that a regulator, which may be the insurance regulator or another regulator, classifies a product designed as an index insurance contract as a noninsurance product. The alternative classification is most likely to be a derivative or a gaming contract. Some other likely regulatory issues will relate to how the product is sold (for example, additional market conduct requirements or limitations on delivery channels), which would add to the transaction cost.

Beyond these primary regulatory risks, other regulatory risks include the following:

- The index insurance product, although insurance, falling in a class of insurance business for which the insurer is not licensed or authorized
- Limits on the types of clients to whom the insurance can be sold
- Refusal of the regulator to permit certain delivery systems for the product
- Additional requirements on insurers providing index insurance, perhaps as to technical provisions or in respect of market conduct, which impose additional costs on the insurer

In some countries, regulatory approval is required for new insurance products. Although usually regarded as highly inconvenient for traditional products, a requirement for prior regulatory approval substantially mitigates the regulatory risk, as the most likely adverse consequence is simply that the product will not be approved. However, increasingly, regulators are moving toward a more principles-based system for regulating insurance and other financial services products. Rather than approving specific products, the regulatory framework sets out principles and rules. The regulator may provide additional guidance, but there is no product approval process. In this case, there is clearly a risk that the product is determined not to be insurance after it has been developed, marketed, and sold. This is much more serious, not just because significant costs will have been incurred in the product development process, but because it would throw into doubt the status of products sold. Furthermore, if the regulator subsequently determines that the products are derivatives or gaming contracts, there may be serious breaches of and possibly offenses against the investment business or gaming legislation. If the regulator has been fully engaged as the product develops, there is a reasonable likelihood that, even if this were the case, neither criminal nor regulatory enforcement action would be taken against the insurer.

Given that index insurance is still a new type of insurance product, dialogue with the regulator should be carried out from the beginning of the project. Even though the regulator may not be required to approve new insurance products, every effort should be made to ensure that the regulator understands the product and has considered all the relevant regulatory issues. Furthermore, the regulator might be able to provide an indication of any potential future changes to the regulatory framework. There is a tendency for regulators not to consider proposals for pilots with rigor since it is only a pilot. But proceeding with a pilot without a full regulatory review, even with the support of the regulator, does not reduce regulatory risk.

Of course, regulatory risk cannot be completely eliminated. International standards change, regulators may change their thinking regarding how to apply regulations, and the legislature, which has the ultimate control of the regulatory framework through primary legislation, may introduce or amend legislation that the regulator did not expect. In many countries, legislation at the level of regulations is under the control of the government, which may also make changes that are not expected by the regulator. Regardless, it is important to attempt to mitigate this risk as effectively as possible at the outset.

Regulatory areas to be considered by practitioners when starting a program include these:

- Contacting the appropriate person or persons at the regulatory authority
- Engaging any other necessary regulatory authorities (such as the securities regulator)
- Providing the regulator with a good understanding of the regulatory issues raised by the product
- Fairly and adequately discussing the project and possible problems with regulators
- Identifying any plans for future changes in the regulatory regime

7.2.1 Regulatory Issues

Given that index insurance is not specifically provided for in the regulatory framework of most countries, there are specific issues that practitioners will need to consider with the regulator. It may be appropriate for the regulator to impose special conditions on insurers to ensure that policyholders are adequately protected and that there is no contagion between index insurance and other lines written by the insurer in order to ensure that insurers continue to offer the insurance after a heavy loss.

Provisioning and reserving. The normal rules for technical liabilities, as they relate to general insurers, will almost certainly not be wholly appropriate for index insurance. In particular, the requirements for technical provisions that apply to traditional products will need to be adjusted. For all insurance, insurers are required to provision for unearned premiums. In the case of traditional insurance products, premium is released from unearned premium to earned premium in tranches over time as the risk expires. With a weather risk policy, the risk does not expire on a proportionate basis over time but rather remains until after the end of the insured period, so it is important that all premiums received are regarded as unearned until it is known whether payment is due under any policies. If payments are due, the appropriate amount of premium should be treated as a known claims provision, pending payment, the balance being treated as earned premium. In addition to provisioning, WII exposes insurers to catastrophic risk and adequate reinsurance coverage should be obtained (where the premium income is sufficient to justify it).

Practitioners should also consider whether it is appropriate for insurers participating in the program to be required to establish an equalization reserve to smooth gains and losses over time. Due to the covariate nature of the risk, the insurer is likely to experience a number of good years and less frequent bad years. If the underwriting gains in the good years are treated as profit, there is a possibility that insurers will be tempted to refuse to offer insurance the following year or, at worst, if the claims are sufficiently large, they will have an adverse effect on the insurer's solvency. It should be noted that international accounting standards do not permit an equalization reserve to be treated as a provision, but it may be established as a true reserve.

Delivery channels. Given that one of the principal objectives of index insurance is to reduce transactions cost, it is important that efficient delivery channels be used to sell the insurance. In many countries, this requires the use of alternative channels to individual agents, such as banks and MFIs acting as agents. The regulatory frameworks of some countries do not allow corporate agents; in others, banks may be restricted from acting as agent under the banking legislation. It may be necessary to press for the amendment or introduction of regulations to permit the use of alternative delivery channels.

7.3 CONCLUSION

The possible consequences of proceeding with an index insurance program in circumstances in which a full investigation of legal and regulatory risk, but in particular legal risk, has not been carried out could be significant. If an index contract is determined by a court to be illegal or unenforceable, not only could significant development costs be wasted, but the reputation of index insurance, and possibly traditional insurance, could be damaged. Clients who have entered into contracts and paid premiums could find themselves without enforceable rights. This could cause very serious consequences at an individual level, particularly if the client has taken action on the basis of the insurance, such as taking out a loan or planting additional crops. Introducing a product operating outside a country's regulatory framework could have similar consequences. Supporting an index insurance project that is determined to be legally flawed or not properly regulated could result in significant reputational damage to any group supporting these activities.

To date, limited attempts in pilot countries have been made to complete comprehensive legal and regulatory reviews when implementing pilots, despite the possible consequences. Donors and practitioners need to practice some caution regarding how pilots are advanced and perform careful legal and regulatory reviews with international and local expertise as a first step in a project design.

Chapter 8: REFLECTIONS ON EXPERIENCE GAINED

Although the nature of this paper as a practical guide and overview for practitioners does not lend itself well to a section on conclusions, we would like to take this opportunity to set out some reflections based upon the experience of implementing a number of pilots and research activities. As we have pointed out at various stages, these reflections are in no way meant to be considered definitive—there may well be a number of breakthroughs in this field that will open new avenues or opportunities for a wider application of the product. We have broken down the reflections into several sections for ease of reference.

8.1 TECHNICAL CHALLENGES

Complexity. WII is a very technical product that requires a high degree of technical and financial knowledge, awareness, and capacity. These requirements are necessary not only at the design stage, but also during monitoring and product adaptation to new data and crops. This also directly affects the ease with which this product can be scaled up in new areas.

Costs. While there is still a belief that WII may enable costs to be reduced, experience has shown that the upfront development costs of this product are very high. This is a mixture of factors, such as the need to hire expensive international consultants and have them present in the country to work with stakeholders, the extensive costs associated with building the capacity of the local insurers, the costs incurred in educating potential policyholders on the product so that they can make an informed decision as to whether to buy the product or not, and so on. Without a dramatic scale-up in terms of number of policyholders, amortizing these upfront costs will be challenging and may dissipate any real advantage that this product might have over other traditional forms of insurance.

Duality of basis risk. The risk that actual loss will not be reflected by a proxy or parametric (which uses measurement of a variable at another place) is inherent in WII. The product effectively has a "built in" basis risk. While this is clearly a risk for the holder of the policy, it is also a risk for the insurance company that sold it. A cornerstone of a successful insurance company is the trust that people place in it to "make good on their promises." When those promises are perceived to be broken because of a failure of an index to trigger a payout, this will often have negative consequences for the insurance company in terms of future sales (not just with WII products).

Accuracy. Although the index is based on the use of data and complex modeling technology, the problem remains that you are trying to use mathematics to reflect a series of natural processes (that is, the growth of plants across a wide area). In developing countries, seed varieties are often mixed, farming practices are often suboptimal and highly variable, and information on actual planting dates are often inaccurate and lack conformity in any given area. Basis risk is generally considered to be about the problem of weather at the insured's field being accurately represented by the weather at a weather station. However, an equally important part of basis risk is whether the index itself (even given accurate representation of weather) accurately captures the phenology of the individual plants on the insured field.

8.2 PRACTICAL CHALLENGES

Ability or willingness to pay. While the purchase of insurance may be a logical action in the economic sense, the ability or willingness of farmers in developing countries is a totally different phenomenon. Indeed, this is not limited only to them—many homeowners in developed countries would not carry home insurance unless it was a mandatory requirement of their financing agreement (even allowing for the low premium rates). Most farmers in developing countries have extremely low disposable incomes (if any) and a limited awareness of financial products such as insurance. Given this, most are loath to pay insurance premiums, as many do not monetize their crop, especially if their government has a history of writing off debts or providing compensation. Add to this the complexity of explaining how WII works and on what basis pay outs are calculated and one can see that demand is a real obstacle to scaling up.

Farmers actually want full indemnity. Index products do not offer indemnity—you can suffer a loss and not receive a payout either because of a lack of a trigger of the index due to lack of severity or because of the loss being caused by a variable that was not covered by the index (for example, you have drought coverage and your crop is destroyed by pest). Generally, what farmers actually want is an indemnity from loss, no matter what the cause. While it is possible to structure insurance with multiple indexes, this is very complicated, would likely end in very expensive premiums, and would be plagued by basis risk issues in relation to multiple, not single variables.

Lack of capacity. There is currently a lack of technical capacity in the insurance sectors of most developing countries, which is a constraint to the scaling up and further development of WII. While it is possible, on a pilot basis, to use external consultants to design an index product and assist in its rollout, marketing, and sales, such assistance is not possible on a wide scale (simply because of lack of qualified professionals).

Outreach and training. While WII may not require local presence in respect to field level assessments, it does require local presence during product rollout and sales. To ensure that farmers understand the product (so that they will either buy it or be able to appreciate when it will pay out), extensive awareness activities and training are needed. The costs inherent in such a process are prohibitive for most local insurance companies and therefore a major constraint to product development.

8.3 WHERE WII CURRENTLY WORKS BEST

Despite the long and apparently negative list of issues presented in 8.2 (which are connected with a micro/farmer-level product), there are a number of circumstances in which WII does appear to play a strong role. The differences between the above situation and those mentioned below are largely connected to the extent to which many of the challenges are removed or managed by the uses presented.

Some areas in which WII or other parametric products show promise are as follows:

As a financing tool for social protection schemes. Although WII may not be for the "poorest of the poor" because of their inability to pay premiums or have an easily identifiable insurable interest, the use of indexes at a district, regional, or national level can be a useful tool to generate funds for social protection measures in the case of natural disasters. Obviously, the issue of who will pay the premium and the ex-ante establishment of distribution channels and methodologies is an important part of the product design.

Large-scale commercial farmers. For large-scale farmers who have a clearly identifiable and insurable loss and equally a value proposition that enables them to pay premiums, WII can be an interesting option (especially where traditional insurance is not available or too expensive). The other advantage for such farmers is that, because of the size of the risk they wish to insure, they often have the option to take their business direct to international reinsurers and thereby circumvent the constraints posed by the lack of local insurance company capacity.

Portfolio risk management at the meso level. Input suppliers, banks, and processors often lend either cash or product to a wide group of farmers and are therefore exposed to the production risk that faces their farmers. Given the usual geographic spread of their farmers, they naturally tend to reduce the covariance of the risk and arguably the net basis risk (through aggregation). The use of WII by such meso-level stakeholders can be effective in reducing their exposure to certain given risks. However, care should be taken, as many risks that actually drive farmer default cannot be covered by WII—for example, side selling, market price risk, quality, and so on. In addition, there is a risk that if a farmer is aware that their counterparty has insurance, then they will be more likely to default, even in a case in which that default is not due to a risk covered by the index. From an ethical point of view, there is also a challenge, in that it is possible that a bank might receive a payout under their WII product, yet still seek to recover funds from the farmer.

Sovereign risk transfer at the macro level. If a country is running a contingent risk that relates to a weather variable, the use of a WII product can be extremely useful. Although at this level, the product is slightly different in nature (a derivative, as opposed to insurance), the general principles are the same. The payouts received from such a derivative could be used to stabilize budgetary shocks, purchase food for vulnerable populations, or finance social safety net programs. While this is a very attractive form of risk management, countries often suffer from a lack of ability to finance premiums or face political challenges in the use of public funds for nontangible and potentially "risky" premium payments.

Contingent finance, as opposed to risk transfer. Very similar to the previous application, the use of parametrics related to contingent financing is another interesting use of the index model. However, in the case of contingent financing, a country faces slightly less "risky" premium payments, which are replaced by much smaller commitment fees. The main advantage for politicians is that they do not have to pay relatively large amounts of money and potentially receive nothing in return—with contingent finance, they have to pay back, but only in the case of the risk being realized.

Annex 1: QUESTIONNAIRE FOR COLLECTING AGRICULTURAL INFORMATION

AN ILLUSTRATION FOR DROUGHT COVERAGE FOR MAIZE

GENERAL INFORMATION

Date:
Location:
Country:
Crop:
Type of coverage:
Other information:

PRODUCTION

1. What variety of maize is the most common in the area?
2. What is the average farm size for maize farmers?
3. What is the typical planting period for maize (month/week)?
4. What is the earliest date that maize can be planted?
5. What is the last date when maize can be successfully planted (month/week)?
6. Can you provide more details on the crop calendar of maize, highlighting the main plant growth phases?

PHYSIOLOGICAL OR PHENOLOGICAL PHASES	WRSI PHASES	PERIOD (APPROX. DATE OF PHASE BEGINNING)	LENGTH OF PERIOD (DAYS)
Germination	Planting and establishment		
Leaf development			
Stem elongation	Vegetative		
Inflorescence emerging, heading	Flowering		
Flowering, anthesis			
Development of fruit	Maturation		
Ripening			

7. Is maize production in this area rain-fed or irrigated? (If both, indicate relative proportion.)
8. What is the average cost of production in the area (in total costs of inputs per hectare or other area unit—if different, specify)? Specify if it includes labor costs and/or land rent.
9. What types of fertilizers or inputs are used by maize growers? When are they applied during the season? What are the specific costs of these inputs per hectare?

ITEMS	TYPE	AMOUNT (LTS, KG/ HECTARE)	VALUE (IDR)	MONTH INPUTS APPLIED
Seed				
Fertilizer				
Chemicals (specify)				
Other				

10. What is the optimal yield in the area?
11. What is the average yield in the area?
12. In which of the last 10 to 20 years do you recall having the best yields?

YEAR	SIZE OF LAND	YIELD	NOTES

13. In which of the last 10 to 20 years do you recall having the worst yield?

YEAR	SIZE OF LAND	YIELD	NOTES

INCOME

1. Do farmers in the area have alternative sources of income? What percentage of farmers rely only on farm income?
2. How relevant are maize revenues for households' incomes in the area?
3. Is maize produced for commercial purposes or for self-consumption?
4. What are the main sales markets for maize?
5. On average what are the prices for maize? Give recent years' high versus low.

