



Risk Management in Brazilian Agriculture: Instruments, Public Policy, and Perspectives

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LIST OF ACRONYMS

ABGF - Brazilian Guarantee Funds and Guarantee Management Agency (*Agência Brasileira Gestora de Fundos Garantidores e Garantias*)

ARC - Agricultural Risk Coverage

CADENA - Natural Disaster Assistance Program For the Agricultural and Fishing Sector (*Componente de Atención de Desastres Naturales en el Sector Agropecuario y Pesquero*)

CAP - Common Agricultural Policy

CMN - National Monetary Council (*Conselho Monetário Nacional*)

CONAB - National Company of Supplying (*Companhia Nacional de Abastecimento*)

CPI - Climate Policy Initiative

CPR - Rural Product Note (*Cédula de Produto Rural*)

EAGF - European Agricultural Guarantee Fund

EMBRAPA - Brazilian Agricultural Research Corporation (*Empresa Brasileira de Pesquisa Agropecuária*)

ENESA - State Agricultural Insurance Entity (*Entidade Estatal de Seguros Agrários*)

EU - European Union

FAO - Food and Agriculture Organization

FCIC - Federal Crop Insurance Corporation

FESR - Rural Insurance Stability Fund (*Fundo de Estabilidade do Seguro Rural*)

FNGCA - National Guarantee Fund for Farming Calamities (*Fonds National de Garantie des Calamités Agricoles*)

FNGRA - National Fund for Risk Management in Agriculture (*Fonds National de Gestion de Risques en Agriculture*)

IBGE - Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*)

INCRA - National Institute for Colonization and Agrarian Reform (*Instituto Nacional de Colonização e Reforma Agrária*)

IPCA - Extended National Consumer Price Index (*Índice Nacional de Preços ao Consumidor Amplo*)

MAPA - Ministry of Agriculture, Livestock and Supply (*Ministério da Agricultura, Pecuária e Abastecimento*)

MATOPIBA - Maranhão, Tocantins, Piauí and Bahia

NASS - National Agriculture Statistical Service

OEPA - State Agricultural Research Organizations (*Organizações Estaduais de Pesquisa Agropecuária*)

PAM - Municipal Crop Production (*Produção Agrícola Municipal*)

PAP - Crops and Livestock Plan (*Plano Agrícola e Pecuário*)

PGPM - Minimum Price Guarantee Policy (*Política de Garantia de Preços Mínimos*)

PLC - Price Loss Coverage

PROAGRO - Agricultural Activity Guarantee Program (*Programa de Garantia da Atividade Agropecuária*)

PRONAF - National Plan for Family Farming (*Programa Nacional de Fortalecimento da Agricultura Familiar*)

PSR - Rural Insurance Premium Subsidies Program (*Programa de Subvenção ao Prêmio do Seguro Rural*)

PUC-Rio - Pontifical Catholic University of Rio de Janeiro (*Pontifícia Universidade Católica do Rio de Janeiro*)

R&D - Research and Development

RECOR - Common Record of Rural Operations (*Registro Comum de Operações Rurais*)

RMA - Risk Management Agency

SICOR - System of Rural Credit and PROAGRO Operations (*Sistema de Operações do Crédito Rural e do PROAGRO*)

SNPA - National Agricultural Research System (*Sistema Nacional de Pesquisa Agropecuária*)

SUSEP - Superintendence for Private Insurance (*Superintendência de Seguros Privados*)

US - United States

USDA - U.S. Department of Agriculture

SAB - Basic Crop Insurance (*Seguro Agrícola Básico*)

ZARC - Agricultural Climate Risk Zoning (*Zoneamento Agrícola de Risco Climático*)

EXECUTIVE SUMMARY

Rural producers face a wide range of adverse events that expose them to potentially heavy losses. In agriculture, both natural risks - such as droughts, floods, pests, diseases, and fires - and market risks - such as price variation - are frequent. While the modernization of the agricultural sector leads to commodity specialization and the adoption of technologies with higher expected returns, it may also result in a larger production variance, creating more uncertainty and increasing producers' exposure to risk (See Dercon and Christiaensen, 2011). Modernization has accelerated in Brazil in recent years, raising the importance of risk management instruments.

