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 FINANCING 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 microcredit 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.

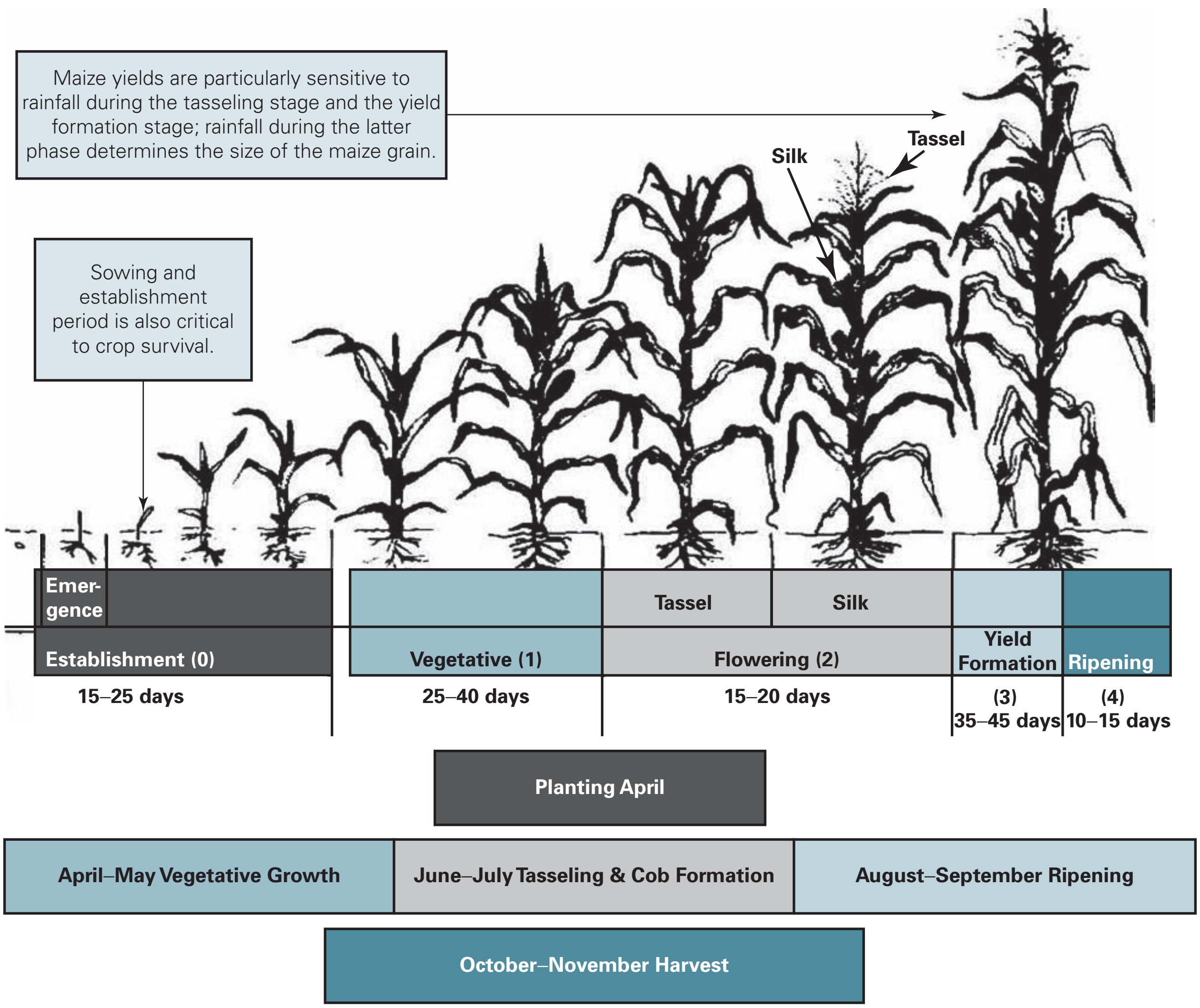
Figure A6.1 and figure A6.2 provide two examples of how crop phenology can be used in determining the critical growth periods of a crop and the effects of adverse weather during these periods. This information is also useful for estimating the increasing accumulated production costs where the insured 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		Tillering		Booting	Flowering	Grain Filling		Harvest
Rice crop cycle 3	Seeding	Transplant	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:

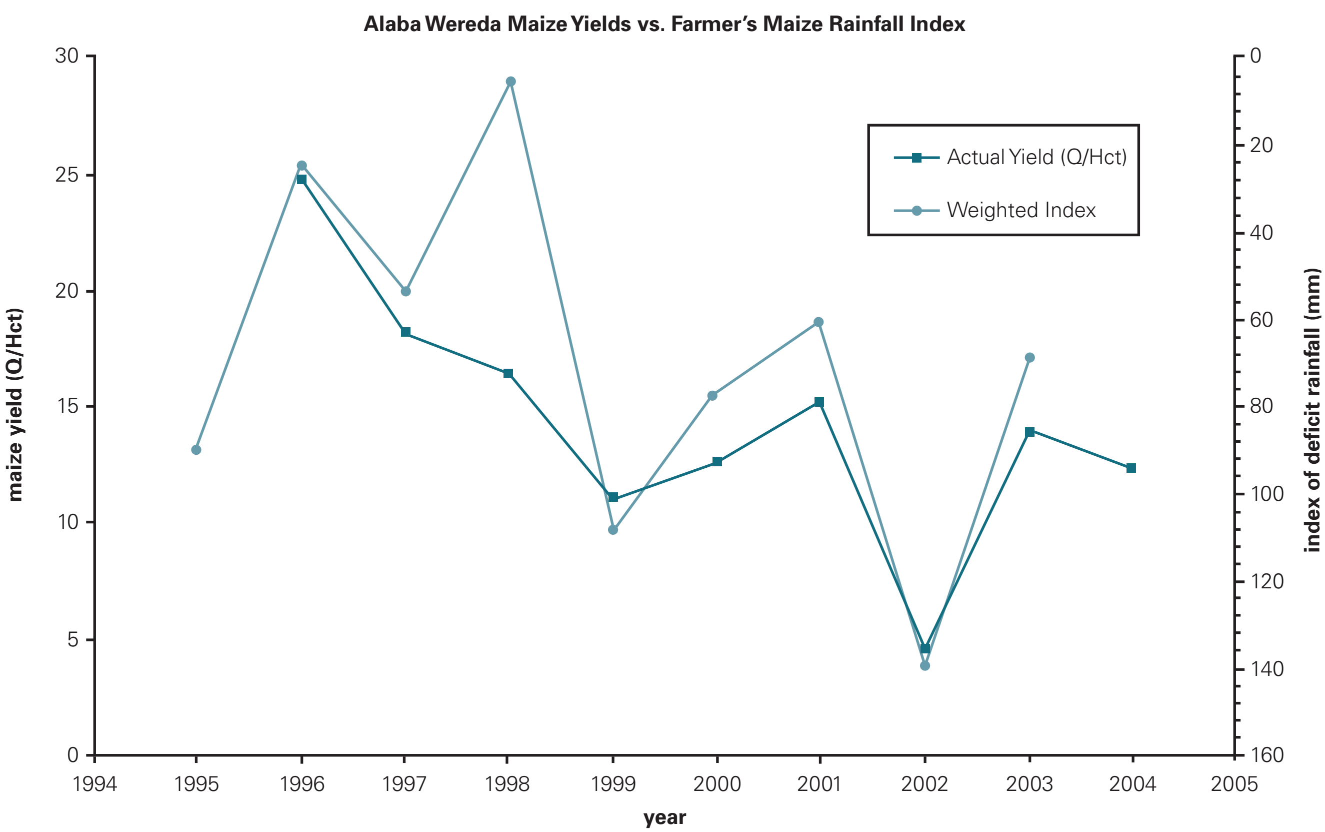
Historical Yield Data

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:

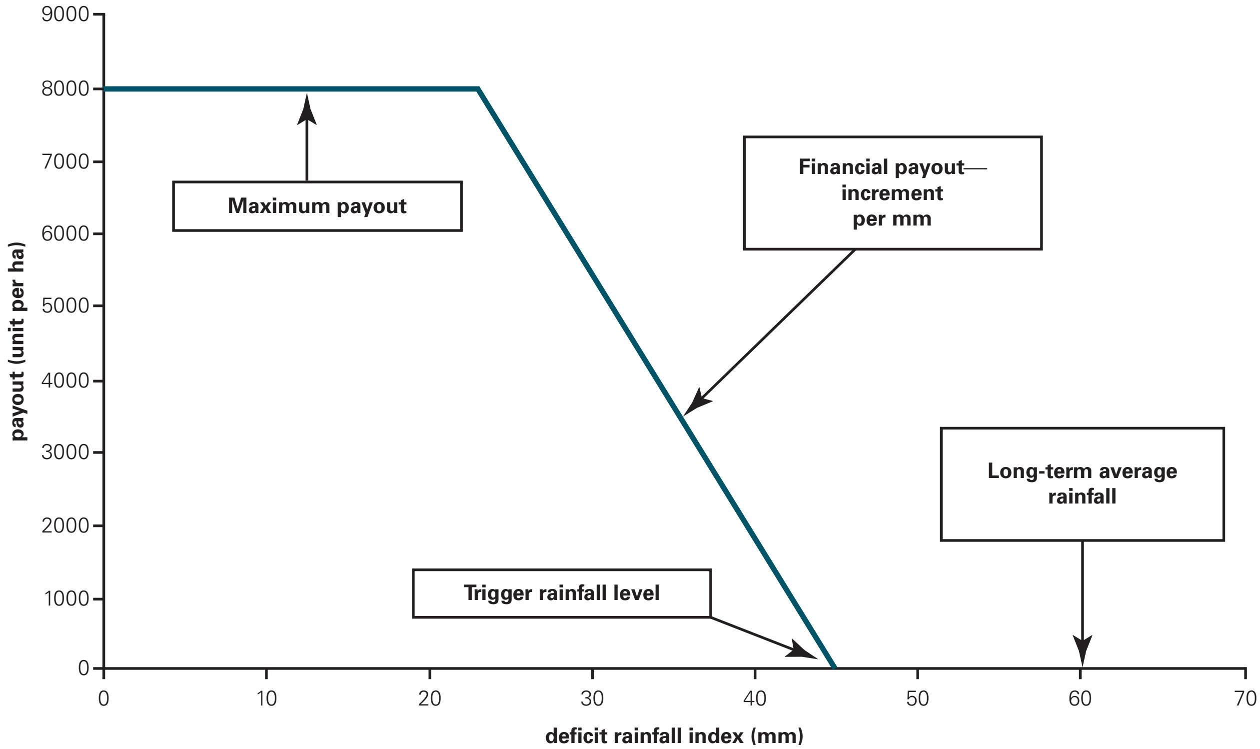
- Identifying the financial exposure per unit of the defined index
- Identifying the financial exposure to a specific weather event
- Establishing the limit (in the case of calibrating an index for an index-based insurance contract) or the total financial protection required per risk period. In this 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.

REFERENCES

FAO. 1998. *Crop Evapotranspiration: Guidelines for Computing Crop Water Requirements.* Irrigation and Drainage Paper No. 56. Rome.

FAO. 1986. *Yield Response to Water.* Irrigation and Drainage Paper No. 33. Rome.

Frere, M. & Popov, G. 1986. *Early Agrometeorological Crop Yield Assessment. Production and Protection Paper No. 73*. Rome, FAO.

Senay, G. & Verdin, J. 2003. Characterization of Yield Reduction in Ethiopia using a GIS-Based Crop Water Balance Model. In *Remote Sensing*, 29(6): 687–692.

Verdin, J. & Klaver, R. 2002. Grid cell based crop water accounting for the famine early warning system. In *Hydrological Processes*, 16: 1617–1630.