6. Is there any forward contracting for maize?
7. During which month do most farmers normally sell their production?

RISK

1. What are the main risks for farmers' income?
2. What are the primary production risks?

a. Pests?	
b. Diseases?	
c. Weather?	
d. Lack of access to inputs?	
e. Other?	

3. What are the specific weather risks that production faces?

a. Drought?	
b. Excess rain?	
c. Temperature?	
d. Other?	

4. If farmers are exposed to weather risks, how do they currently manage them?
5. In how many years out of 10 are yields reduced because of drought?
6. In which of the last 10 years do you recall having the most favorable weather for production?

YEAR	SIZE OF LAND	YIELD

7. In which of the last 10 years do you recall having the worst weather for production?

YEAR	SIZE OF LAND	YIELD

RAINFALL CONTRACT PARAMETERS (IF DROUGHT OR EXCESSIVE RAIN RISKS APPLY)

1. Do farmers in the area practice dry planting or do they wait for onset of rainfall?
2. How do farmers judge when rain is sufficient for planting?
3. What do they do if rains are insufficient for planting? Plant a different crop or plant anyway? Do they ever not plant if rainfall is not good?
4. a. Which periods in the growing season are the most critical to have rainfall for a successful harvest?

PLANTING	ESTABLISHMENT (GERMINATION & LEAF DEV.)	VEGETATIVE (STEM ELONGATION)	FLOWERING	MATURATION

KEY: Not important, somewhat important, very important, critical

b. Are there periods during the growing season when too much rain has destroyed or damaged the harvest?

PLANTING	ESTABLISHMENT (GERMINATION & LEAF DEV.)	VEGETATIVE (STEM ELONGATION)	FLOWERING	MATURATION

KEY: Not important, somewhat important, very important, critical

5. a. In the drought years, at which growth stage(s) was the crop most affected?

b. In the excess rainfall years, at which growth stage(s) was the crop most affected?

WRSI PHASES	YEAR	YEAR	YEAR	YEAR
Planting and establishment				
Vegetative				
Flowering				
Maturation				

6. Does rainfall at the reference station reflect the rainfall pattern of the area? Do parts of the area have different rainfall patterns?

ACCESS TO FINANCE

1. How do farmers normally finance input costs?

DO NOT BUY INPUTS	OWN FINANCES	LOAN FROM BANKS	MONEY LENDERS	OTHER SOURCES	INTERESTED IN FINAN-CING BUT NO ACCESS

2. What type of financing? What are the terms?
3. What time of year is the financing received? What time of year is financing needed?
4. What types of collateral do they normally provide?
5. What month are they expected to pay back loans?
6. Would having access to some form of insurance improve farmers' access to credit?
7. Have there been experiences with rescheduling or default? If so, when and why?

Annex 2: TERMS OF REFERENCE FOR RISK MAPPING THE AGRICULTURAL SECTOR

CASE OF JAMAICA[20]

INTRODUCTION

The Government of Jamaica (GOJ) has requested support from the World Bank in helping the country to design and implement a strategy for managing weather risks in the agricultural sector. These terms of reference detail the objectives, scope of work, and products for hiring a consulting firm (the Firm) to conduct a risk mapping exercise in the island. The findings of the tasks detailed here will serve as inputs for the Government of Jamaica for designing a weather risk management (WRM) strategy in partnership with the private sector. Findings of this exercise will also be used by the World Bank to formulate a sector support project to assist the government in implementing a WRM program.

BACKGROUND AND JUSTIFICATION

The history of agricultural insurance in Jamaica has not been good. This has been partly blamed on high catastrophic exposure (and lack of reinsurance capacity), but in reality it is a mixed result of difficulty of designing appropriate insurance for delivery to small farm holdings, complex tropical crops, technical difficulties in modeling weather risks and flood damages to agricultural crops, and a generally uninterested local insurance market (with some exceptions). Only for a few examples has traditional named-peril insurance worked or nearly worked in the country.

Since 2006, most insurance products ceased to operate, leaving agriculture highly exposed to weather risks. Moreover, given that the vast majority of farmers are small holding units, the government is highly concerned with how to protect this segment, and is interested in organizing an efficient distribution channel to provide support to small farmers in the aftermath of a catastrophic event. The reality is that both large agricultural chains and small farmers are absorbing all the weather risks, without a risk transfer mechanism in place—neither publicly backed and run nor privately (re)insured.

Undoubtedly a parametric approach (if feasible) would overcome some of the above constraints and provide all the usual advantages the literature tend to highlight for these types of insurance products, but the basis risk issue is going to be extremely difficult to deal with. The findings of this activity will throw light into the debate on the appropriate instruments to manage risks in agriculture.

Lately, the Government of Jamaica, with the support of the commodity boards, is organizing a registry of farmers, with the intention to improve the transparency and efficiency of the public mechanisms to channel farmer support in the event of catastrophic hurricane damages.

The Ministry of Agriculture (MOA) provides ex-post ad-hoc handouts to small farmers after a disaster and would like to move toward an ex-ante explicit program for covering vulnerable producers against adverse weather events. Such an ex-ante program could be financed, according to the risk layers, by a mix of government funds, contingent lines of credits, and reinsurance. The outputs of these terms of reference will inform the GOJ in the design of a weather risk management strategy and help various stakeholders in making informed decisions regarding weather risk measures in the country.

SCOPE OF WORK AND ACTIVITIES

The Firm tasks will be limited to: (1) collect the historical weather data available in the various weather service networks existing in the country and produce weather hazard maps for the agricultural sector and (2) conduct an exposure assessment of the most important crops to weather hazards. In order to accomplish both set of tasks, the Firm will undertake the following activities:

1. The Firm will develop an inventory of available historical meteorological information that can be used by

20 These terms of reference (TOR) could be adapted to obtain weather risk maps at the national, regional, or pilot (localized) level, depending on the level of aggregation required. Similar TOR were actually used for risk mapping the Blue Mountain Coffee Area.

the insurance industry for designing crop insurance contracts. The inventory will take the following information into account:

a. Listing of all weather stations
b. Type of station
c. Institution or agency administering
d. Localization (geo-referenced)
e. Weather variables that are registered (rainfall, temperature, wind speed, evaporation coefficient, solar light time, and so on)
f. Number of years with daily observations
g. Number of daily missing observations (or percentage of total)
h. Type of data transmission (automatic, by radio, by telephone, and so on)
i. Current state of data (digitalized, manuscript, and so on)

2. The Firm will perform quality control and data cleaning over the available historical weather data supplied by the weather service in order to work on a reliable set of weather data that can be used for risk hazard mapping. Having arrived at a reliable set of weather data, the Firm will assess the spatial and temporal usefulness of the weather database to be used for assessing agricultural risks, taking into account the agro-meteorological zones, distribution of farm land, and location of weather stations.
3. The Firm will draw general weather hazard maps for the various regions of the country related to the following risks:
   a. Monthly climatology of maximum temperature (May)
   b. Annual climatology of rainfall
   c. Mid-summer drought index
   d. Daily extreme precipitation

   The weather hazard maps will be layered with maps containing the density and type of producers, and type of crops for every macro agro-meteorological region. The findings of this activity plus the findings of the exposure assessment will serve as inputs for the Ministry of Agriculture to design their weather strategy framework.
4. The Firm will generate expected hazard frequencies of weather variables (rainfall, temperature, wind speed, and so on, depending on the identified risk) for capturing frequency and intensity of weather events in the identified macro homogeneous weather zones, based on the historical database. In other words, the experts will be trying to construct the whole range of probabilities, based on historical weather data sets, for various intensities or magnitudes of events. This is also known by insurers as the "return period."

DELIVERABLES, DURATION, AND RESPONSIBILITY

In order to comply with the task's objectives and make findings accessible to decision makers in the government, the Firm will address the issues of each consulting component and combine the analysis into a single report. To arrive at a final document, the Firm will produce the following deliverables:

1. A work plan at the beginning of the consulting tasks, detailing the team, methodology, and calendar that will be used to develop each component
2. Detailed findings for each of the components of this consulting task
3. A final report synthesizing the technical findings, including the definition of the homogeneous weather macro zones, illustrating the weather risks with maps

The Firm will develop the activities specified in these terms of reference and deliver the products in the period from July 1 to October 31, 2008.

Annex 3: TERMS OF REFERENCE FOR THE CREATION OF GRIDDED WEATHER PRODUCTS

CASE OF GUATEMALA

PURPOSE

The purpose of this consultancy is twofold, assessing the feasibility of creating regular grids of climate variables and creating the gridded weather database to be used by the local insurance industry of Guatemala for the development of agricultural index insurance products.

The creation of regular grids will be used to estimate the historical records of new or recently installed meteorological stations and allow calculating climate variables in pixels that are homogeneously distributed and have full historical records. The feasibility of creating regular grids depends on the temporal-spatial coverage of existing weather records. A minimum spatial coverage of field weather stations will be established by the Firm in order to successfully apply the gridding process; based on its analysis, it is possible to define the resolution of the regular grids.

It is important to consider that the spatial density is not constant, as the number of records generally changes every day, due to stations that stop operating or simply because of the absence of records. Therefore, it is indispensable also to estimate the evolution of such coverage, which might be expressed as porosity (percentage of missing data within a given period) or its complement, percentage of valid records. The analysis of temporal coverage will therefore allow the establishment of the period covered by the regular grid.

DESCRIPTION OF THE CONSULTANCY

This consultancy will be developed by the Firm in two stages, one involving the feasibility of creating a regular grid resulting in the various options for doing so, and a second, involving the actual creation of the regular grid based on the chosen option at the end of the first stage.

First Stage: Feasibility

The Firm must assess the feasibility of creating gridded (that is, mesh-based) weather data product for rainfall and temperature in Guatemala that could be used by the local insurance industry in the country to develop index-based weather insurance products for agriculture.

The objective of such a product would be to enable better risk mapping and greater access to risk transfer products in areas with inadequate weather infrastructure. The Firm should assess the conditions of creating the data grid to address these specific needs, outlining the benefits and limitations of producing the grid data as a result of the analysis in the preparatory stage. The methodology to assess this feasibility and ultimately to create such a product should be proposed by the Firm and accepted by the World Bank, and it should be based on practical experiences that has been done in similar countries.

The Firm will assess the feasibility of creating gridded weather data products in Guatemala for both rainfall and temperature (minimum and maximum) based on a blend of existing station data and existing gridded data products (for example, North American Regional Reanalysis [NARR],[21] National Oceanic and Atmospheric Administration [NOAA]'s Climate Prediction Centre datasets,[22] and the National Centers for Environmental Prediction/National Center for Atmospheric Research [NCEP/NCAR] Reanalysis[23]) to support the weather station–based data observations. The World Bank will provide the Firm with an inventory of weather stations and station data in the country. The World Bank will also provide information for specific land political divisions in case it is required (for example, geographic location and extension of rural and urban zones).

The minimum information for the preparatory stage includes the following:

1. Field weather station catalogue: Weather station ID, latitude and longitude of the existing field stations

21 http://www.emc.ncep.noaa.gov/mmb/rreanl/.

22 http://www.cpc.noaa.gov/products/Global_Monsoons/American_Monsoons/SAMS_precip_monitoring.shtml.

23 http://www.cdc.noaa.gov/cdc/reanalysis/reanalysis.shtml.

2. Dataset: Weather station ID, date and readings of daily precipitation, and observations of maximum and minimum temperatures

The first deliverable of the study will be a report summarizing the Firm's conclusions as to the options of creating a gridded weather product that offers higher spatial and temporal resolution coverage for rainfall and temperature index–based weather risk management than the existing weather stations network in Guatemala. Evidence and explanation to support this conclusion will be required. At the end of the first stage, the Firm should outline the methodology to be used to construct the gridded product based on the option the World Bank will agree on, its characteristics, necessary investments, and a timeline for completing the product.

The characteristics of the gridded product to be defined include the following:

- Interpolation methodology and technical details
- Temporal resolution
- Spatial resolution
- Geographic domain
- Initial and final date

The activities for conducting the feasibility stage are outlined in table A3.1, with an approximate timetable for completion of the analysis.

Second Stage: Creating the Product

The second step will consist of creating the product. The Firm will reproduce the methodology that was proposed during the feasibility stage and accepted by the World Bank for the generation of the gridded dataset and for evaluating its precision.

TABLE A3.1: Timetable for the Feasibility Stage of the Project

ID	ACTIVITY	MONTH 1				MONTH 2				MONTH 3			
		1	2	3	4	1	2	3	4	1	2	3	4
1	Analysis of the temporal coverage												
2	Analysis of the spatial coverage												
3	Analysis of possible preliminary fields												
4	Elaboration of report and presentation												

Source: Authors.

The gridded analysis from the Firm is based on the Cressman methodology (Cressman, 1959). The methodology consists of correcting a preliminary field based on observations. The preliminary field used by the Firm is the NARR (Messinger *et al.*, 2006) developed by the NOAA. The Firm has gridded analysis for the following variables: precipitation, maximum temperature, minimum temperature, potential evapotranspiration by Hargreaves Method. The gridded analysis has the following characteristics: temporal resolution is daily, pixel size equal to 0.2° (~20 km), and the initial date is January 1, 1979. The final date is as current as the last climatological information available, and the last NARR data published.

The evaluation will consist of comparing the gridded dataset with the field weather dataset to estimate the error associated with the interpolation. In case a second independent network (that is, not included in the Cressman analysis) is provided by the World Bank, a second comparison between this network and the gridded dataset will be performed. The World Bank will select up to two temporal resolutions (for example, daily or monthly) for the analysis.

Finally, a graphic user interface (GUI) will be created to acquire individual time series from the gridded dataset in a friendly manner. The user will be able to define interactively the following parameters:

1. The pixel of interest by geographic coordinates, or a drop-down catalogue of stations
2. Variable of interest
3. Period of interest
4. Up to two temporal resolutions (for example, daily or monthly)

Additionally, the GUI will provide:

1. A few basic statistics (defined by the World Bank in agreement with the Firm)
2. A time series plot
3. Optionally, an interface for a daily surface contour map of a climate variable

The GUI will be designed so it can be installed and executed on any PC with Windows XP without the acquisition of any additional software by the user. The selection of the development environment for the GUI depends entirely on the Firm.

The deliverables of the second stage include the gridded dataset in text format, a report, installation discs, and tutorial of the GUI, among other activities as it can be seen in table A3.2.

TABLE A3.2: Activities and Calender for the Second Stage of the Project

		MONTH 1				MONTH 2				MONTH 3				MONTH 4				MONTH 5			
ID	ACTIVITY	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Acquire three-hourly data from NARR																				
2	Estimate daily cumulative rainfall and maximum and minimum temperatures in agreement with the times of reading on the local climatological network																				
3	Format the local climatological dataset																				
4	Apply Cressman analysis																				
5	Evaluate the gridded analysis by comparison with a second independent local climatological network																				
6	Develop the GUI																				
7	Elaborate report and presentation																				

Source: Authors.

DELIVERABLES, DURATION, AND RESPONSIBILITY

In order to comply with the objectives of this consulting assignment, the Firm will produce the following deliverables:

1. A work plan at the beginning of the consulting tasks, detailing the team, methodology, and calendar that will be used to develop each component
2. A document with detailed findings for the feasibility stage, outlining the options for proceeding with the second stage for the creation of the grid weather database
3. A final report synthesizing the technical findings
4. The regular grid database for Guatemala with the agreed spatial and temporal resolution, plus the software for the GUI with its respective manual for use

The Firm will develop the activities specified in these terms of reference and deliver the products in the period from February 1 to November 30, 2008.