Brazil has a large potential for improving risk coverage opportunities for its producers, which will be even more essential in the face of climate change. Improving risk management practices and public policies could accelerate the process of modernization and sustainability in Brazilian agricultural production. Government incentives require a design crafted to meet producers' needs. In this report, Climate Policy Initiative/Pontifical Catholic University of Rio de Janeiro (CPI/PUC-Rio) researchers analyze the current risk management instruments and public policies and discuss pathways for improving their impact on Brazilian agriculture.

This report discusses the strengths and shortcomings of the main public policies regarding agricultural risk management, highlights the potential for rural insurance growth, and outlines steps for the future. It brings together data from SUSEP, the Ministry of Agriculture (Ministério da Agricultura, Pecuária e Abastecimento - MAPA), the Central Bank of Brazil, and other relevant sources. The empirical analysis aims to provide a better understanding of the current state and recent trends of agricultural risk management in Brazil and to identify how to better tailor public policies.

In Brazil, the modernization of agriculture in the past decades has led to the conversion of pasture to cropland, reducing deforestation pressure associated with the expansion of agricultural land. The continuation of this process requires additional investments in intensification and productivity, particularly in pastureland, so that increases in livestock production do not require area expansion. Simultaneously, the conversion of pastures to cropland significantly alters a business' risk profile, since crops are more susceptible to climate variations. Livestock farming is generally more resilient in the face of the unforeseen events that often impact rural activities. Specialization of cultures, adoption of new technologies, and sustainable production methods lead to higher expected returns but may cause greater uncertainty in results. Thus, to encourage producers to adopt such practices, their exposure to risk needs to be addressed. That is why the modernization of the agricultural sector enhances the importance of better opportunities for producers to manage their risks.

Market failures in rural insurance have broad consequences leading to underinvestment, less efficient agricultural production, and adverse land use impacts. Producers with inadequate risk management tools often make poor production decisions, such as avoiding crop specialization or the adoption of new technologies that can subsequently increase their exposure to risk. That is, producers will often avoid engaging in activities that have higher expected profits but more uncertainty in returns as a way to self-insure against both natural

and price risks. This behavior has negative effects on agricultural productivity and land use, with important consequences for forests and the environment.

In Brazil, rural insurance and other tools for agriculture risk management is scarce and difficult to access in many regions (see Box 1 for an overview of Brazil's risk management instruments). In 2018, almost 60% of the country's municipalities had no rural insurance contracts (for crop, livestock, or forest), according to the Superintendence for Private Insurance (Superintendência de Seguros Privados - SUSEP).¹ Moreover, few crops in Brazil are insured, and soy is most frequently covered (32% of crop insurance contracts in SUSEP). Nevertheless, the Brazilian rural insurance market recently experienced significant growth. The rural insurance premium increased from R\$88.2 million in 2006 to R\$2 billion in 2018, corresponding (adjusted for inflation) to a twelve-fold increase (SUSEP).² Life insurance for rural producers makes up 20% percent of all rural insurance premiums, though this type of insurance does not have a direct impact on production choices.

Only a few companies dominate Brazil' rural insurance market. In the 2019/20 agricultural year, one company represented 52.3% percent of the market and only 14 insurers total were present during that year, according to data from SUSEP.³ Public policy should provide incentives to reduce market concentration, increase competition among firms, and, consequently, increase the variety of risk management instruments available to rural producers.

The remainder of this report proceeds as follows. Following this Executive Summary, Box 1 gives a brief description of Brazil's risk management instruments. The main recommendations for improving Brazil's agricultural risk management policies are highlighted next. Section 1 starts the analysis of risk management instruments in Brazil, exploring the data from SUSEP. Section 2 discusses the four main public policies for Brazilian producers: PSR, PROAGRO, *Garantia-Safra*, and PGPM. Section 3 describes the Agricultural Climate Risk Zoning (*Zoneamento Agrícola de Risco Climático* - ZARC). Section 4 presents the Brazilian reinsurance market and the Rural Insurance Stability Fund (FESR). Section 5 reviews the economic literature on how risk management instruments impact agricultural activity and land use in Brazil and other developing countries. Section 6 makes an international comparison of insurance coverage and policies. Finally, Section 7 discusses the pathways ahead and suggestions to improve Brazil's risk management instruments and public policies.