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																														
	Establish access to all historical data from the Met Office for pilot areas									✗																				START OF SEASON	
	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)

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

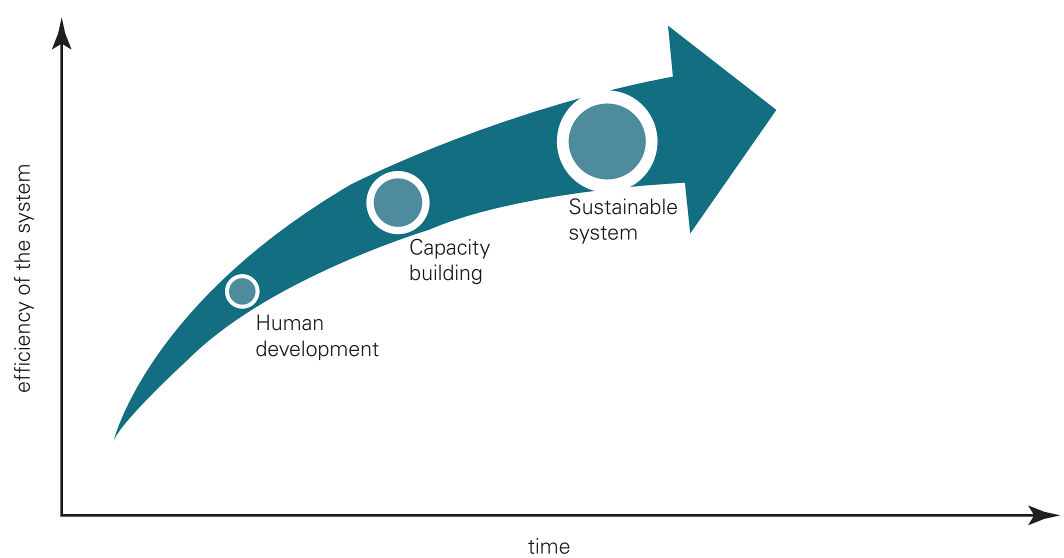
At the start of the project, Ukraine's agri-insurance potential was underdeveloped and lacked capacity. It represented a system in early stages of development. At the same time, Ukraine had the potential to be a world leader in agricultural exports. Its agricultural production is exposed to many natural 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).