Annex 4: INFORMATION CHECKLIST FOR A PREFEASIBILITY PILOT PROJECT

OBJECTIVE	QUESTIONS	REQUIRED INFORMATION
Definition of insurable interest	• What are the objectives of the government or champion organization in respect to agricultural insurance?	• Political definition
	• What do you intend to cover with the insurance? A contingent fund against catastrophic events, aggregated risk, or individual farms?	• Political definition
	• What types of producers are your target group? Commercial farmers, subsistence farmers, small commercial producers?	• Political definition • Definition of the segment of producers to be protected • Quantity of producers within the selected area or provinces • Description of productive systems • Average area cultivated in crops within the selected segment of farmers • Geographical distribution with the greatest level of disaggregation as far as number of producers and are to be protected
	• What level of coverage will be offered? Income? Costs of production? Rural credit? An income compensation estimate in catastrophic events?	For insuring income losses: • Structure of agricultural produce markets • Commercialization system of agricultural products • Information systems of agricultural products • Monthly statistics of farm gate prices for agricultural products to be insured • Statistics of cultivated areas, sown areas, production and yields, with the greatest possible desegregation for each one of the crops that will be insured For insuring production costs: • Description of agricultural models for each of the crops to be insured, and areas • Production costs for each of the crops to be insured, and areas, indicating the dates for agricultural activities • Gross margins for each of the crops to be insured • Statistics of cultivated areas, sown areas, production and yields, with the greatest possible desegregation for each of the crops to be insured For an income compensation type of insurance in catastrophic events: • Description of agricultural models for each of the crops to be insured, and areas • Production costs for each of the crops to be insured, and areas, indicating the dates for agricultural activities • Current government expenditures used to support farmers in the event of catastrophic events • Statistics of cultivated areas, sown areas, production and yields, with the greatest possible desegregation for each of the crops to be insured

OBJECTIVE	QUESTIONS	REQUIRED INFORMATION
Definition of the insurance beneficiary (or target group)	Who is the policyholder? The state? At what level? If an aggregator, who? Individual farmers?	• Political definition • Defining the parameters to be used for declaring a catastrophe for payouts: weather indexes, area yield indexes, ad-hoc declaration • Defining the level of weather events that will kick-start the payments • Operational scale of the insurance: farmer, group of farmers, province, department, national • Who pays the premium? The government? Producers? The government with producers share? Producers with government subsidies? An aggregator (processor, exporter)? • What are government resources to finance a catastrophic insurance for agriculture? Is there any premium subsidy for commercial insurance? • What type of system will be in place for farmers' participation? Voluntary, compulsory? Compulsory for obtaining credit? In this case, how many (segment) producers have access to credit? • How will the premium-collecting channel work? (in case farmers participate in premium payments total or partially) • What is the system for channeling the payouts? • What are the mechanisms for controlling subscription in case insurance is individual? Are there information systems in place? • Are there farmer registries? • Can a farmer pay for the insurance? If yes, how much could they pay and what type of coverage?
Definition of the crops and areas to insure	• Annual food crops? Annual cash crops? Perennial agricultural crops? • What are the risks to be covered? • What districts, provinces, departments? • What level of coverage will be offered? • Which definition of losses will be used? Named perils? Multi-risks? Indexed risks?	• Identification of crop cycles and phenological phases for each of the crops to be insured, and crop calendars for each area • Description of each zone or area to be insured, including type of soils, topography, percentage of agriculture under irrigation and rain-fed, frequency and intensity of each risk that will be covered by the insurance, for each month of the crop cycle • Overlapping production zones with maps of frequency and intensity of adverse weather events • Information on average cultivated areas for last three years of each of the crops to be insured for each of the districts, provinces, or departments • Recompilation of recommended agronomic practices for each of the crops to be insured in each zone. Sowing limit dates, sowing density, agronomic activities, and so on • Prioritization of crops and zones to start piloting a program
Definition of product to be offered	Which product could be offered? • Damage insurance • Multi-peril insurance • Index weather insurance • Area yield insurance • Other	• Policy contract to be used • Conditions and criteria to activate coverage • Level of coverage • Subscription capacity and loss adjustment. Experience and capacity (for damage and multi-peril insurance) • Statistics of cultivated areas, sown areas, production and yields, with the greatest possible disaggregation for each of the crops to be insured. The level of disaggregation will depend on the scale of operation (district, province, department). Reinsurers usually need 10 years of data up to last agricultural year • Agricultural information systems. What institutions are responsible for these tasks? What methodology they use for estimating results? How long it takes to publish agricultural results? • Weather data, description of weather stations and localization, inventory of weather data for at least last 20 years

OBJECTIVE	QUESTIONS	REQUIRED INFORMATION
Mechanisms to reach farmers	• Which channels will be used to collect premiums from farmers? • Which channels will be used for channeling payouts to farmers?	• Government agencies • Partnership with other institutions (cooperatives, processors, exporters, and so on) • Banks and other financial service providers • Possibility to link insurance with other agricultural services • Audit and controls
Risk evaluation	• Which is the intensity and frequency of each risk that affects crops to be insured in each of the regions where the insurance will operate?	• History of government assistance for each of the crops to be insured, identifying the causes and regions where support was provided • Determination of potential losses for each of the identified risks to be insured. The exercise is to identify the vulnerability curves of crops • Estimation of maximum probable loss. This activity can be done by a consultant or the reinsurers based on the information that has been provided
Institutional evaluation	• Which institutions will operate the insurance? • Who will subscribe the risks and what is the capacity? • What is the operational capacity? • What are the information systems in place?	• Who will be responsible for operating the insurance? Insurance companies? The government? Mixed system? • Description of operator resources and capacity in managing agricultural insurance • Staff: Professional qualification and experience in agricultural insurance • Underwriter: experience in agricultural insurance • Loss adjusters: experience in agricultural insurance and availability • Operational costs and resources
Risk financing	• What part of the risk will be assumed by farmers, public sector, insurance, and reinsurance? • Who will pay the cost of the insurance?	• How much of the risks will be retained by the insurance companies? • How much of the risk will be retained by the public sector? • How much of the risk will be transferred to the reinsurance? What type of transfer method will be used? Proportional or not proportional? • How much public resources are available for subsidizing the premiums? Assume part of the catastrophic layer?

Source: Authors.

Annex 5: TERMS OF REFERENCE FOR A WEATHER INSURANCE FEASIBILITY STUDY

LOCAL AND INTERNATIONAL CONSULTANTS CASE OF BANGLADESH

A. TERMS OF REFERENCE: AGRICULTURAL SECTOR EXPERT

BACKGROUND

The agricultural sector plays a major role in the Bangladesh economy. The main sources of livelihood for the rural population are agriculture and rural nonfarm sectors, which directly or indirectly depend on agriculture. Agriculture is dominated by small and subsistence farmers. A large share of the rural population consists of landless laborers (about 34 percent of rural households) and subsistence farmers with less than 0.5 hectares of land (about 41 percent); they depend on agriculture and the rural nonfarm sectors for employment. At the same time, agriculture accounts for about 22 percent of GDP. The rural nonfarm sector, which is driven primarily by agriculture, accounts for another 35 percent of GDP.

Agriculture is particularly exposed to natural disasters. Bangladesh is one of the world's most vulnerable countries to natural hazards, such as floods, droughts, and cyclones, which affect particularly the rural areas and the agricultural sector. Flooding is a recurrent event in Bangladesh. Most of its territory consists of floodplains, and up to 30 percent of the country experiences annual flooding during the monsoon season—while periodic extreme floods affect 60 percent of the national territory. Although annual flooding is beneficial, severe flooding hurts the population and causes major losses in rice production.

Recent major flooding occurred in 2007, which directly affected over 14 million people, caused over 1,000 deaths, affected over 2 million acres of agricultural land, and damaged and destroyed infrastructure (over 30,000 km of roads) and social and educational facilities as well as private assets, including housing, crops, livestock, and fisheries. The preliminary damage and loss assessment[24] for the crops, livestock, and fisheries subsectors were estimated at about US$648 million. The country subsequently experienced another natural disaster, Cyclone Sidr, in November 2007, which caused estimated damages and losses of BDT 115.6 billion (US$1.7 billion)[25]—equivalent to 2.8 percent of Bangladesh's gross domestic product.

Bangladesh is also vulnerable to recurrent droughts. Some 2.3 million hectares are prone to drought, and between 1960 and 1991 droughts occurred 19 times. Western regions are especially vulnerable to droughts. During the Rabi season 1.2 million hectares of cropland face droughts of various magnitudes, and a severe drought can damage more than 40 percent of broadcast output. During the Kharif season drought causes significant damage to the transplanted aman crop on about 2.3 million hectares. In addition to causing agricultural losses, droughts significantly increase land degradation.

The impact of adverse events, therefore, turns out to be significantly large for the poor people and negatively affects their household income and consumption levels. With the scarcity of affordable and suitable risk management tools, when exposed to adverse shocks low-income households may be forced to reduce food consumption, take children out of school, and sell productive assets, which jeopardizes their economic and human development prospects. Expanding financial access, particularly to insurance services, will help the poor deal more effectively with their financial vulnerability and will reduce the impoverishment experienced by the household under adverse shocks (Roth, McCord, and Liber, 2007). With a vast majority of farmers growing rain-fed crops and therefore being vulnerable to the vagaries of the monsoon rains and floods, agricultural risk management products become particularly important for Bangladesh.

24 2007 Floods in Bangladesh: Damage and Needs Assessment and Proposed Recovery Program—a joint report by the World Bank and the Asian Development Bank, November 2007.

25 Cyclone Sidr in Bangladesh: Damage, Loss, and Needs Assessment for Disaster Recovery and Reconstruction—a report (draft) prepared by the Government of Bangladesh Assisted by World Bank, United Nations Agencies, and the International Development Community with Financial Support from the European Commission, February 2008.

The study is in response to a request from the government of Bangladesh. Key counterparts for the study include the Department of Insurance (Ministry of Commerce), Ministry of Finance, Ministry of Fisheries and Livestock, Ministry of Agriculture and its relevant agencies (Department of Agriculture Extension [DAE], Bangladesh Agricultural Research Council [BARC], Department of Livestock Services [DLS], and so on), Ministry of Food & Disaster Management, Bangladesh Bureau of Statistics, Palli Karma Sahayak Foundation [PKSF], and its partner organizations, Bangladesh Insurance Association, and private or state-owned insurance companies. Other counterparts include meteorological and research institutions preserving weather and agricultural data, donors, and possible beneficiaries (farmers and micro-credit borrowers).

ACTIVITIES

The consultant will support the World Bank team and international agricultural insurance expert in their tasks (see draft terms of reference of the international agricultural insurance expert in Section B). In particular, he will perform the following tasks:

1. Work independently and continue dialogue during the assignment with key counterparts on possible risk insurance products for Bangladesh agricultural sector and help them conceptualize the role they need to play at designing and implementation stages based on international experience of different insurance models.
2. Prepare background papers on Bangladesh agriculture and cooperative sectors including cropping system; geographical variations; emerging issues; role of regulations, regulators, and apex bodies; key players; farmers' risk profiles, risk-coping mechanism, and government's role.
3. Assist in analyzing the possibility of market-based insurance product in Bangladesh and public-private partnership in financing agricultural insurance.
4. Collect data and statistics as per data sheet to be supplied by international consultant (a sample of data sheet of similar study is attached)—translate data and wordings where necessary.
5. Organize and arrange field visits, meetings, focus group discussions, and workshops in coordination with the World Bank team or other consultants (during the study as well as during its dissemination).
6. Collaborate with other consultants on data analysis using Excel spreadsheet.
7. Liaise with the potential stakeholders (individuals or institutions) of this study.
8. Help the team identify the main counterpart, whether that be the Department of Insurance, PKSF, BRAC, or a possible advisory committee comprising multi-party stakeholders and act as the focal point to run the secretary.
9. Work closely with other consultants and the World Bank team in exploring the dynamics of partnership among microfinance institutions and insurance companies, possible challenges (for example, reinsurance mechanism), institutional framework, and the role of regulations or regulator and apex bodies, such as PKSF, insurance association, and so on.
10. Work closely with other consultants and the World Bank team in drafting and finalizing the background reports and follow up with institutions and individuals to ensure that these reports reflect the realities on the ground. In addition, significantly contribute in drafting different chapters of the final report based on an outline to be discussed mutually later on.
11. Assist in disseminating the study objectives and findings to the stakeholders (including government, agricultural, microfinance, and insurance sector) both at the time of preparation and finalization of the study.

The data and information to be collected are described in Annex 5A.

The assignment is expected not to exceed 40 days, from November 1, 2008, to June 30, 2009.

Assignment Budget

ITEMS	RATE (TK.)	UNIT (DAY)	TOTAL
Daily fees	XX	40	XX

Source: Authors.

This assignment will involve travel within Bangladesh (outside Dhaka). Prior to traveling the consultant must seek clearance from the Bank on the purpose and duration of the trips. The consultant will be reimbursed at cost, the legitimate expenses for travel, accommodations, subsistence, and other approved study-related expenses in the field, upon presentation of appropriate receipts. No expenses will be reimbursed for any visit inside Dhaka and engaging any other person (for example, enumerators) in this assignment. The consultant has to independently arrange the travel and any other logistics required in this assignment.

B. TERMS OF REFERENCE: INTERNATIONAL AGRICULTURAL INSURANCE EXPERT

Activity 1: Agricultural and Weather Risk Assessment

The consultant will provide an agriculture (livestock and major crops) risk assessment and a basic weather risk assessment in Bangladesh. The specific components of this task are as follows:

1. Develop a list of data to be collected by the local consultant.
2. Assess the quality of agricultural data collected.
3. Assess the agricultural data collection system in light of international best practices and propose an action plan to further improve the system for insurance purposes.
4. Data building and data cleaning (using data collected during the identification phase and, where necessary and possible, obtain additional data during field trip) for crop data (yield, area, production, cause of loss) for major crops, livestock data, and weather data.
5. Loss risk assessment
   a. To carry out a statistical analysis of agricultural risks and weather risks, including, but not limited to, average annual loss, loss exceedance curve, and so on, for each agro-climatic zone/weather station/administrative unit.
   b. To analyze the impact of catastrophic losses on
      i. The crop portfolio
      ii. The livestock portfolio
      iii. The aggregate crop portfolio
6. Develop an insurance portfolio model (for example, Excel spreadsheet) to assess the potential exposure of stakeholders (for example, farmers, local insurance companies, government) to natural disasters (for example, drought, floods).