1 SUSEP is the agency responsible for the insurance and reinsurance market regulations in Brazil.

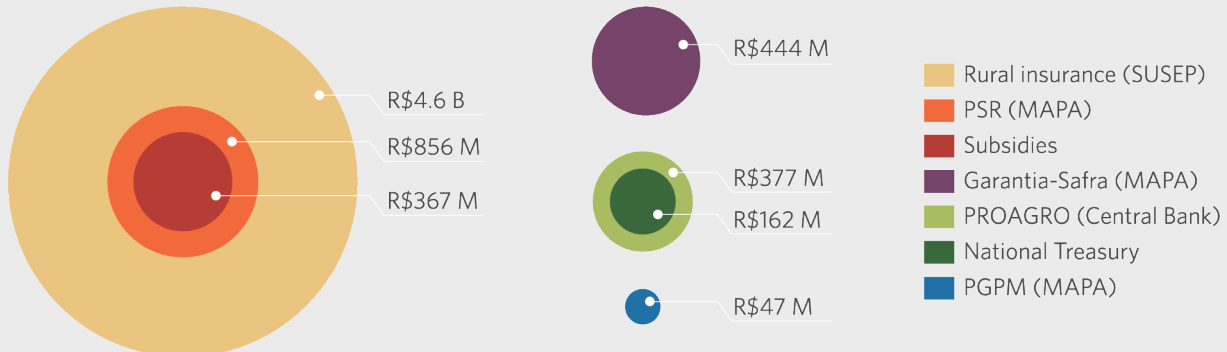
2 Adjusting by inflation using the Extended National Consumer Price Index (*Índice Nacional de Preços ao Consumidor Amplo* - IPCA), the R\$88.2 million in 2006 correspond to R\$172.8 million in December 2018.

3 These numbers correspond to rural insurance in the categories of agriculture, livestock, and forestry.

BOX 1. BRAZIL'S RISK MANAGEMENT INSTRUMENTS

Brazil's agricultural producers can access crucial risk management instruments and count on relevant insurance programs offered by the government. However, these instruments and programs are limited in size and scope and do not provide the range of risk management options for producers to make decisions that lead to efficient farming practices. Figure 1 shows the main risk mitigation instruments in Brazil in 2018. Among the total amount of rural insurance premiums⁴ in SUSEP in 2018 (R\$4.6 billion), R\$2.1 billion represents crop, livestock, or forest insurance, which are categories potentially eligible for subsidies in the scope of the Rural Insurance Premium Subsidies Program (*Programa de Subvenção ao Prêmio do Seguro Rural* - PSR). Of those R\$2.1 billion in 2018, R\$856 million were subsidized by PSR. The total subsidy amount was R\$367 million, and the production value insured was R\$12.3 billion. For the same year, the insurance premiums subsidized by the Agricultural Activity Guarantee Program (*Programa de Garantia da Atividade Agropecuária* - PROAGRO) - a rural insurance that protects producers from losses caused by natural events and covers financial obligations related to rural credit for operational costs - were R\$377.2 million. The total production value covered under this program reached R\$13.4 billion. The Harvest Guarantee Program (*Garantia-Safra*), a program to support family farming affected by losses caused by droughts and floods, paid R\$444 million in the agricultural year 2017/18. Finally, the Minimum Price Guarantee Policy (*Política de Garantia de Preços Mínimos* - PGPM), a policy to correct price distortion to producers, paid R\$47 million in 2018.⁵

Figure 1. Structure of Agriculture Risk Management Instruments in Brazil, 2018



Note: Data include all types of rural insurance. All data on insurance programs and subsidies correspond to the 2018 calendar year, with the exception of *Garantia-Safra* that corresponds to the 2017/18 agricultural year.

Source: Climate Policy Initiative with data from MAPA, SUSEP, and SICOR

Risk management programs historically receive considerably fewer public resources than rural credit programs. Nearly R\$225.6 billion were allocated to rural credit programs in the 2019/20 agricultural year through the Crops and Livestock Plan (*Plano Agrícola e Pecuário* - PAP) and the National Plan for Family Farming (*Programa de Fortalecimento da Agricultura Familiar* - PRONAF). The cost of subsidies to rural credit programs is estimated to be approximately R\$10 billion per year. By comparison, according to the Central Bank of Brazil, the National Treasury allocated R\$161.5 million to PROAGRO in 2018. Also, the average subsidy of PSR from 2010 to 2019 was around R\$383.6 million. However, for the 2019/20 and the 2020/21 agricultural years, increases in PSR funding were announced, reaching R\$1.0 billion and R\$1.3 billion, respectively.

