INNOVATIONS IN INSURING THE POOR

Index Insurance Applied to Agriculture: The Mexican Case

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Uncertainty and risk are characteristics inherent in agricultural activities, and one of the main sources of risk is weather. Because agriculture depends heavily on rainfall, it is sensitive to weather changes. Agriculture is also vulnerable to extreme weather events; floods, droughts, and frosts cause both production and capital losses. Approximately 98 percent of the catastrophic risk to agriculture in Mexico stems from two types of weather events: droughts (accounting for 80 percent) and cyclones (accounting for 18 percent). Low-income rural populations are highly vulnerable to the harmful effects of weather, yet their access to insurance programs is almost nonexistent.

The private and public insurance sectors

The private sector's limited participation in agricultural insurance in Mexico has been oriented toward large or very well organized producers. Low-income agricultural producers do not have access to insurance, but rather rely on monetary transfers from the government in the wake of extreme weather events.

The systemic risk present in agriculture discourages private sector insurers from entering this market. The risk is catastrophic in nature, and insurers face high financial costs in building up sufficient reserves to cover sustained losses. In addition, much of the rural agricultural sector is characterized by low profitability and highly fragmented possession of land that is subject to extreme weather risks. Operating costs for insurers are also high because of the sociodemographic and geographic characteristics of Mexican agriculture.

Given this environment, the Mexican government has generated mechanisms to help low-income producers who have no public or private insurance reduce the risk of catastrophic losses from weather. In 1995, it established the National Fund for Natural Disasters (FONDEN), a federal program that provides ad hoc funds following natural disasters to local governments and public dependencies for infrastructure rebuilding and for restoration of natural resources, natural protected areas, coastal areas, and riverbeds. In 2003 the Fund to Assist Rural Populations Affected by Weather Contingencies (PACC) was created to target assistance to small farmers in the event of weather-related shocks, including frost and wind damage. Costs are shared between the federal government (70 percent) and state governments (30 percent). These fiscal resources have covered the rural population's urgent needs related to catastrophic weather events, but uncertainty about the occurrence of such events has meant that in some years these resources have been assigned to other programs.

Catastrophic Agricultural Insurance (CAI)

In response to this situation, AGROASEMEX[1] has developed Catastrophic Agricultural Insurance (CAI)—an index hedge designed to protect small producers affected exclusively by drought events. Federal and state governments buy the insurance to manage the risk they face from making weather-contingent payments to rural residents. The insurance allows the federal and state governments to increase payments to those affected by drought without increasing the budget. A region's access to this insurance is limited by three requirements: extensive and consistent historical climate data, infrastructure to measure weather changes in real time, and the agroclimatic conditions to allow crops to develop adequately. In contrast to FONDEN and PACC, AGROASEMEX does not rely exclusively on fiscal resources; rather, it is a development agency and a specialized reinsurance institute oriented to risk management for federal and local governments.

With CAI, AGROASEMEX ensures feasibility through two central hypotheses:

1. there is a functional relationship between rainfall and the level of agricultural production during certain periods of a plant's growth cycle; and
2. this relationship can be represented satisfactorily by means of a simulation model of the agricultural process which includes plants, soil, and weather.

Methodology and theoretical framework

Some agricultural risks may not be commercially insurable because of these specific industry characteristics:

1. the presence of correlated or systemic risks, particularly those related to extreme weather phenomena;
2. the probability of extreme events with large expected losses that are difficult to quantify; and
3. agriculture's high costs of operation.

One viable solution to these problems is index insurance. Index insurance offers operating and technical elements that permit it to handle adverse weather phenomena more efficiently by correlating crop types to risks. It can also reduce the cost of offering insurance by analyzing regional, not individual, risk and vulnerability; establishing thresholds or critical levels for weather variables that serve as indicators of impact; reducing the need for individual contracts, field inspections, or adjustments of individual losses; and

[1] AGROASEMEX (Agro-Aseguradora Mexicana) is a national insurance institution whose mission is to protect the heritage and production capabilities of the rural sector. The Mexican federal government is the majority program sponsor. AGROASEMEX is a public policy instrument contributing to the creation of a national risk management system for the comprehensive protection of the rural agricultural sector. As a national insurance institution, AGROASEMEX provides reinsurance services to Mexican insurance institutions, mutual societies, and insurance funds. As a development agency, it drives the participation of private and social agents in the farming market. AGROASEMEX replaced the previous monopolistic public institution ANAGSA (National Agricultural Insurance). With the formation of AGROASEMEX, the agricultural insurance market was opened to the private sector.

reducing insurance market problems such as adverse selection and moral hazard.