Activity 2: Challenges in Developing Market-based Agricultural Insurance

The consultant will review the current agricultural insurance products offered by the domestic insurance market and will identify the technical and operational challenges for the emergence of an agricultural insurance market:

1. To review technical, operational, and financial practices and agricultural insurance products of local insurance companies, including:
   a. Underwriting techniques (crops and livestock)
   b. Loss adjustment techniques (crops and livestock)
   c. Pricing methodology
   d. Risk financing strategy (for example, reinsurance treaties, reserves)
   e. Organizational structure
2. Recommendations on how to improve the current insurance practices and products based on international experience.
3. Review the agriculture reinsurance market in Bangladesh.
   a. Local and international players
   b. Conditions for increasing traditional reinsurance capacity
   c. Conditions for increasing nontraditional (for example, weather index) reinsurance capacity
   d. Market efficiency
4. Conduct demand analysis corresponding to level of risks: Identify what level of risk each group of stakeholders (farmers, insurance companies, government) is ready to assume. In particular, setting the appropriate level of premium for the targeted farmers would require demand analysis to understand the dynamics of the customer base and create a more bankable product. Some of the factors to consider include the willingness to pay, perceptions of risk, and the type of features that farmers would be attracted to as well as structure of the tenancy.
5. Revisit the idea of full-scale market-based insurance and study whether this is a viable option in an environment like Bangladesh where the fiscal sustainability is low and the pricing of the product is a challenge.
6. Identify areas for agriculture insurance product development.
   a. Identify crops, livestock, and hazards that may be feasible for agricultural insurance, and particularly index/parametric insurance.
   b. Identify the constraints and challenges of the current legal and regulatory framework and come up with recommendations for an enabling environment for agricultural insurance, particularly the role of MFIs as delivery channel.
   c. Develop a detailed action plan (including terms of reference) for both the pilot and implementation phases of crop and livestock insurance products.

Activity 3: Public-Private Partnership in the Financing of Agricultural Insurance

The consultant/s will analyze options for a public-private partnership in agricultural insurance. The specific tasks for this assignment are:

1. Review relevant public-private partnerships in agriculture insurance in selected countries (with a particular focus on India). This review will be presented in a synthetic way to highlight benefits and challenges of each model.
2. Analyze the current public support to agricultural credit.
3. Identify the role of the government in the support to the domestic agriculture insurance market through a clear distinction between social insurance and market-based insurance.
4. Propose options for a public-private partnership in agricultural insurance, aiming to:
   a. Foster the development of the domestic agriculture insurance market.
   b. Promote the development of affordable and effective agriculture insurance products to farmers and others exposed to the impact of agricultural risks.
   c. Protect the domestic insurance industry against catastrophic losses.
   d. Facilitate access to private (traditional and non-traditional) reinsurance capacity.
5. Review agriculture insurance subsidy programs and their associated costs and benefits.

Activity 4: Design and Rate Prototype Agricultural Insurance

The consultant will design and rate prototype agricultural insurance (for both crop and livestock on selected regions) products that can be piloted in a next phase.

EXPECTED OUTPUTS

The outputs expected of the consultant include:

1. List of data/information to be collected in the context of this assignment
2. A report on agricultural and weather risk assessment in Bangladesh
3. A database of information collected during this assignment
4. An interactive portfolio risk model (for crops and livestock)
5. A report on the technical and operational review of current agriculture insurance practices and a detailed discussion of challenges and potential solutions
6. A report on public-private partnerships in agriculture insurance in Bangladesh
7. A report on prototype agricultural risk insurance (for both crop and livestock on selected regions) products that can be piloted in a next phase

It is noted that the outputs of this consultancy are dependent on the availability and quality of data.

All outputs are required in English and to be prepared using standard PC-compatible software.

The consultants will be expected to bring their own laptop computer while on mission in Bangladesh.

TIMETABLE

The World Bank report needs to be published by May 2009. Therefore, most of the consultants' inputs are expected to be received by March 2009.

Annex 5A: BANGLADESH: DATA AND INFORMATION TO BE COLLECTED

The local consultant will collect data as available, according to the list to be provided by the international consultant–World Bank team. The sample data requirement includes but is not limited to the following:

1. **Geographic and land use regions**

   Identify the broad classification of geographic and agricultural land-use regions, such as Mountains/Hills (X percent of area), lowland plains (X percent of area), and so on. Find out the following key information for each region:

   - Climatic data for key representative stations, including mean monthly rainfall; mean, maximum, and minimum monthly temperatures; frost-free days, and so on
   - Rural household data: Number of crop and livestock households per region, average farm size, and so on
   - Cropping calendar for each region, including planting dates and harvest dates for each season and major crop type
   - Crop production data 2007: Key crops, planted area and average yields, irrigated versus rain-fed agriculture
   - Summary of livestock numbers by class of animal 2007 or latest census by region

2. **Agricultural cropping**

   It is important to access crop production statistics for the major regions listed above as well as data at the district level or even down to the individual subdistrict. Check at what level data are available. For each district, the following data would be needed:

   - Number of arable farm households per district
   - Total arable area: irrigated area and rain-fed area, 2007 or latest year
   - Total cropped area per district per season (rabi and kharif) and by crop for latest year available (2007?)
   - For the most important crops, district-level time-series crop production and yields ideally for the past 15 to 20 years—the data to include sown area, harvested area (whichever available), production, and average yield
   - Gross margin costs of production and return data for key crops in each of the regions

   Which organizations are responsible for measuring and estimating crop sown area, production, and yields? What methods are used for estimating average yields in each district or subdistrict?

3. **Crop risk assessment and production loss data**

   Find out whether the Ministry of Agriculture, Department of Agricultural Extension, or any other agency record crop damage or loss data on an annual basis for major events in each department by crop and by cause of loss. Is such data available for the past 15 to 20 years? This data is very useful to assess risks to crop production in each region or department.

4. **Livestock**

   Assuming livestock statistics are recorded at district level:

   - Number of households owning livestock by class of animal: cattle, buffalo, sheep and goats, pigs, horses, mules, poultry, and so on, in 2007 or latest census year
   - Total numbers of livestock by class per district for most recent year 2007
   - Average market values for livestock by class, 2007
   - Trends in livestock ownership over time

5. **Livestock mortality statistics**

   It is hoped that the Ministry of Fisheries and Livestock or any other government ministry or agency records mortality data in livestock by type of animal and by cause of loss in each department. If so, please access for as many years as possible.

6. **Meteorological service data availability**

   - Which public and private organizations are responsible for recording meteorological data in

Bangladesh? One is Bangladesh Meteorological Department (BMD). What are others?
- Density of and location of meteorological stations in Bangladesh (automatic and manual stations, official WMO stations, and other stations)
- For each station, how long a time series exists of daily rainfall data and daily average, maximum, and minimum temperatures? (Note we do not need to access this data at this stage.)
- Are daily meteorological data records saved in electronic format?
- What is the protocol in Bangladesh for the World Bank to access daily meteorological data (that is, area costs involved)?
- For selected representative stations in the main cropping regions, can we access annual and monthly rainfall and temperature data for the past 20 to 30 years?

7. Data and information to be collected for any other possible areas of agriculture sector and agricultural insurance that are identified critical during this assignment.
8. Support and work very closely with the financial sector expert in collecting and analyzing the following data:

a. Insurance market

It is hoped that general information on the insurance market can be obtained through the Department of Insurance or the Insurance Association. An overview of the key players and degree of insurance market development is needed.

- An overview of Insurance Regulatory authority(ies)? Governing ministry? What is the reporting arrangement?
- An overview of insurance companies in Bangladesh—public and private, life and general classes
- Insurance statistics—market penetration for major classes and premium volumes
- Reinsurance arrangements and key local and international players and reinsurance regulations
- Does agricultural insurance legislation exist? If so obtain copy of any law governing the agricultural insurance.
- An overview of insurance products and regulatory framework in microfinance sector

b. Agricultural crop and livestock insurance in Bangladesh

It is essential that the team understands that there is no crop insurance in practice in Bangladesh. Livestock insurance:

- Has been implemented since 1980 by the state-owned insurance company Sadharan Bima Corporation (SBC). An overview of this program, with current status, is necessary.

Key data to be collected from Ministry of Livestock & Fisheries, SBC, and relevant research organizations:

- National livestock development policy wording
- SBC livestock insurance program wording (including all modifications)
- Terms and conditions for insurance—tagging, health inspections, certificates, and so on
- Delivery channels—bank branch offices
- Insured classes and sums insured per animal
- Premium rates for each class animal
- Livestock results for as many years as possible (for example, number of policies, number of livestock by class, premiums, sums insured, claims and loss ratio)
- Who benefits from livestock insurance—types of producer?
- What percentage of livestock producers by class of animal have access to livestock insurance?
- Organizations responsible for loss assessment (veterinary service)
- Operational systems, procedures, and administrative costs
- Reinsurance arrangements

Overview of the self-insurance scheme of Milk Vita and The Community Livestock and Dairy Development Project for their cooperative members and farmer groups and associations

- Government (or private-sector) initiative for development of livestock insurance
- Issues and options and future directions for livestock insurance in Bangladesh

c. Rural services: Banking and microfinance, input suppliers, output marketing, farmer organizations

An overview is needed of the organization of small-scale Bangladeshi crop and livestock producers into cooperatives or associations or microfinance groups with a view to examining options for the future delivery of agricultural insurance on a group basis.

Equally we need to obtain an overview (listing by organization) in each region of the range of credit and input service organizations available to farmers. Analytically evaluate the current structure and operation of the credit and input service organizations for determining if the same can again be used to channel and administer crop and livestock insurance.

For rural banks and microfinance organizations data on the following is required:

- Types of credit
- Lending terms to crop producers and livestock owners
- Volume of lending (number of beneficiaries)
- Repayment rates and causes of delayed repayment or default

Details of agricultural crop and livestock extension services?

d. Government support to agriculture

Does government pay any premium subsidy for livestock insurance? In past, did government pay any premium subsidy for crop insurance? If so:

- Which government department provides or used to provide premium subsidies, and annual costs of premium subsidies?
- Other forms of government support to livestock or crop insurance (for example, subsidies on administration costs, or excess claims compensation)?
- **Government disaster relief program:**
    - Organization(s) responsible for implementing
    - Events for which compensation is paid
    - Criteria for assessing losses and compensation levels
    - Compensation payments past 10 years
- Input price subsidies: If so, details
- Output price support—minimum prices: If so, details
- Other forms of government support to crop and livestock producers (for example, taxation policy)

e. Demand for crop, livestock, and other agricultural insurance

Are there any studies that exist in Bangladesh on the potential demand by farmers for crop, livestock, fisheries, or any other agricultural risk insurance? If not, then the consultant, with support from the team, will have to try to assess this at an early stage of assignment by talking to key producer representatives or organizations.

The consultant needs to meet other key stakeholders who are keen to promote crop, livestock, and any other agricultural insurance including government departments, banking or microfinance sector, development organizations, and so on to define their objectives for insurance and target farm sectors in Bangladesh and to consider the product design options available—for crops, traditional and index covers; for livestock, individual animal versus group animal insurance; and so on

f. Commentary on the viability of developing agricultural risk insurance market

Critically evaluate and comment on the crop or livestock loss data over the years. The comments should include the potential impact on the farmers for not having a vibrant agricultural risk insurance market in Bangladesh. Also need to highlight, in line with the data, collected the advantages of developing such a market.

Annex 6: INDEX INSURANCE CONTRACT DESIGN

FEASIBILITY

Having successfully completed the prefeasibility stage and made the decision to progress with a WII approach, the next step is to create a product that can be used to manage weather risk. The design process aims to create a contract based on a weather index that will sufficiently quantify the fiscal impact of the weather risk on clients and adequately provide compensation for those risks. Creating an index that serves as an accurate proxy for loss is the first step in the process, followed by defining the contract parameters based on that index (for example, insured amount, risk retention levels, and the triggers per phase for the insurance contract).

SELECTING AN INDEX

In order to design a contract, it is critical to have an index that accurately reflects losses. There is no one single way to design an index, and indices can vary significantly. An appropriate index for a client will predict loss events and their magnitude with a sufficient level of accuracy. In some cases simple indices such as the amount of total cumulative rainfall in a season will be appropriate, while in other cases much more complicated indices such as dynamic crop models will be appropriate. In all cases once a robust index that accurately captures the losses faced by clients is determined, one can go on to design and structure an appropriate index-based weather insurance contract or simply analyze the weather exposure of a client, thereby guiding investment decisions, business plans, and actions for various entities exposed to weather risk.

Many considerations go into selecting an appropriate index depending on what the index will be used for and its target audience. Ultimately the index selected must:

- Identify the critical weather risks at various stages of the crop cycle
- Quantify the value of exposure to weather risks at different phases during cycle
- Provide information for assigning weights to given weather risks
- Quantify the farmer's weather exposure per unit of the defined index
- Quantify the yield volume lost per unit index

In order to achieve this, the experts are seeking answers to the following questions:

- What weather risks are critical in causing yield variability?
- Which are the critical periods for the crop in terms of weather risks?
- Is there sufficient scientific research on the crop cycle and resilience of the crop to weather risks to be able to design an index that can proxy with sufficient accuracy?
- What is the right weight to assign to critical and noncritical phases for the index?
- What are the exposed values at various phases of the crop cycle?
- Does the proposed index capture the risk in question?

One particular feature of creating an index for index insurance in agriculture, unlike other insurances, is that there is an additional need to understand how a crop behaves in response to changes in weather variables at different stages of plant development. A plant will react differently to weather stress depending on what stage of growth it has reached. Therefore in many cases it is important that the contract designed quantify potential losses or reductions in yields at various phases of the crop cycle. Assistance of a crop expert or agronomist who knows the phenology of the identified crop can be very helpful in the design and selection of an appropriate index.