⁴ Total premium values are the net premium (what is paid by producers) plus government subsidies.

⁵ In 2018, the only product that had support for commercialization was rice (MAPA, 2020).

RECOMMENDATIONS FOR IMPROVING BRAZIL'S AGRICULTURAL RISK MANAGEMENT POLICIES

- Strengthen the recent expansion of the Brazilian insurance market in terms of the number of insurance policies, the geographical distribution, and the variety of instruments available.
- Increase the number of companies operating in the rural insurance market to reduce market concentration, increasing the role of private insurers.
- Develop risk management instruments that meet the agriculture sector's needs and expand farmers' knowledge of these products to increase the demand for insurance.
- Construct an integrated data system with agricultural potential, soil types, agricultural risks, and producer risks, as well as other relevant information. This data should help to expand insurers' operations.
- Reframe rural finance instruments and redirect public resources from credit toward insurance policies, more specifically, expanding PSR's beneficiaries. The migration of public resources from the credit channel to the promotion of risk management instruments and financial derivatives should have a long-term perspective to avoid disruptions to the agricultural sector.
- Promote the expansion of the agricultural price insurance market. Incentivize market-based instruments, such as selling options specifically targeted at price risk.
- Invest in Agricultural Climate Risk Zoning (ZARC) and agricultural Research and Development (R&D).
- Place greater emphasis on integrated risk management to support agriculture.

1. RISK MANAGEMENT IN BRAZIL: OVERVIEW

This section analyses the structure of risk management instruments in Brazil. Table 1 illustrates the distribution of insurance premiums paid for different types of rural insurance in the Brazilian market in 2018, according to data from SUSEP and the Ministry of Agriculture (for PSR). Crop insurance represents a significant part of the insurance coverage, totaling 46% of the insurance market. PSR covers crop, livestock, and forest insurance, but 99% of PSR's insurance coverage corresponds to crop insurance. While not benefitting from governmental programs, Rural Pledge Insurance, Farm Owners Multiple Peril (includes farming and cattle products), and Rural Producer Life Insurance correspond to more than half of the rural insurance premiums paid in 2018, representing R\$2.4 billion.

Table 1. Rural Insurance Modalities in Brazil, 2018⁶

Insurance Types	Total Insurance Premium (2018)	% of Rural Insurance Value (Premium)	Description of Coverage
Crop Insurance	SUSEP: R\$2.1 billion PSR: R\$424.8 million (net premium) R\$318 million (subvention)	SUSEP: 45.8% PSR: 99% (net premium) 99% (subvention)	Agricultural crops in the case of losses generated by climatic shocks, covering the entire plant life cycle.
Livestock Insurance	SUSEP: R\$5.7 million PSR: R\$788,974 (net premium) R\$645,522 (subvention)	SUSEP: 0.1% PSR: 0.2% (net premium) 0.2% (subvention)	Animals for consumption and/or production; work animals, used for transportation and traction work in the property; and animals used for breeding.
Forest Insurance	SUSEP: R\$20 million PSR: R\$1.7 million (net premium) R\$942,678 (subvention)	SUSEP: 0.5% PSR: 0.3% (net premium) 0.3% (subvention)	Damage caused to insured forests; protecting against fire; diseases; pests with no methods of combat, control, or prophylaxis; climate adversities.
Rural Pledge Insurance	SUSEP: R\$1.2 billion	SUSEP: 26%	Goods directly associated with agricultural activities and included as a guarantee for rural credit operations.
Farm owners Multiple Peril (Includes Farming and Cattle Products)	SUSEP: R\$328 million	SUSEP: 7.3%	Goods directly associated with agricultural activities, not including goods that appear as a guarantee for rural credit operations.
Rural Producer Life Insurance	SUSEP: R\$906 million	SUSEP: 20.1%	Producers who are debtors of rural credit, amortizing, or settling their financial obligations in case of death.
TOTAL	SUSEP: R\$4.6 billion PSR: R\$488.1 million (net premium); R\$367.4 million (subvention)		