To effectively operate CAI, AGROASEMEX implemented the following key actions:

1. **Isolate the effect of climatic events from the other factors of production.** AGROASEMEX developed a specific model (Simulation Model for Agricultural Insurance) in which it is possible to represent the effect of a weather variable on production levels and therefore to calculate the threshold values of this variable.
2. **Determine the periods of protection.** AGROASEMEX decided on the term of the insurance in light of the timing of water requirements for sowing and crop growth.
3. **Create agroclimatic zones of homogeneous response.** AGROASEMEX identified groups of weather stations with similar characteristics to determine climatologically homogeneous regions. The existence of microclimates in the zones where AGROASEMEX intends to operate, however, does reduce the efficiency of the weather indexes.
4. **Determine the threshold values of the weather variable.** AGROASEMEX determined threshold values for rainfall during each cropping phase; when actual rainfall is lower than the threshold value during any phase, it is considered an insurable adverse event.
5. **Establish weather stations and weather databases.** To make index insurance viable, a long-term, reliable, and homogeneous database of weather information is needed, as are weather stations that report weather data quickly.
6. **Derive an actuarial valuation of risk.** AGROASEMEX used a method of actuarial valuation of risk that must be adjusted to the volatility that is inherent in rainfall patterns.

Evaluating CAI's concepts and methods

In 2002, after addressing the methodological and conceptual issues related to CAI, AGROASEMEX carried out an experimental test of the insurance scheme to identify strengths and weaknesses as well as to identify areas for technical and operating improvement. The test carried out field trials to evaluate the strength of the threshold values for rainfall by assessing the correlation of the threshold values, crop growth, and production levels. During the sowing phase, observed rainfall levels in all cases exceeded the threshold values and thus no adverse events were registered. To evaluate the strength of the threshold values established for this phase, a level of soil moisture was identified to determine the date when the soil reached its maximum moisture capacity at each of the climate stations considered in the test. The results showed that for all stations, the maximum moisture capacity was reached in the dates pre-established in the insurance contract for both sorghum and corn. During the flowering and crop growth phases, AGROASEMEX found that the linear models used, and consequently the threshold rainfall values, were well correlated with field conditions for crops.

The results of this test of CAI support the feasibility of the methodology and concepts developed by AGROASEMEX. This form of insurance was well suited for commercialization under the assumptions and conditions established in the test and in the regions tested. One additional task was to establish an efficient procedure for choosing the weather stations to be used in the insurance scheme, through coordination between CONAGUA (National Water Commission) and AGROASEMEX, to guarantee a rapid flow of rainfall data.

Between 2003 and 2005, AGROASEMEX insured an area of 1.5 million hectares containing 186 weather stations. The total sum insured was US$88.1 million, premiums were US$13.3 million, and indemnities totaled US$10.5 million. A transfer of risk to the international market starting in 2004, through Partner Re, helps AGROASEMEX to insure the most vulnerable sectors of the rural population.

In 2006 CAI was estimated to cover 2.3 million hectares containing 297 weather stations, with a total insured sum of US$131.9 million and premiums of US$17.3 million. According to AGROASEMEX estimates, CAI covered 3 million hectares in 18 states in 2009. The growth of this form of insurance is limited by the availability of weather databases that comply with quality standards. Alternatives for improving analysis and data collection are being explored.

Conclusions

For the Mexican case, index insurance applied to the agricultural sector represents a viable method of coping with catastrophic events with regional or multiple impact related to extreme weather in a low-cost and efficient way. The associated risk is transferable to the international reinsurance market through index schemes when they meet two conditions: (1) the climatic databases comply with standards of quality established by the risk taker, and (2) measurement infrastructure is available to guarantee efficient data collection and transmission of values. ■

For further reading: AGROASEMEX, "La Experiencia Mexicana en el Desarrollo y Operación de Seguros Paramétricos Orientados a la Agricultura," Working Paper (Mexico City, 2006); J. Skees, P. Hazell, and M. Miranda, "New Approaches to Crop Yield Insurance in Developing Countries," Environment and Production Technology Division Discussion Paper 55 (Washington, D.C.: International Food Policy Research Institute, 1999); J. Skees, P. Varangis, D. Larson, and P. Siegel, "Can Financial Markets Be Tapped to Help Poor People Cope with Weather Risks?" Policy Research Working Paper 2812 (Washington, D.C.: World Bank, 2002).

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