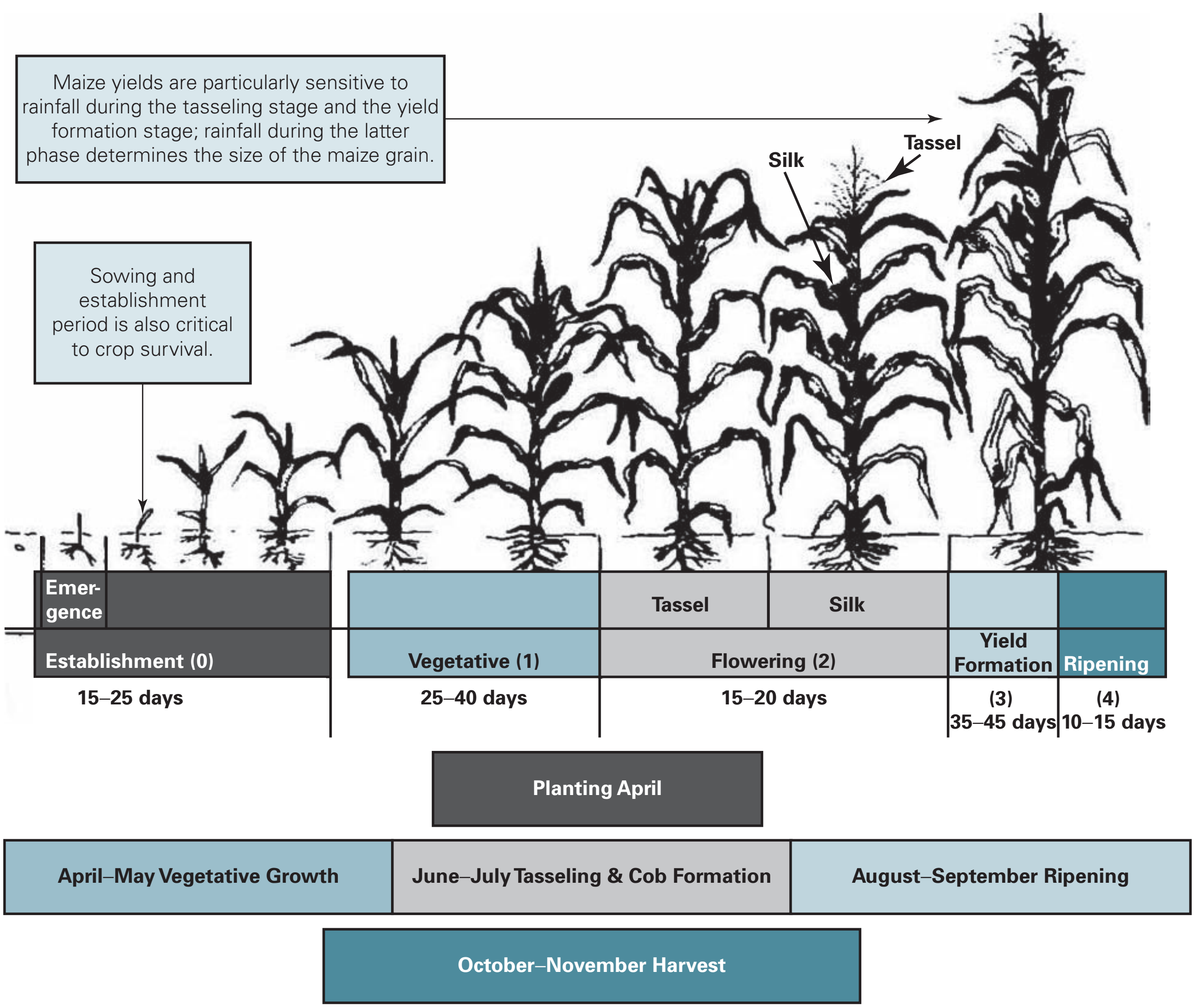
Figure A6.1 and figure A6.2 provide two examples of how crop phenology can be used in determining the critical growth periods of a crop and the effects of adverse weather during these periods. This information is also useful for estimating the increasing accumulated production costs where the insured amount is defined in terms of production costs.

FIGURE A6.1: Example of Rice Crop Cycles

	June	July	Aug	Sep		Oct	Nov	Dec
	1 2 3 4	1 2 3 4	1 2 3 4	1 2	3 4	1 2 3 4	1 2 3 4	1 2 3 4
Rice crop cycle 1		Seeding	Tillering		Booting	Flowering / Grain Filling		Harvest
Rice crop cycle 2	Seeding	Transplant	Tillering		Booting	Flowering / Grain Filling		Harvest
Rice crop cycle 3	Seeding		Tillering		Booting	Flowering / Grain Filling	Harvest	
Rice crop cycle 4	Seeding	Tillering			Booting	Flowering / Grain Filling	Harvest	
	21 days / 5 days	49–70 days			14 days	14 days / 21 days	depends on available machines and labors	
Average rice growth stage	Seeding	Transplant	Tillering	Growing	Booting	Flowering	Grain Filling	Harvest
Average rice height (cm)	0–25	25–50	50–70	50–70	70–110	110–160	160	160
Critical water depth (cm)	25	25	40	70	20	160	160	160
Critical flooding time (days)	>3	>3	>4	>4		>4	>4	>4

Source: ASDECON 2008.

FIGURE A6.2: Example of Maize Farmer Cropping Calendar



Source: FAO.

Figure A6.1 is an example of rice crop cycles from seeding in June until harvest in December in a rice-producing district in Thailand. Figure A6.2 shows a maize crop cycle from planting in April until harvest in November, with the identification of critical periods of rainfall at various phases in a particular location.

APPROACHES TO INDEX SELECTION

Different approaches and information sources can be used to select an appropriate index. The three primary sources of information that can be used to assess the underlying relationship between weather data and production risk are as follows:

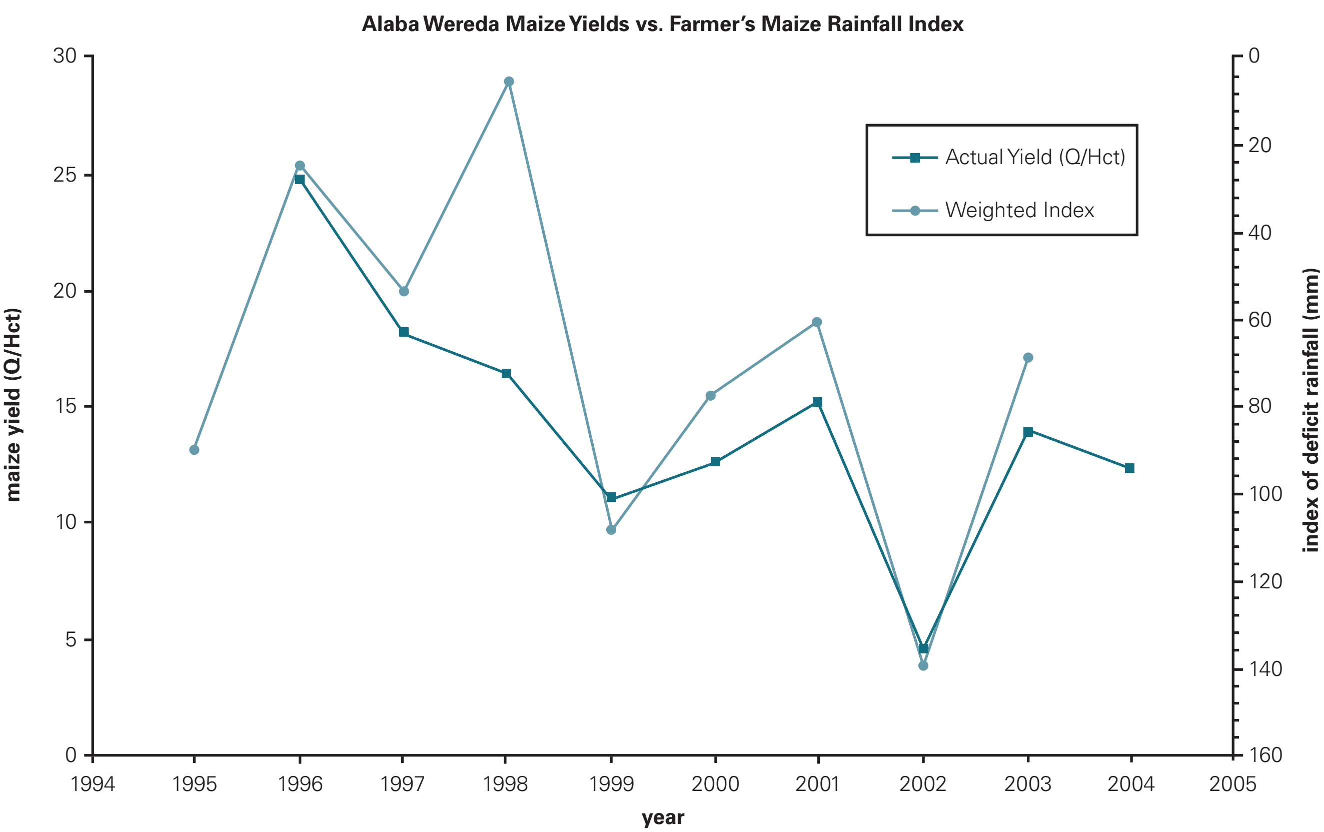
Historical Yield Data

A common approach to selecting and verifying the appropriateness of a given index is to analyze historical yield data. Historic district-level yield data is usually available from a government agency but possibly from local agricultural research institutions. In addition, individual farmers or groups of farmers, such as cooperatives and agribusinesses that have been involved in producing a crop, will also keep records of historical yields by season and production region. While historical yield data is the most obvious source of data to assist in defining an index, this data can often be noisy depending on the consistency of record keeping, the length of historical data sets, and the level of resolution at which the data is kept.

An example of how an index could be tested against historical yield data is shown in figure A6.3.

As can be seen, the index in this situation does appear to provide a relatively close correlation between the index and the actual yields. Only in one year (1998) was there a notable departure in yields. If the correlations are not very strong, then the first option may be to revisit the proposed weightings in the index to assess whether they need to be adjusted. While this may increase the correlation, care needs to be taken to avoid a phenomenon known as "overfitting." This is where an index is weighted in a certain way and variables are then constructed to ensure a high level of correlation.

FIGURE A6.3: Illustration of Index Versus Historical Yields



Source: Authors.

Farmer and Local Expert Interviews

A second approach to selecting a weather index is to utilize farmer or local expert recollections of difficult years. It is particularly valuable if these actors can recall the growing seasons when the crop faced particular difficulties in a certain year due to weather or some other risk. Such interviews can also be very useful for verifying other sources of data, such as historical yield data, and understanding the underlying causes for and ramifications of the variations in such composite data sources. As with the historic yields data, this information is likely to be noisy, and it can be difficult to discern the impact of specific events. However, it also provides important information that could distinguish a robustly performing index from one that is inappropriately designed. In some cases, this may be the only information one may have to identify an appropriate index.

Crop Model Output

A third approach to verifying a weather index is to compare the index against the output of a crop model that has been run to generate synthetic yield information based on varying weather inputs. In addition, crop models, in many cases, can be used as the underlying index. Crop models can be simple water-balanced crop models, such as WRSI or AquaCrop, for deficit rainfall risk introduced in the last module, or more sophisticated process-based crop models can also be used to generate synthetic yield information and check whether an index works well. The key benefit of crop models is that weather data is the only varying input; therefore, variations in their output are only driven by weather fluctuations and not other sources of production risk.

The final decision as to the acceptability of an index will obviously lie with the task manager or promoter of the WII initiative. While the experts will be hired to provide their input, they will not be taking responsibility for the final product. This is a challenging situation, as most task managers will not have sufficient technical knowledge to enable them to assess the accuracy of the index. However, for assessment of the index's performance in terms of assessing yield it is important to test the degree to which they match or correlate with the risk that the clients face and demonstrate how efficient the index is at providing a proxy for yield. Ideally, a cross-check against several sources of information to select an index is important as each has an information source that will have its own limitations and unique characteristics.

QUANTIFYING THE FINANCIAL IMPACT

While an index can provide information on yield deviations, for the purposes of insurance these changes in yield need to be quantified in terms of financial loses. This can be done, for example, by considering a producer's production and input costs per hectare planted or by considering his expected revenue from the sale of the crop at harvest. By running a regression analysis against historical or simulated production data or simply by looking at historical financial worst and best years, available information can be used to establish the relationship between different values of a weather index and the financial loss or gain a farmer can expect.

Once the index has been identified, it must be calibrated to capture the financial impact of the specified weather exposure as measured by the index. In order to do this, the variation in crop yield predicted by the index must be converted into a financial equivalent that mirrors the producer's exposure. Once a weather index has been developed, it is relatively straightforward to use financial information to calculate the financial impact of this weather risk for producers.

Three approaches can be used:

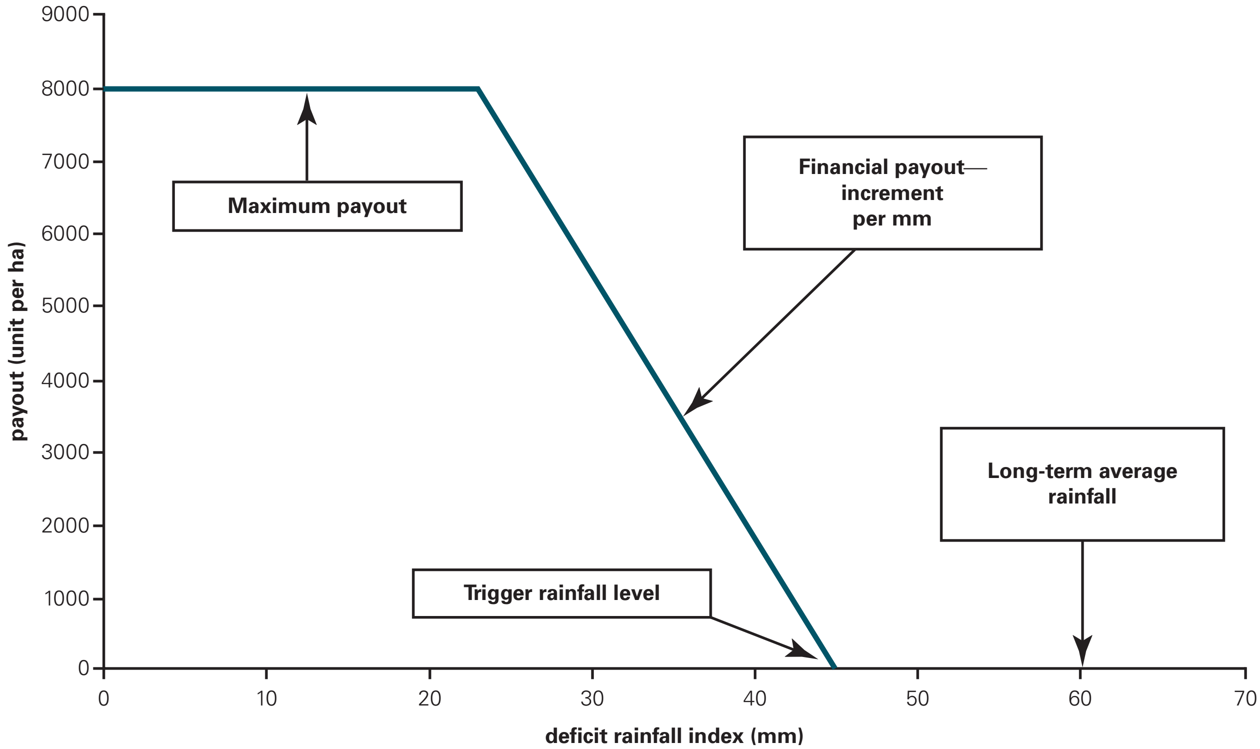
- Identifying the financial exposure per unit of the defined index
- Identifying the financial exposure to a specific weather event
- Establishing the limit (in the case of calibrating an index for an index-based insurance contract) or the total financial protection required per risk period. In this approach, a limit is set on the maximum payout necessary in a worst-case scenario. Then the payout per unit of the defined index is assessed by working back from this limit.

The approach that is chosen depends on the nature of the underlying index and the weather event. The first two approaches are best when using an index to perform a risk analysis. The third approach is most often used. This approach requires identifying the maximum protection required per risk period and then using that to inform the financial exposure per unit index for the contract that has been designed. Most often, the value that is insured by the farmer in index-based weather insurance programs is typically the value of the farmer's initial inputs or the credit he has taken out to secure these inputs and not necessarily the full value of the expected production (revenue) that is insured.

STRUCTURING THE CONTRACT

Once an index has been designed that appropriately proxies potential losses due to weather risk, this index must then be used to structure a contract. A wide range of contracts

FIGURE A6.4: Contract Parameters in an Indexed Contract



Source: Authors.

can be designed based on that index. The contract selected must perform an insurance function for the buyer (that is, the index must capture the risk in question and perform well from an agro-meteorological point of view), thereby satisfying both client and regulatory requirements. The specific details, values, and combinations of these features (and the resulting contract) depend on the risk profile and demands of the clients, and the context in which the insurance contract is being introduced to manage weather risk.