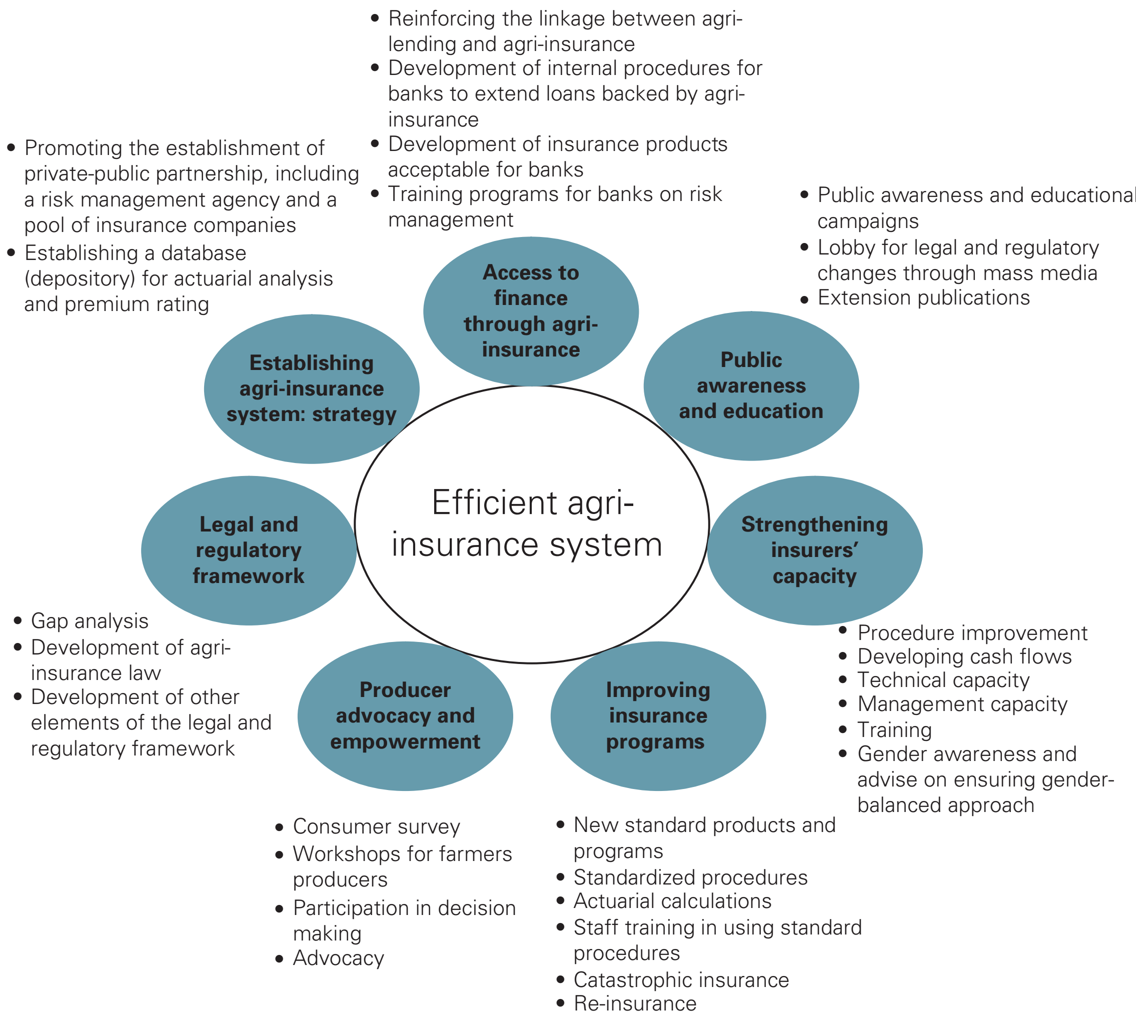
Leveraging Canadian and U.S. experience in North America, a threefold strategy was developed. First, human resource development was necessary to underpin development. For development to take place, sufficient capacity is required in government ministries, the insurance regulator, private insurance companies, 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



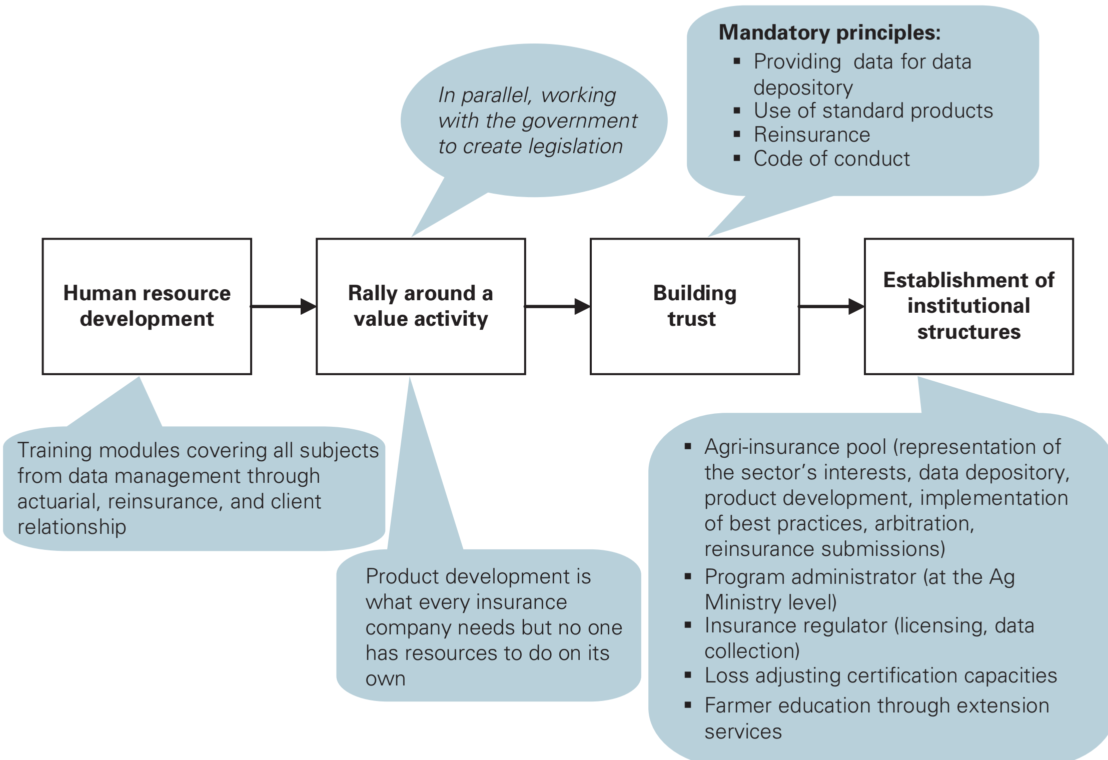
Source: IFC.

