Agriculture plays an important role in the state of Santa Catarina, Brazil. Most of its production depends on small family-owned farms, which are greatly exposed to climatic and price shocks. In order to help small farmers to manage risks, the federal and state governments have been carrying out several programs and measures to reduce and transfer agricultural risks. However, these initiatives are facing increasing fiscal constraints and could benefit from increased use of some of the market-based risk management instruments.

Santa Catarina ranks seventh out of 26 Brazilian states in terms of agricultural production. One-half of the state’s agricultural output is livestock-based; the remainder includes perennial crops (41 percent) and forestry products (9 percent). The state’s most important perennial crops are corn, soybean, tobacco, rice, beans, onions, and wheat. Including agro-industry, the agricultural sector accounts for approximately 60 percent of exports and employs 40 percent of the labor force. Agricultural export growth is consistently above 15 percent annually. Exports consist mainly of meat (poultry and swine) and wood (furniture and cellulose).

About 20 percent of the population lives in rural areas, of which some 90 percent are farmers. Of the state’s 193,000 land holdings, 90 percent consist of small family-farms of 50 hectares or less (34 percent are 10 hectares or less) which contribute 70 percent of the state’s agricultural GDP (AgGDP). The main family farm contribution to the state’s AgGDP includes maize (70 percent), beans (73 percent), rice (67 percent), swine and poultry (80 percent), milk (83 percent) and onion (91 percent). The average farm size is 34 acres, for a total of roughly 6 million acres (cultivated land is less than 1.5 million acres, 1.7 million acres are grazing grounds for animals and the rest is covered in forests).

About 30 percent of cultivated land is mechanized and 2.4 percent is irrigated.

Weather Risks

Aside from the price fluctuations of inputs and outputs, the most important risks for the farmers of Santa Catarina are extreme weather. Weather risks include drought, flooding, hail, and frost. In this note we focus on weather risks.

Figure 1
Map of Santa Catarina

Source: EPAGRI
The most prominent climatic challenges are floods in the coastal region and droughts in the western plateau (figure 1). Of these extreme weather events, floods are the most visible, because they receive widespread media coverage and sometimes cause deaths. However, drought poses a much more significant challenge to agricultural productivity. The areas that are typically affected by drought are some of the most agriculture-intensive (having triggered the irrigation investments in the past) and therefore this particular risk is the most significant in terms of impact on both overall output and farm income.

**Layering Weather Risks**

Given that most farms in Santa Catarina are small and that agricultural production is mainly rainfed, weather risks play a key role in the production variability and farmer’s income. Agricultural risks have different sources, frequency, and potential to cause losses, all of which determine the risk management strategies and instruments to be used. Classifying risk into different “layers” (figure 3) is a key risk management practice that gives valuable criteria to clarify and further establish effective risk transfer strategies. The risk layers can be structured per level of potential losses, with different mechanisms and/or institutions addressing each layer:

- The risk retention layer, where farmers would retain the loss, either individually or with financial service providers.
- The market insurance layer, where the risk would be transferred to an insurance company or financial institution.
- The market failure layer, where the risk would often not be insured by individual farmers due to cognitive failure and ambiguity loading. Cognitive failure refers to the fact that many decision makers tend to underestimate their exposure to low-frequency, high-consequence losses and are unwilling to pay the full costs of an insurance product. Ambiguity loading refers to the fact that insurers will typically load premium rates heavily for low-frequency, high-consequence events, where considerable ambiguity surrounds the actual likelihood of the event.

**The Role of the State**

As it is the case for any other market, the economic rationale for public intervention relies on real or perceived market failures. Moreover, as governments often provide ex-post disaster relief, in Brazil the government also supports farmers through ex ante (insurance market) strategies. However, the state governments also play important roles at the other risk layers.

**Layer 1 (High-frequency/Low-consequence events)**

- Strengthen the agriculture sector infrastructure (roads, dams, irrigation systems) and facilitate the implementation of innovative technologies (pest management systems) to small farmers.
- Provide agricultural extension regarding: risk exposure, crop diversification, intercropping, plot diversification, and/or adoption of advanced cropping techniques (fertilization, irrigation, resistant varieties).
- Provide an institutional and legal framework for the development of risk polling vehicles, such as cooperatives or mutuals.
• Promote the supply and demand of financial instruments needed to cope with production and market risks at the farm level, such as savings accounts and credit.

• Create information systems capable of delivering timely and reliable data to farmers (early warning systems, agro meteorological forecasting).

**Layer 2 (Moderate-frequency/Moderate-consequence events)**

• Provide a center of expertise able to support the development and scaling up of agricultural insurance, derivatives, and other risk transfer instruments (several governments in the region have been establishing agriculture risk management units with their Ministries or Secretariats of Agriculture), bringing expertise in this area from the federal to the state level.

• Create and manage a centralized database of agricultural and weather statistics, and make the database available to financial institutions.

• Promote innovation among insurance companies and financial institutions, and access to international best practice through training courses, operations manuals, and other means.

• Provide a conducive regulatory framework for agriculture financing.