All index-based risk management solutions that offer client protection in exchange for a premium share key features and characteristics:

1. **The index**: The complete specification of the index and data used to construct it, which has already been discussed.
2. **The protection period**: The risk protection period of the contract, including the start and end date of the contract. This is the "length" of coverage.
3. **The trigger level(s)**: The attachment level (or strike) at which the weather protection begins and financial compensation is received.
4. **The payout rate**: The financial compensation per unit index deviation above or below the trigger(s). Also known commonly as a "tick."
5. **The maximum payout**: The maximum payout of the index insurance contract in each risk protection period.

Different clients will require different payout rates, maximum payouts, and trigger levels. It is, however, the trigger level that has the most influence on the premium rate for a contract since the trigger level identifies how much risk the client will retain and how much they want to insure. By controlling the frequency of payments and a client's risk retention level, which are key statistical properties of the contract payouts, the trigger level or levels largely determine the premium for the insurance provided (figure A6.4).

Once contract design is finished, this contract should again be checked against available information to determine if it accurately captures potential losses. Similar to the way in which the underlying index was checked, the contract itself can be checked by looking to see if historical payouts from the contract correlate with loss years as indicated by historical yield data, farmer information, and crop model outputs. Some critical questions to ask about the contract include the following:

- Does the contract capture local conditions and crop specific agro-meteorological risk?
- Does the contract adequately cover the major identified risks?
- Is the risk retention fixed in the contract acceptable to farmers?
- How often and how much the prototype contract will be paying out?
- Do various levels of payouts respond to farmers preferences?
- Cost-benefit of such a contract versus other alternatives to manage risks (for example, irrigation)?
- Will farmers be paying too much premium for too little coverage?
- Does the prototype contract meet the project stated objective?

Annex 7: WATER REQUIREMENT SATISFACTION INDEX (WRSI)

A TECHNICAL NOTE

BACKGROUND

Studies by the FAO have shown that WRSI can be related to crop yield deviations, and these water-balance crop growth models have been extensively tested in many climates. Indeed the WRSI model was initially developed for use with weather station data to monitor the supply and demand of water for a rain-fed crop during the growing season.

WRSI is expressed as a percentage and is defined as the ratio of seasonal actual evapotranspiration experienced by a crop to the crop's seasonal water requirement; hence it monitors water deficits throughout the growing season, taking into account the phenological stages of a crop's evolution and the periods when water is most critical to growth. A description of this agro-meteorological modeling and forecasting approach used by FAO in national food security systems can be found at the FAO website.

The model is also currently used by the Famine Early Warning Network (FEWS-NET) to monitor agricultural areas around the world for signs of drought on a near-real-time, spatial, and continuous basis using a combination of satellite-derivative rainfall estimates and rain station data to compute WRSI values. There are many more robust and data-intensive physically based crop models available, but FEWS-NET adapted the FAO WRSI model for implementation in 2002 because of its limited data requirements and simplicity in operational use. These models also form the backbone of most crop production early warning systems run by government agencies in nonhumid tropics, particularly in Africa.

TECHNICAL DETAIL

The WRSI measures crop performance based on the balance between water supply and demand during the growing season. Usually, the computation of the water balance is updated on a dekadal basis.[26] During each dekad, the WRSI is computed as the ratio between evapotranspiration[27] and the water requirement of the crop.

If "actual evapotranspiration"—a function of water availability in the soil—is identified as AET and the "water requirement"—a function of atmospheric conditions and plant growth phases—as WR, WRSI is determined by the following relationship:

$$WRSI(i) = 100 * AET(i)/WR(i)$$

The underlying conceptual scheme is that of a bucket that is replenished by rainfall and depleted by evapotranspiration. A critical step in the computation of WRSI is in the update of the soil water content. If during a given dekad the sum of soil water content plus the cumulated rainfall is less than the plant water requirement, then a water deficit is recorded. In more specific terms, if AET is less than the WR determined by atmospheric conditions and by the plant's growing phase, the plant suffers a determined level of water stress. Conversely, if the sum of soil water content plus the cumulated rainfall exceeds the plant water requirement there is no water deficit.

The WR can be calculated by adjusting "potential evapotranspiration" (PET) to the condition of a specific plant in a given growing phase.

PET (also known as "ETo" in FAO terminology) can be defined as the evapotranspiration rate from a reference surface (a hypothetical grass reference crop with specific characteristics), not short of water,[28] and is a function of local weather

26 A "dekad" is a conventional way of dividing a month in three intervals. The first two dekads of each month go, respectively, from the first to the tenth day and from the eleventh to the twentieth day of the month in object, while the third dekad goes from the twenty-first to the last day of each month. Hence, the third dekad may be composed of more or less than 10 days. Dekadal rainfall is the sum of rainfall measured in each dekad.

27 FAO documentation defines evapotranspiration as the combination of two separate processes whereby water is lost from the soil surface by evaporation and from the crop by transpiration (http://www.fao.org/docrep/x0490E/x0490e04.htm).

28 http://www.fao.org/docrep/X0490E/x0490e04.htm#reference%20crop%20evapotranspiration%20.

parameters, such as solar radiation, air temperature, wind speed, and humidity. As PET depends mainly on solar radiation, which is fundamentally an astronomical parameter, climatological tables for this parameter are usually considered as representative of the actual value.

Using PET values, the WR of a specific plant in a particular growing phase can be computed as follows:

$$WR(i) = PET(i) * K_c(i),$$

where i indicates the dekad, PET the potential evapotranspiration during the considered period, and K_c a crop coefficient, dependent not only on the crop in object but also on the particular growing phase the crop is in.[29]

The WRSI calculation also requires start-of-season (SOS) and end-of-season (EOS) times and hence the length of growing period (LGP) for each crop considered and a potential sowing window for a crop. The LPG for the particular variety of crop should be verified by local agro-meteorological experts. The SOS dekad is the dekad when the crop is planted. This can be the actual dekad in which the crop is usually planted in the area if known or, if in an area where the planting depends on the start of the rainfall season, an objective method must be defined to identify the timing of a farmer's sowing decision if it is not fixed every year.

In Malawi, for example, assuming a farmer will sow his crop once the rainy season begins, usually in November, and when there is enough moisture in the soil to plant his crop and secure good probability of seed germination. According to agro-meteorological experts at the Malawi Meteorological Office, successful sowing is usually associated with the first occurrence of 25 to 30 mm of rainfall within a 10-day period, anytime from the middle of November to the middle of the following January. This definition has been used in Malawi to trigger the start of index-based weather insurance contracts for groundnut and maize farmers.

WRSI can then be related to crop production or yield estimate by using the following linear yield-reduction function:

$$\text{Actual Yield} = 1 - (1 - \text{WRSI}) * \text{Seasonal Ky} * \text{Maximum Potential Yield}$$

However, FAO also encourages users to establish their own Ky[30] through linear regression of WRSI against their own local yield data. The beauty of using a model such as the WRSI is that as it only uses rainfall as a variable input parameter, it is the only nonconstant parameter in the system. Therefore when looking over several rainfall seasons, by using historical rainfall data from the weather station, one can observe the impact due to rainfall deficit and deviation only on a crop's yield from year to year. In other words the model does not capture other aspects that can impact yield levels, such as management practices, technological changes, and pest attacks. These other risks are captured in the historical yield data, and because of this, using historical yield data can lead to misleading results when one is trying to quantify the risk and impact of only rainfall on a crop's performance. By considering the variations in WRSI from the long-term average, from the previous year or some other baseline, one can quantify the relative difference in yield from that baseline due to the impact of rainfall alone. It is this quality that we can exploit to inform the design of weather insurance contracts.

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Many of these reports can be found online. AgroMetShell is free software that can be downloaded to run WRSI water balance calculations. Some of the information can be found online; other pieces of information (such as water holding capacity of the soil) need to be collected from local experts, such as local agricultural research stations, Ministry of Agriculture, local universities, or the agro-meteorology division on the National Meteorological Services Department.

29 Kc crop values are available in table 12 of the FAO Irrigation and Drainage paper no. 56 (http://www.fao.org/docrep/X0490E/X0490E00.htm).

30 Seasonal yield-response factors (Ky) for each crop to convert WRSI values to yield estimates (Source: FAO, confirmed by local agro-meteorological experts).

Annex 8: EXAMPLE OF INFORMATION TO INSURED FARMERS

CASE OF MALAWI

WEATHER INSURANCE

The weather is unreliable. It impacts agricultural production in many ways. Poor yields and crop damage due to adverse weather can lead to lower revenues and difficulty in paying back loans and meeting household expenses. Weather insurance is a new way that farmers, banks, and sponsors in Malawi can minimize the financial impact of bad weather.

WHAT IS WEATHER INSURANCE?

- It is a new type of insurance that covers crop production losses caused by excessive and deficit rainfall.
- It is not based on changes in a yield on a farmer's field, but rather measures changes of rainfall amounts received at his nearest weather station.
- It does not cover losses related to pests, flood, localized storms, hail, temperature, or poor farm management.

HOW DOES THE PRODUCT WORK?

- The insurance is sold as part of a loan package, and payouts from the insurance automatically contribute to paying off the loan.
- Rainfall is measured throughout the season at the farmer's nearest weather station.
- The coverage starts when the rainfall received is adequate for transplanting and ends when the crop is ready for harvesting.
- If the rainfall is deficit or excessive for healthy crop growth during any part of the growing period, the farmer will receive an insurance payout that will be offset against his outstanding loan amount.
- The insurance payout amount is calculated using a formula that is specified in the insurance contract and made automatically if rainfall amounts are above or below given levels.
- The more extreme the rainfall compared to historical averages, the larger the payout and more of the loan is paid down.
- To get the product, you must pay a premium to the insurance company.
    - Premiums are included as part of the loan package.
    - Premiums are not refundable if there is no payout.
    - No matter what happens you must always repay your loan fully.

WHY SHOULD YOU CONSIDER BUYING WEATHER INSURANCE?

- All farmers know that rainfall is unpredictable, which creates risk for farmers, their sponsors, agribusinesses, and banks.
- If it does not rain or there is too much rain, yields can drop, resulting in losses to your income and making it difficult to repay your loans.
- Weather insurance is a new insurance product designed to help you repay your loans in times of rainfall stress and access credit again the next year.

If you are interested in weather insurance and want to know more contact:

YOUR LOCAL REPRESENTATIVE

Annex 9: MONITORING THE PERFORMANCE OF AN INDEX INSURANCE CONTRACT

ILLUSTRATION OF A WEATHER INSURANCE PAYOUT CALCULATION IN MALAWI

Crop:	Hypothetical Crop
Location:	Kasungu Weather Station
Transplanting Window:	15 November–20 December 2008 (inclusive)
Coverage Period:	17 weeks (119 days) from and including transplanting date
Maximum Payout:	231,000 MKW per hectare
Premium:	12,239 MKW per hectare

HOW DO I CALCULATE THE TRANSPLANTING DATE?

- For every day in the transplanting window, accumulate the total daily rainfall received on that day and the previous two days to calculate the total rainfall received in that three-day block.
- The transplanting date is defined as the last day of the first three-day block within the transplanting window to receive greater than or equal to 35 mm of cumulative rainfall.
- If none of the blocks has cumulative rainfall total greater or equal to 35 mm, the transplanting date becomes the last day of the three-day block with the highest cumulative rainfall total.
- If there is no rainfall during the transplanting window, the transplanting date is 20 December 2008.

HOW DO I CALCULATE THE DEFICIT RAINFALL PAYOUT?

- Use the calculation table provided to write down the answers to each step below.
- From and including the transplanting date, accumulate the total rainfall received within each week (seven-day block) for 17 consecutive weeks.
- Calculate the average rainfall received within each pair of consecutive weeks, so that there are 16 values of two-week average rainfall completed in the calculation table.
- For each average value write the following result in the deficit rainfall column:
  - If the value is greater than or equal to 25 mm, the result is 0 mm.
  - If the value is less than 25 mm, the result is equal to the difference between 25 mm and the average value, multiplied by the appropriate weighting factor given in the table.
- Sum these results over all 16 two-week average rainfall values to calculate the total deficit rainfall.
- If this value is less than or equal to 85 mm, no payout is due.
- If this value is greater than 85 mm, a payout equal to the difference between 85 mm and the total deficit rainfall value multiplied by 357 MKW is due to the farmer.

HOW DO I CALCULATE THE EXCESS RAINFALL PAYOUT?

- For each average value write the following result in the excess rainfall column:
  - If the value is less than or equal to 80 mm, the result is 0 mm.
  - If the value is greater than 80 mm, the result is equal to the difference between 80 mm and the average value, multiplied by the appropriate weighting factor given in the table.
- Sum these results over all 16 two-week average rainfall values to calculate the total excess rainfall.
- If this value is less than or equal to 110 mm, no payout is due.
- If this value is greater than 110 mm, a payout equal to the difference between 110 mm and the total excess rainfall value multiplied by dollars, but amounts would appear too inflated.

HOW DO I CALCULATE THE TOTAL PAYOUT DUE?

- The total payout due to the farmer is the sum of the deficit rainfall payout and the excess rainfall payout up to the maximum payout.

WEATHER INSURANCE PAYOUT CALCULATION TABLES

Rainfall data will be given to you by your bank or sponsor

TABLE A9.1: To Help you Find the Transplanting Date

3-DAY BLOCK	DATES	CUMULATIVE RAINFALL	TRANSPLANTING DATE	3-DAY BLOCK	DATES	CUMULATIVE RAINFALL	TRANSPLANTING DATE
1	13 Nov–15 Nov		15-Nov	19	1 Dec–3 Dec		03-Dec
2	14 Nov–16 Nov		16-Nov	20	2 Dec–4 Dec		04-Dec
3	15 Nov–17 Nov		17-Nov	21	3 Dec–5 Dec		05-Dec
4	16 Nov–18 Nov		18-Nov	22	4 Dec–6 Dec		06-Dec
5	17 Nov–19 Nov		19-Nov	23	5 Dec–7 Dec		07-Dec
6	18 Nov–20 Nov		20-Nov	24	6 Dec–8 Dec		08-Dec
7	19 Nov–21 Nov		21-Nov	25	7 Dec–9 Dec		09-Dec
8	20 Nov–22 Nov		22-Nov	26	8 Dec–10 Dec		10-Dec
9	21 Nov–23 Nov		23-Nov	27	9 Dec–11 Dec		11-Dec
10	22 Nov–24 Nov		24-Nov	28	10 Dec–12 Dec		12-Dec
11	23 Nov–25 Nov		25-Nov	29	11 Dec–13 Dec		13-Dec
12	24 Nov–26 Nov		26-Nov	30	12 Dec–14 Dec		14-Dec
13	25 Nov–27 Nov		27-Nov	31	13 Dec–15 Dec		15-Dec
14	26 Nov–28 Nov		28-Nov	32	14 Dec–16 Dec		16-Dec
15	27 Nov–29 Nov		29-Nov	33	15 Dec–17 Dec		17-Dec
16	28 Nov–30 Nov		30-Nov	34	16 Dec–18 Dec		18-Dec
17	29 Nov–1 Dec		01-Dec	35	17 Dec–19 Dec		19-Dec
18	30 Nov–2 Dec		02-Dec	36	18 Dec–20 Dec		20-Dec

The transplanting date is defined as the last day of the first 3-day block to receive greater than or equal to 35 mm of cumulative rainfall.