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.

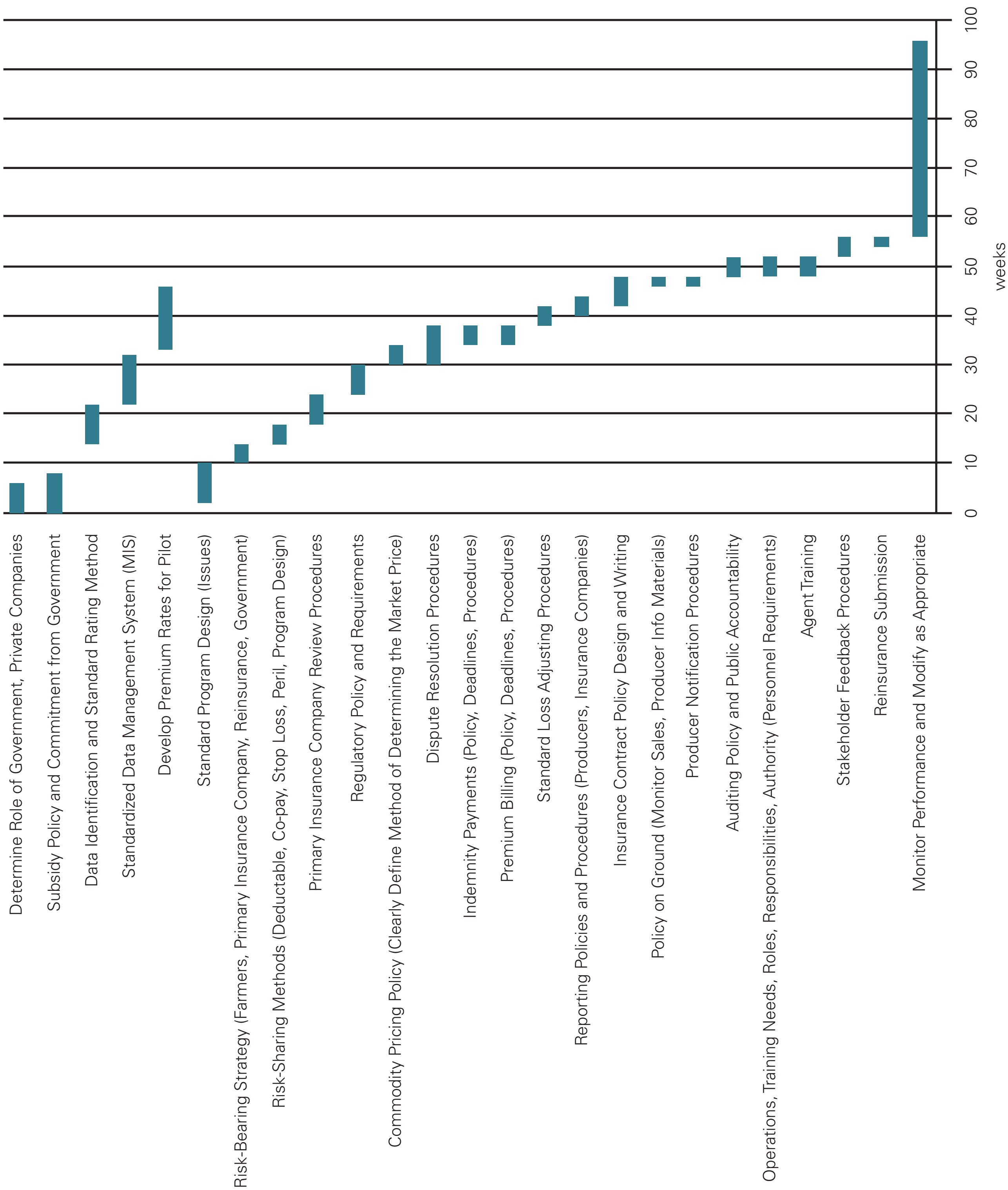
agricultural crops were developed and launched in the market during the course of the project and sales are increasing year by year. New standard insurance products are a platform for all stakeholders work together and create win-win scenarios (figure A11.3).