**Layer 3 (Low-frequency/High-consequence events)**

• Use risk financing/transfer instruments as appropriate for large systemic negative shocks (weather derivatives, insurance, catastrophe bonds, contingency credit lines, stabilization funds, etc.) to support vulnerable farmers through public programs.

• Implement social safety networks (conditional cash transfer programs) and effective reconstruction and rehabilitation programs.

• Implement rapid ex-post farmer support delivery mechanisms to respond to catastrophic events.

**Public Risk-Mitigation Measures**

Because Brazil is a federal state, all agricultural policies come from the central government. In addition, the Ministry of Agriculture works with the state-owned Banco do Brazil, which is responsible for most agricultural credit and agricultural insurance. State institutions for agricultural policy are charged primarily with implementation and research. Santa Catarina State Agricultural Research and Rural Extension Agency (EPAGRI) is the main institution responsible for the day-to-day agricultural sector operations. Other important state agencies include the Center for Monitoring and Analyzing Agricultural Production and Public Policies (CEPA) and the Center for Information on Natural Resources and Hydrometeorology (CIRAM). EPAGRI also works in direct coordination with farmers, farmers’ cooperatives, and all the municipalities of the state. EPAGRI has focused mainly on droughts and floods.

**Private Risk-Mitigation Measures**

In addition to government-funded preventive measures, farmers take other actions to protect themselves from weather risks. One traditional method is the diversification of income. Farmers in Santa Catarina often cultivate several crops with different growth and harvest cycles. When drought does occur it may damage some crops but it is unlikely to last long enough to affect all crops. Moreover, many farmers also farm animals, especially cows, pigs, chickens, and turkeys as a savings mechanism against the whims of the weather. More modern initiatives include the purchase of genetically modified drought-resistant seeds. The Brazilian Agricultural Research Corporation (EMBRAPA) has long been working on genetically modified seeds that can survive with lower amounts of rainfall. However, despite the fact that many farmers now use these drought resistant varieties, a severe drought can still wipe out more than half of a harvest.

**Weather Risk Transfer Programs**

Weather risk transfer programs supported by the federal government usually come in the form subsidies to agriculture insurance policies. For instance, it is mandatory for any farmer who wishes to take out a loan from Banco do Brasil to purchase insurance covering the whole amount borrowed. This linkage between rural credit and insurance prevents weather shocks from having a spike in agriculture credit default rates, while maintaining the credit worthiness of farmers. The following programs have been implemented by the federal government in order to reduce the financial vulnerability of small farmers:
• The Agricultural Guarantee Program (PROAGRO): Created in 1973 and implemented in 1975, the purpose of PROAGRO was to guarantee that farmers will repay their entire financial debt, in the eventuality of losses caused by adverse climate conditions and diseases.

• PROAGRO PLUS: Created in 2004, PROAGRO PLUS is similar to PROAGRO, but offers additional direct compensation to farmers for lost revenue.

**Going Forward: Improving the Management of Weather Risks**

Currently, Santa Catarina does not have explicit programs to cope with weather risks. Response to floods have been ad-hoc and not designed ex-ante. The state government is now considering moving towards a comprehensive water management strategy and planning in order to address all dimensions of weather risk management in the state.

Given the small size of most farms in Santa Catarina and that only one-third of family farms are covered through PROAGRO, alternative approaches should be evaluated in order to ensure that farmers do not undergo a process of de-capitalization and loss of competitiveness as a result of adverse weather events. Further investments in irrigation and the development of a medium to long term strategy of water resources are required. Current risk transfer policies and programs of the state of Santa Catarina rely heavily on federal programs such as PROAGRO. Some recommendations include:

• Take advantage of the present structure of PROAGRO PLUS (farmers are already paying part of the premium) and structure additional state-level support.

• Conduct further studies and incentivize (if the studies’ results are conclusively positive) the implementation of new weather risk management instruments with the potential for reaching small farmers, such as index-based insurance.

Currently, the state government does not use financial risk transfer instruments or strategies to hedge fiscal exposure to weather events. Farmers absorb the risk or rely on federal government support. State-level risk management transfer instruments, such as contingent credit lines, weather derivatives, insurance will improve the management of fiscal exposure to weather events and allow for rapid and quick response in support of the most vulnerable farmers.

To enhance weather risk management beyond the current programs in place, further recommendations include developing a public sector agriculture risk strategy, with a financing plan for hedging public expenditures against systemic shocks (commodity prices, droughts). This strategy can include the need to hedge the state budget’s exposure against extreme weather events by establishing an emergency fund financed by a layered risk structure. Finally, the state could structure a disaster response program and promote the use of agricultural insurance by making farmers aware of the benefits of investing resources in *ex ante* risk management strategies.

**Bibliography**


**About the Authors**

Diego Arias Carballo is a Senior Agriculture Economist in the Agriculture and Rural Development Department (LCSAR); Juan José Leiva is pursuing a Master’s degree in Public Policy at Princeton University; Abdoulaye Sy is a Young Professional in the Poverty Reduction and Economic Management Vice Presidency (MNSED); Nouhoum Traore and Federico Manfredi are pursuing Master’s degrees in Public Policy at Harvard University.