Source: Authors.

If none of the blocks has cumulative rainfall total greater or equal to 35 mm, the transplanting date becomes the last day of the three-day block with the highest cumulative rainfall total. If there is no rainfall during the transplanting window, the transplanting date is 20 December.

TABLE A9.2: To Help You Calculate the Total Payout Due (Fill-in Shaded Cells)

DAYS FROM TRANSPLANTING DATE	WEEKLY CUMULATIVE DAILY RAINFALL TOTAL	TWO-WEEK AVERAGE	DEFICIT RAINFALL (< 25 mm)		EXCESS RAINFALL (> 80 mm)	
			WEIGHT FACTOR	RESULT	WEIGHT FACTOR	RESULT
Week 1: Days 0 to 6						
			1		1	
Week 2: Days 7 to 13						
			1.5		1.5	
Week 3: Days 14 to 20						
			1.5		1.5	
Week 4: Days 21 to 27						
			1.5		1.5	
Week 5: Days 28 to 34						
			1		1.5	
Week 6: Days 35 to 41						
			1		1.5	
Week 7: Days 42 to 48						
			1.5		1.5	
Week 8: Days 49 to 55						
			1.5		1	
Week 9: Days 56 to 62						
			1		1	
Week 10: Days 63 to 69						
			1		1	
Week 11: Days 70 to 76						
			1		1	
Week 12: Days 77 to 83						
			1		1	
Week 13: Days 84 to 90						
			1		1	
Week 14: Days 91 to 97						
			0.75		1	
Week 15: Days 98 to 104						
			0.75		1	
Week 16: Days 105 to 111						
			0.75		1	
Week 17: Days 112 to 118						
			Total Deficit Rainfall:		Total Excess Rainfall:	
			Deficit Rainfall Payout:		Excess Rainfall Payout:	
Total Payout:						

Source: Authors.

Annex 10: ILLUSTRATION OF A WORK PLAN

TABLE A10.1: Sample Work Plan for Index-Based Weather Insurance Program

		JAN				FEB				MAR				APR				MAY				JUN				JUL				AUG	
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Phase 0	**INITIAL BACKGROUND RESEARCH**																														
	Select crops that are potential candidates for the pilot program			✗																										START OF SEASON	
	Select geographical areas that have potential			✗																											
	Identify weather stations with sufficient data and quality data			✗																											
	Identify potential insurance partners			✗																											
	Map the risks profile of the crops, potential clients/beneficiaries, and areas being considered			✗	✗																										
Phase 1	**IDENTIFICATION OF CLIENTS AND DELIVERY CHANNELS**																													START OF SEASON	
	Identify the client - individual farmers, financial institution, other?				✗	✗																									
	Determine the risk profile of the potential clients/beneficiaries				✗	✗																									
	SELECTION OF REGION CLIMATIC FACTORS																														
	Describe the production function (including the phenological steps)					✗	✗																								
	Find historical yield data for each crop and area					✗	✗																								
	Define the necessary technological package and flows for production (including inputs, fertilizers, machinery, etc.)					✗	✗																								
	Determine the profitability of the plant at different yield and price levels (costs of inputs, labors, potential markets)					✗	✗																								
	Quantify yield variation (including the use of historical data and models of simulation)					✗	✗																								
	IDENTIFY RISK TAKER OR INTERMEDIARY FOR THE RISK																														
	Discuss potential contracts with insurance company or risk taker							✗	✗																						
	Discuss size of initial pilot program							✗	✗																						
	Identify risk taking capacity of the insurer							✗	✗																						
	Define partnerships for reaching end users							✗	✗																						
	Calculate potential financial exposure of the risk taker							✗	✗																						
	Estimate costs of pilot project							✗	✗																						
	COMPILE AND MANAGE THE METEOROLOGICAL INFORMATION																													START OF SEASON	
	Establish access to all historical data from the Met Office for pilot areas									✗																					
	Check quality of historical data for pilot sites									✗																					
	Check the security of potential stations									✗																					
	Establish the plan of cooperation with the Met Office that defines how daily, weekly, and quarterly reports will be received									✗																					
	Identify any potential communication or capacity issues obstacles for the program									✗																					

TABLE A10.1: Sample Work Plan for Index-Based Weather Insurance Program (continued)

Phase	Activity	JAN				FEB				MAR				APR				MAY				JUN				JUL				AUG	
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Phase 2	**DESIGN OF PROTOTYPE CONTRACTS**																														
Phase 2	Define the parameters of the contract (index insurance) - define an index which most closely reflects the risk to the pilot area or clientele									✗	✗	✗	✗																		
Phase 2	"Back-testing" of the contract vs. expected payouts									✗	✗	✗	✗																		
Phase 2	Define the limits and schedule of payouts for the contracts									✗	✗	✗	✗																	START OF SEASON	
Phase 2	Quantify the historical payouts									✗	✗	✗	✗																		
Phase 2	Estimate the indicative premiums (pure risk premium)									✗	✗	✗	✗																		
Phase 2	**MARKET RESEARCH**																														
Phase 2	Test the applicability of the contracts with clients/beneficiaries – that is, does the proposed index really match risk?													✗	✗	✗	✗														
Phase 2	Test the contract parameters including payout structure and trigger levels													✗	✗	✗	✗														
Phase 2	Confirm distribution and marketing channels for the pilot if applicable													✗	✗	✗	✗														
Phase 3	**FINALIZE INSURANCE CONTRACTS**																														
Phase 3	Based on stakeholder input, finalize the design and contract structure of the product																	✗	✗												
Phase 3	Finalize contracts between participating parties																														
Phase 3	**FINALIZE INSURANCE ARRANGEMENTS**																														
Phase 3	Analysis of the comparative efficiency between different alternatives for the transfer of risk																		✗	✗											
Phase 3	Determine risk retention capacity of local insurer or risk taker																		✗	✗										START OF SEASON	
Phase 3	Finalize contract wording and terms																		✗	✗											
Phase 3	If applicable begin discussions with reinsurers regarding risk transfer																														
Phase 3	**DISTRIBUTION OF PAYOUTS**																														
Phase 3	Finalize mechanisms for distribution of payout																		✗	✗											
Phase 3	**MARKETING AND CAPACITY BUILDING FOR THE PILOT PROJECT**																														
Phase 3	Develop the communication strategy and activities for promoting the product in the pilot																			✗	✗	✗									
Phase 3	Develop materials to communicate the products to participants																			✗	✗	✗									
Phase 3	Train on how the product works for particpating organizations																			✗	✗	✗									
Phase 4	**SALE OF CONTRACTS FOR THE PILOT PROJECT**																														
Phase 4	Self contract through identified channels																					✗	✗	✗	✗	✗					
Phase 4	**IF APPLICABLE, TRANSFER RISK TO THE MARKET**																													START OF SEASON	
Phase 4	If applicable negotiate the risk transfer scheme with insurers																									✗	✗				
Phase 5	**EVALUATION OF THE RESULTS OF THE PILOT PROJECT**																														
Phase 5	Design criteria for reviewing the technical, operational, financial and perception of the scheme of index insurance																														
Phase 5	Carry out an evaluation of the pilot program																														

Source: Authors.

Annex 11: AGRI-INSURANCE SYSTEM DEVELOPMENT IN UKRAINE

International Financial Corporation (IFC) launched its activities in agri-insurance in Ukraine (2007–2013) in partnership with the Canadian International Development Agency (CIDA). Strategies and methodologies developed in Ukraine are extended to other IFC programs.

WHY UKRAINE?

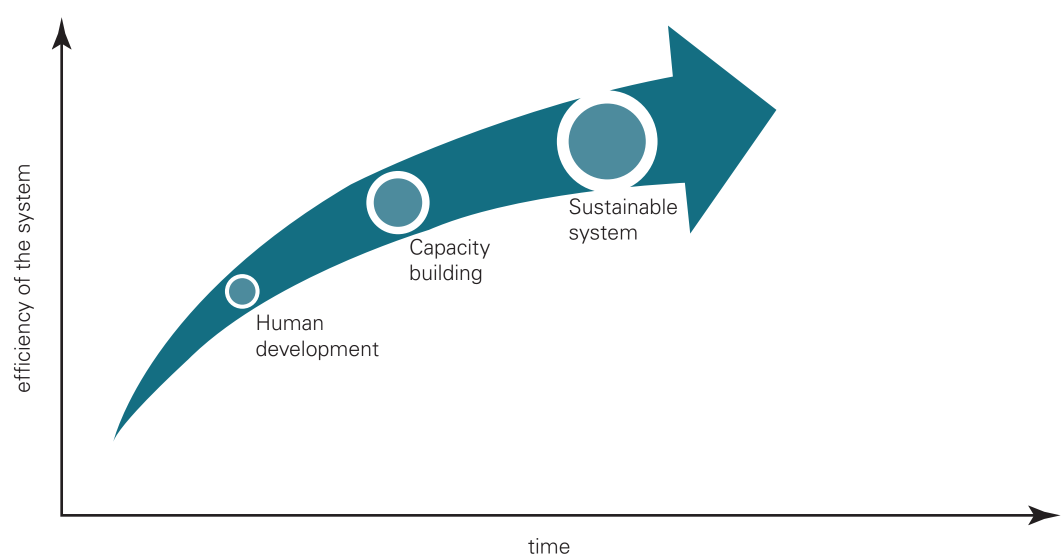
At the start of the project, Ukraine's agri-insurance potential was underdeveloped and lacked capacity. It represented a system in early stages of development. At the same time, Ukraine had the potential to be a world leader in agricultural exports. Its agricultural production is exposed to many natural perils that are beyond producers' control. As shown by global experience and particularly that of Canada—IFC's partner in the project—agri-insurance is well placed to become an efficient risk management tool to protect producers against weather risks, stabilize their incomes, improve access to finance, and help restore production after unfavorable climatic events.

OVERALL OBJECTIVE AND STRATEGIES TO ACHIEVE OBJECTIVE

The IFC Agri-Insurance Project was designed to boost the use of agri-insurance as a risk management tool by establishing a sustainable agri-insurance system based on the public-private partnership, enhancing technical capacity of insurance companies and fostering access to finance due to use of insured crops as collateral (figure A11.1).

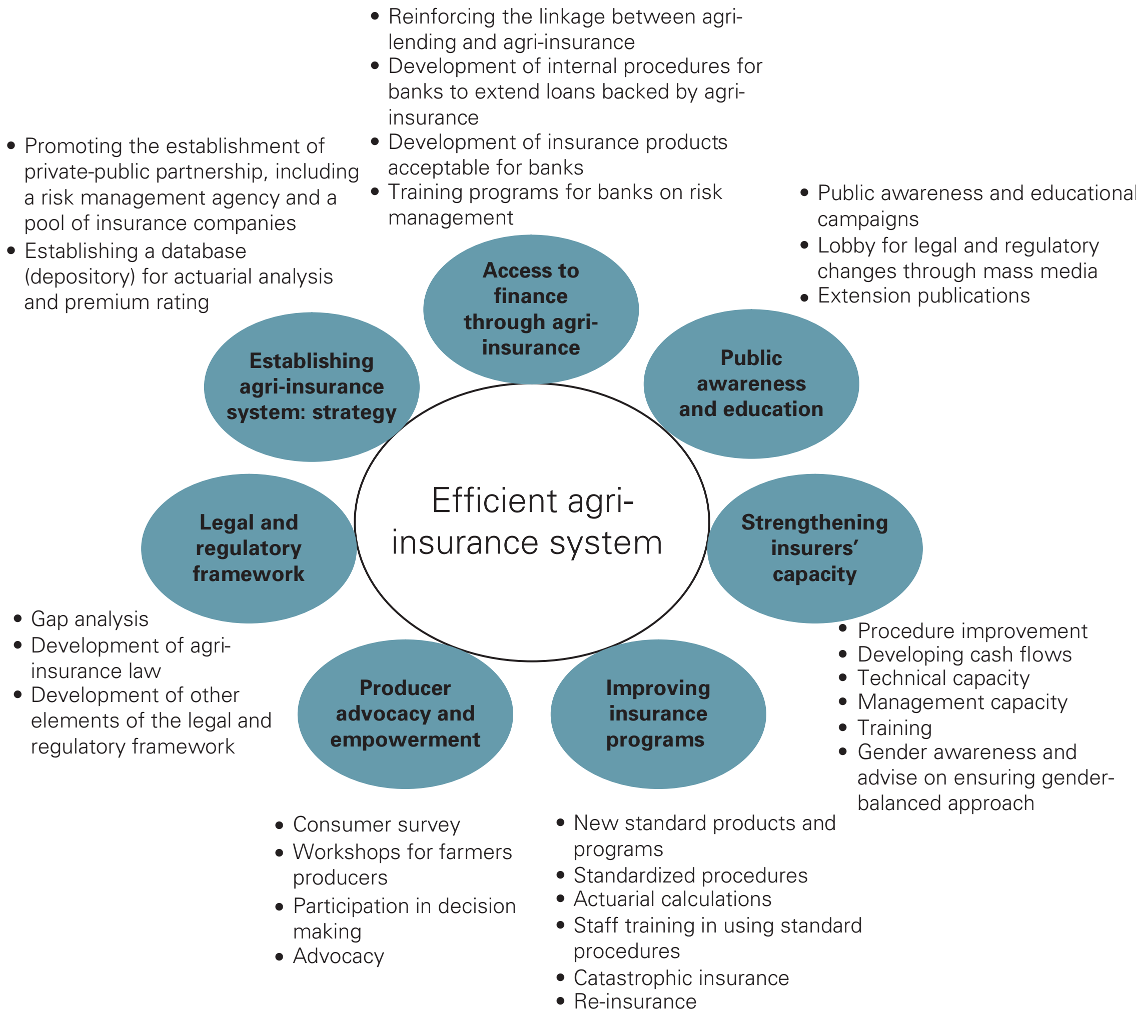
Leveraging Canadian and U.S. experience in North America, a threefold strategy was developed. First, human resource development was necessary to underpin development. For development to take place, sufficient capacity is required in government ministries, the insurance regulator, private insurance companies, and farmer organizations. The challenges to develop agri-insurance are unique, technically and operationally distinct from other kinds of insurance, as evidenced by the need for separate legislation in countries with developed systems. Successful agri-insurance systems throughout the world are characterized by public-private partnerships (figure A11.2).

FIGURE A11.1: Human Resource Development to Sustainability



Source: IFC.