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

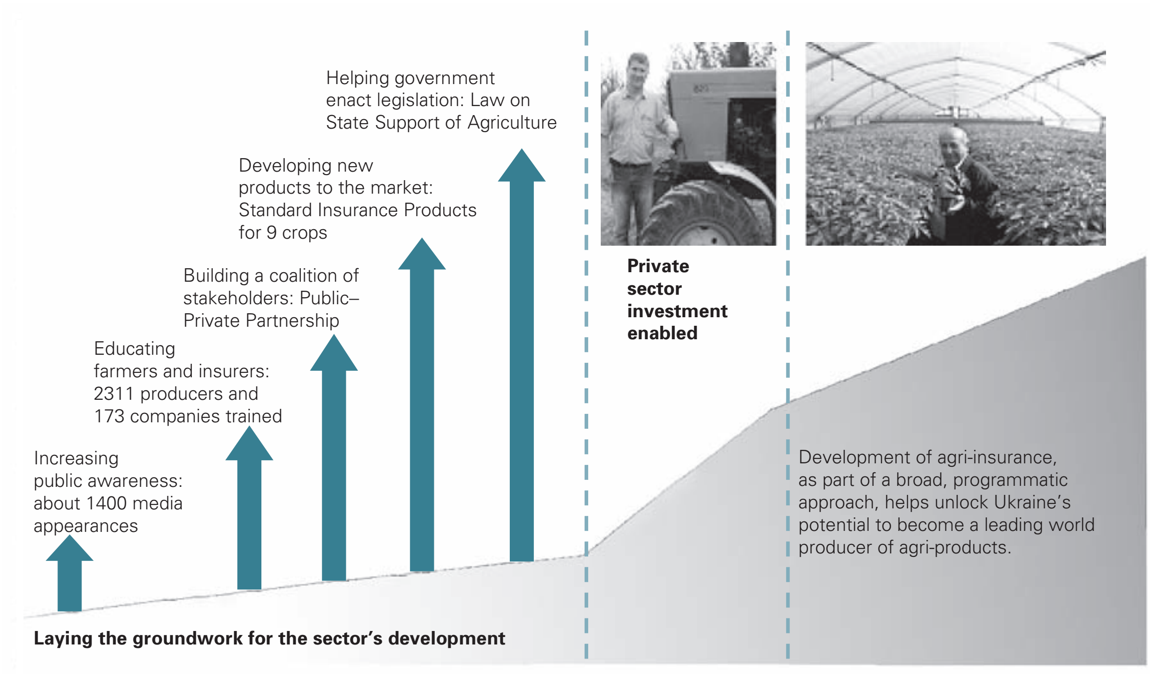
Products by crop	• winter wheat • winter rye • winter barley • winter rapeseed • winter triticale • summer wheat • summer barley • corn • sunflower
Products by season	• whole cycle • winter kill • spring-summer risks
Specifics of the products	• standard contract • actuarial techniques for rates calculation (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.

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