FIGURE A11.2: System Development



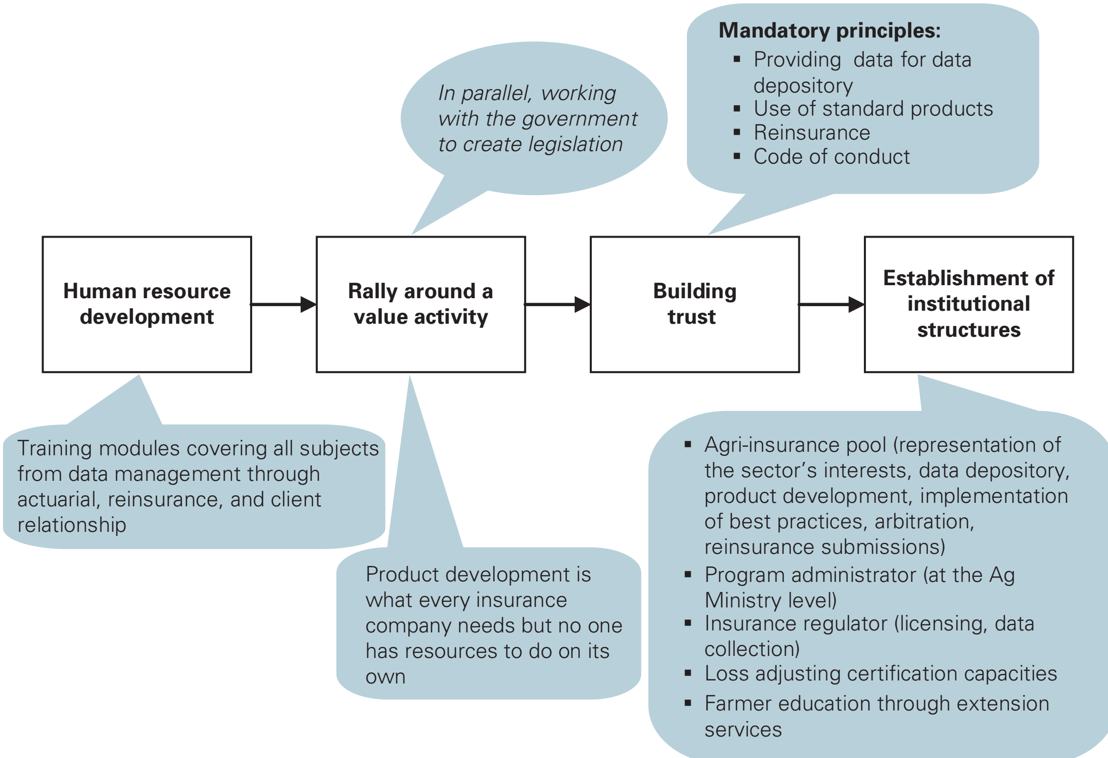
Source: IFC.

Agri-insurance is a highly technical discipline, requiring not only considerable expertise on the part of insurance companies and well-designed insurance products and programs but also thorough understanding and active participation on the part of producers who need to play a role in program design if the insurance program is to address their needs.

Second, agri-insurance involves a system, the elements of which need to work in coordination and the performance can be determined by the weakest link. Private insurance companies must transfer a significant part of the risk to international reinsurers, requiring technical and business competence often beyond the capacity of individual insurance companies (volumes of business are also a big question for reinsurance companies). In Ukraine, similar to other countries, an agri-insurance pool of companies was formed. Government support enables the development of an insurance product; lack of support or data can block its development. Farmer activism is the main driver to obtain government support for agri-insurance. Banks and input supplier involvement is a main commercial driver for the sale of agri-insurance because it minimizes the credit risk, thereby improving farmer access to finance. The regulator can encourage innovation or stifle it. International reinsurers have confirmed their support of a system development approach for steady and sustainable growth.

Third, the work in Ukraine demonstrated the difficulty to develop human resources and the system if the approach was too academic. Training and system development were actualized by concrete work to develop agri-insurance products and launch them in the market. This approach was very successful. Market standard insurance products for nine

FIGURE A11.3: Unity Through Program Development and Market Launch



Source: IFC.

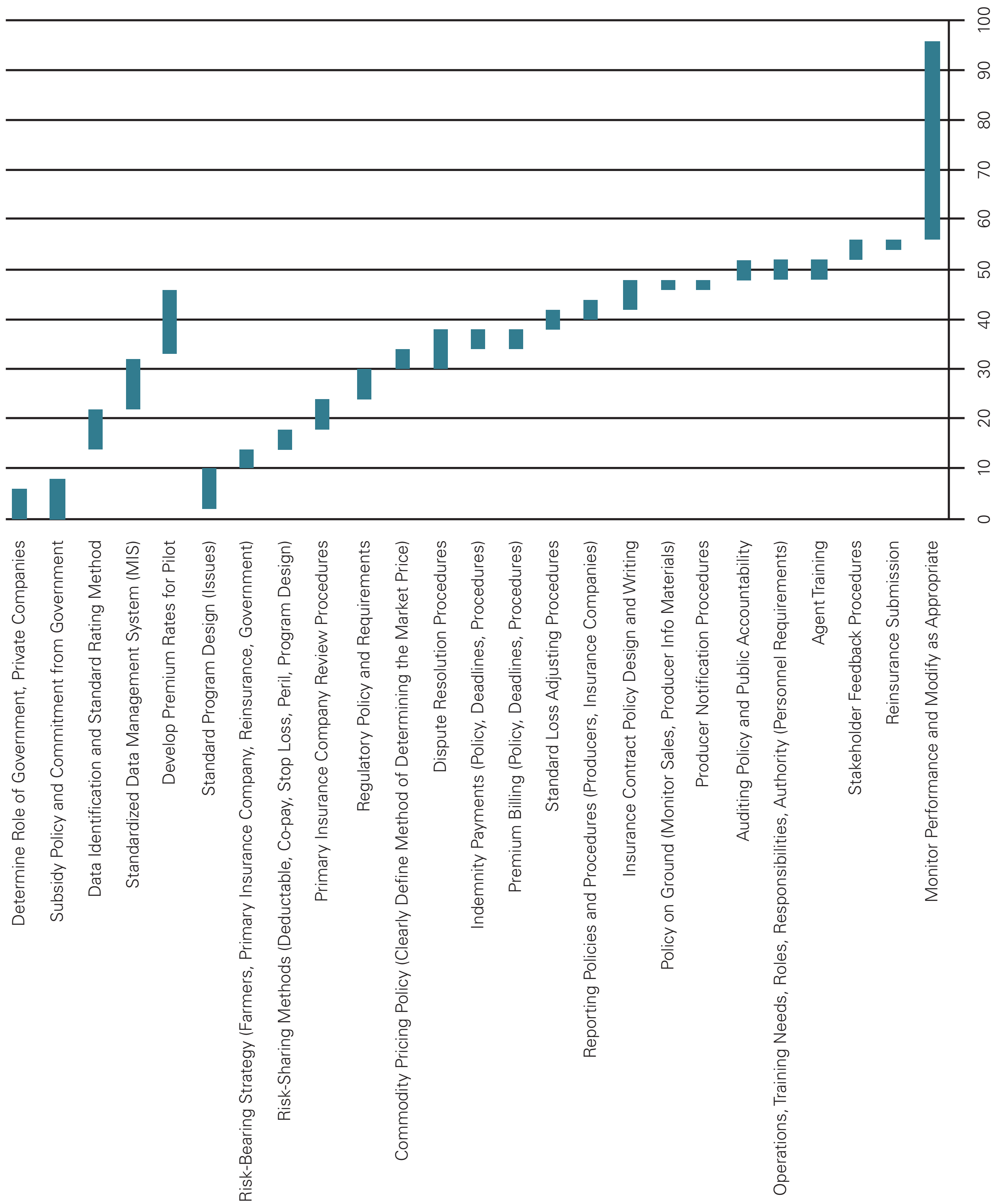
agricultural crops were developed and launched in the market during the course of the project and sales are increasing year by year. New standard insurance products are a platform for all stakeholders work together and create win-win scenarios (figure A11.3).

THE IFC APPROACH

- ***Develop legislation*** in close cooperation with government agencies to implement a public-private partnership as a prerequisite for efficient regulation and implementation of well-designed agri-insurance programs, protect agricultural produce against weather risks, and enable them to regain production capacity after catastrophic events. Provide training and consultations to increase government expertise in managing insurance programs at the regulatory level. The most efficient way for agri-insurance to be sustainable is through a public-private partnership, where government sets clear rules for the game, ensures good regulation, and supports producers by subsidizing premium rates while private-sector insurers do their job by offering good insurance products to producers and paying indemnities.
- ***Standard products***. Countries with developed agri-insurance invariably unite around the need for standard products, where competition between insurance companies is focused on the services that are provided and not distinguished by the products being sold. The necessity for standard products is justified by a wide spectrum of reasons, from reinsurance procedures and costs to farmer understanding and acceptance (figure A11.4).
- ***Support establishment of the agri-insurance pool***. An association of companies active in agri-insurance will manage the data depository, design new programs (including setting product standards, defining the methodology for underwriting and loss adjustment, and actuarial-based premium rating), prepare reinsurance submissions, undertake third-party arbitration, and provide training and consultation to member insurance companies. Individual insurance companies have neither the capacity nor the investment resources required for the agri-insurance requirements, thus the need to pool.

Since agricultural risks are highly systemic and tend to cover considerable territories, insurance companies

FIGURE A11.4: Steps to Develop a Standard Product/Program



Source: IFC.

TABLE A11.1: Agri-Insurance as an A2F Product

Status	• Product fully developed, in use by Ukrainian banks and insurance companies, ready to be offered
Objective	• Reduction of credit risk through crop yield insurance leading to improved lending conditions for agri-producers
Instruments	• Reinforcing the linkage between agri-lending and agri-insurance • Helping design an insurance product aligned with the lending program • Training and certification of bank staff (and partnering insurance companies) • Improvement of banking credit risk assessment procedures • Development of internal procedures for banks to extend loans backed by agri-insurance

Source: IFC.

need to pool and reinsure the largest part of these risks internationally to spread the risks efficiently.

- ***Increase awareness*** about agri-insurance among Ukrainian producers through extension and media campaigns as well as dissemination of information and training events.
- ***Work with Ukrainian banks and input suppliers*** to help them increase expertise in rural lending, as well as to develop and market financially viable loan products with the use of insurance as collateral. Agri-insurance can be instrumental to increase access to finance as producers can use the insurance policy as collateral and get a loan easier or at better terms (table A11.1).

PROJECT PARTNERS AND PARTICIPANTS

- National and local government agencies responsible for agricultural insurance
- Senior management and specialists of insurance companies, agricultural enterprises, agricultural input suppliers, food processing companies, and banks
- Producer associations, extension services, consulting firms, NGOs, and experts working on agri-insurance issues
- Media
- International reinsurers, international consultants from countries with developed agri-insurance system

TABLE A11.2: Standard Insurance Products Developed by IFC Ukraine Agri-Insurance Team

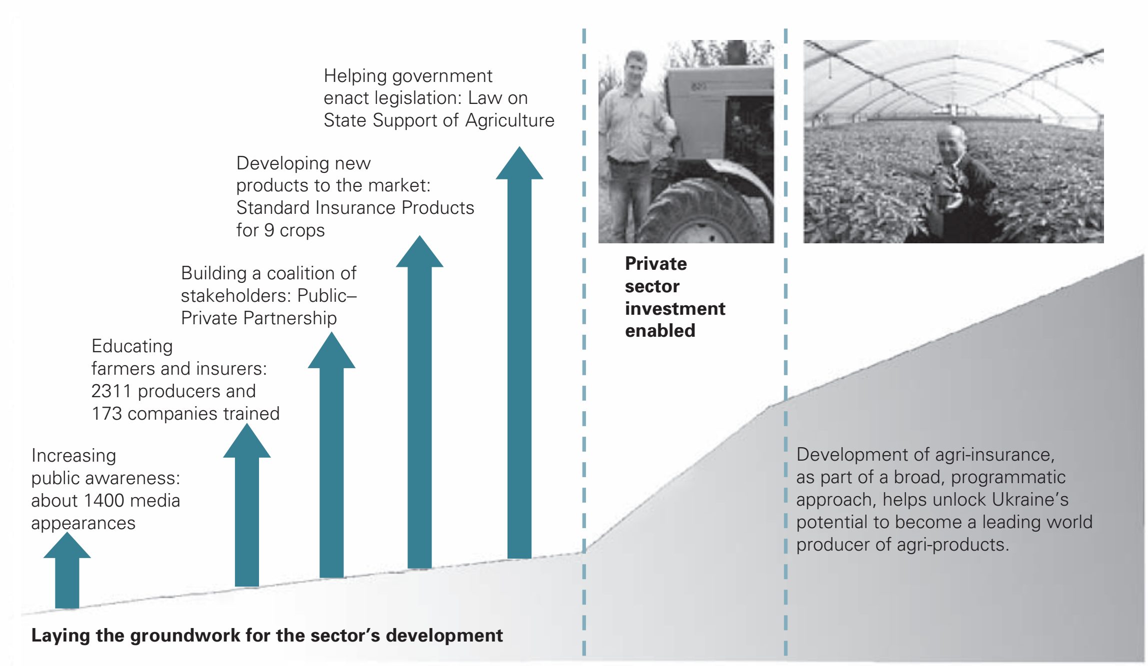
Products by crop	• winter wheat • winter rye • winter barley • winter rapeseed • winter triticale • summer wheat • summer barley • corn • sunflower
Products by season	• whole cycle • winter kill • spring-summer risks
Specifics of the products	• standard contract • actuarial techniques for rates calculation (1980–2010 database) • flexible rates—price and coverage levels can be opted • standard loss-adjusting procedures • international reinsurance • adopted for subsidy programs (if available) • adopted for banks' and input suppliers' products

Source: IFC.

RESULTS OF IMPLEMENTED STRATEGY AS OF JULY 1, 2011

- Facilitated development of the concept of agri-insurance development and the law on agri-insurance with government support
- Established a data depository for developing new insurance products on the basis of actuarially sound calculations
- Provided 564 consultations to 180 entities and 58 training events (totally 526 attendees) for insurers
- The project developed and launched in the market standard insurance products for nine agricultural crops (table A11.2)
- On February 1, 2011, fifteen leading companies providing agri-insurance coverage established the Agri-Insurance Bureau under the project's coordination
- Works with banks and input suppliers to develop and improve the quality of collateral to improve access to finance for agricultural producers
- Implemented an education campaign: 2,311 producers took part in 70 training events all over Ukraine (figure A11.5)

FIGURE A11.5: Helping Ukraine Realize Its Full Agricultural Potential



Source: IFC.

A FARMER TESTIMONIAL: AGRI-INSURANCE HELPS MITIGATE RISKS AND IMPROVE ACCESS TO FINANCE

The IFC Ukraine Agri-Insurance Development Project aims to improve the quality of products offered by Ukrainian insurance companies, advise insurance firms how to develop better products, and consult the public and private sectors on developing a regulatory environment to foster agri-business insurance. The resulting agri-insurance infrastructure will help farmers make better use of their resources and enable them to obtain bank financing more easily, as banks have greater comfort lending if they know farmers' future yield or income is insured against losses. This way the project helps mitigate risks and increases access to finance for local producers.

Olexiy Samoilenko runs a large farm in Ukraine's Poltava region. While the farm has traditionally produced well, he still worries year to year about how it will fare. "The last yield is history—we have to survive from what we have this year," he says, adding, "We would like to ensure the yield, not the field." Samoilenko has been insuring for five years, and when a drought in 2008 wrecked sugar beet yields in Ukraine, his insurance company paid out nearly $3 million.

Supporting and developing agribusiness is one of IFC's key global priorities. By addressing risk mitigation and financing needs in Ukraine—one of the world's largest agri-producing countries—IFC is making a major contribution to its wider strategy in this area.

THE WORLD BANK

Agriculture and Rural Development (ARD)
1818 H Street, NW
Washington, D.C. 20433 USA
Telephone: 202-477-1000
Internet: www.worldbank.org/ard

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