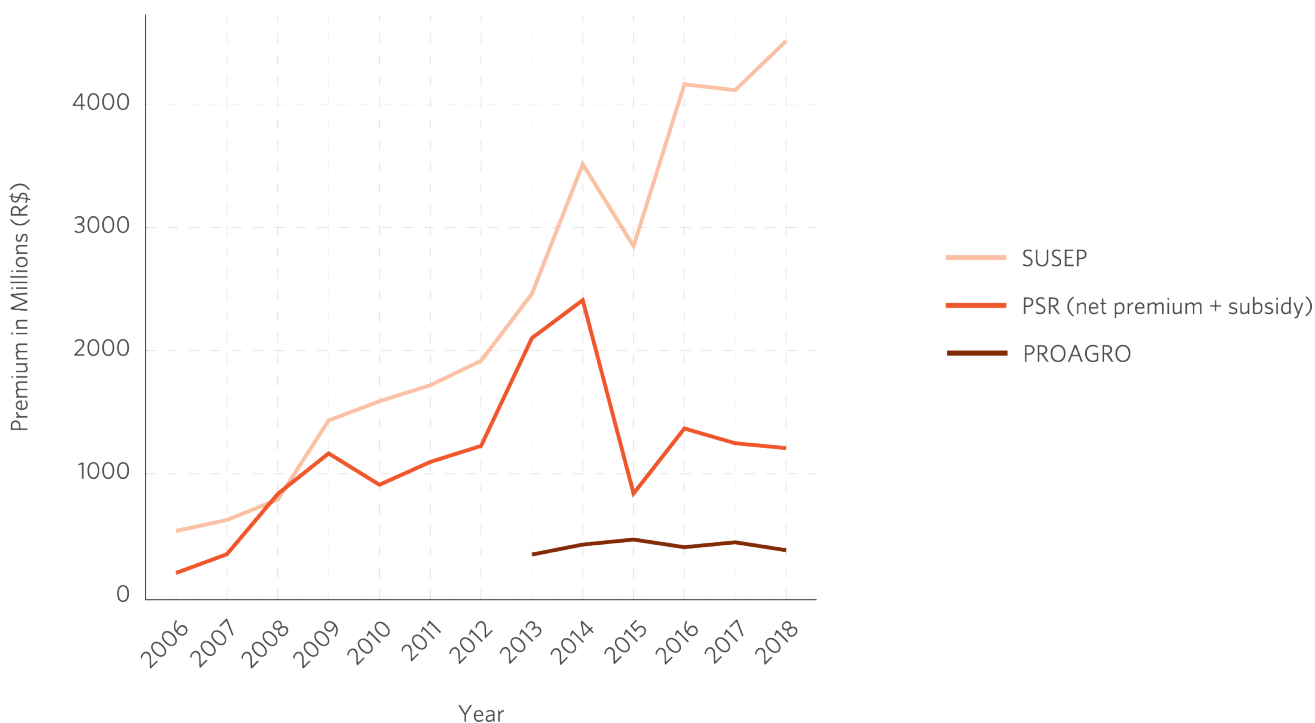
Note: PSR data from MAPA used for this data contain a discrepancy - total values for net premium and subvention are greater than the sum of net premiums and subvention values for crop, livestock, and forest insurance.

Source: Climate Policy Initiative with data from MAPA and SUSEP

⁶ Two other modalities (i) aquaculture insurance, and (ii) rural producer notes (*Cédula de Produtor Rural - CPR*) are not mentioned in the table because there were no positive values found for the premiums of these categories in 2018.

In recent years, Brazil’s rural insurance market has been expanding markedly. Figure 2 shows the evolution of premiums from 2006 to 2018. Overall, insurance reported through SUSEP had a sharp increase (2015 is the only year with a drop). PSR amounts in the figure represent the total premium, which equals the net premium paid by producers plus government subsidies. PSR dropped in 2015 and did not return to the levels of the years 2013 and 2014 until 2018. The government announced it would invest R\$1 billion and R\$1.3 billion in subsidies in PSR insurance for the agricultural years 2019/20 and 2020/21, respectively. These totals represent the program’s highest amounts since its implementation in 2006. MAPA expects a production value of R\$58 billion and an area of 21 million hectares to be insured under PSR in the 2020/21 agricultural year, which would constitute records for the program. Finally, PROAGRO’s premiums, which are not reported in SUSEP data, have levels below PSR in the period analyzed, reaching R\$377.21 million in 2018.

Figure 2. Evolution of Brazil’s Insurance Market, 2006-2018



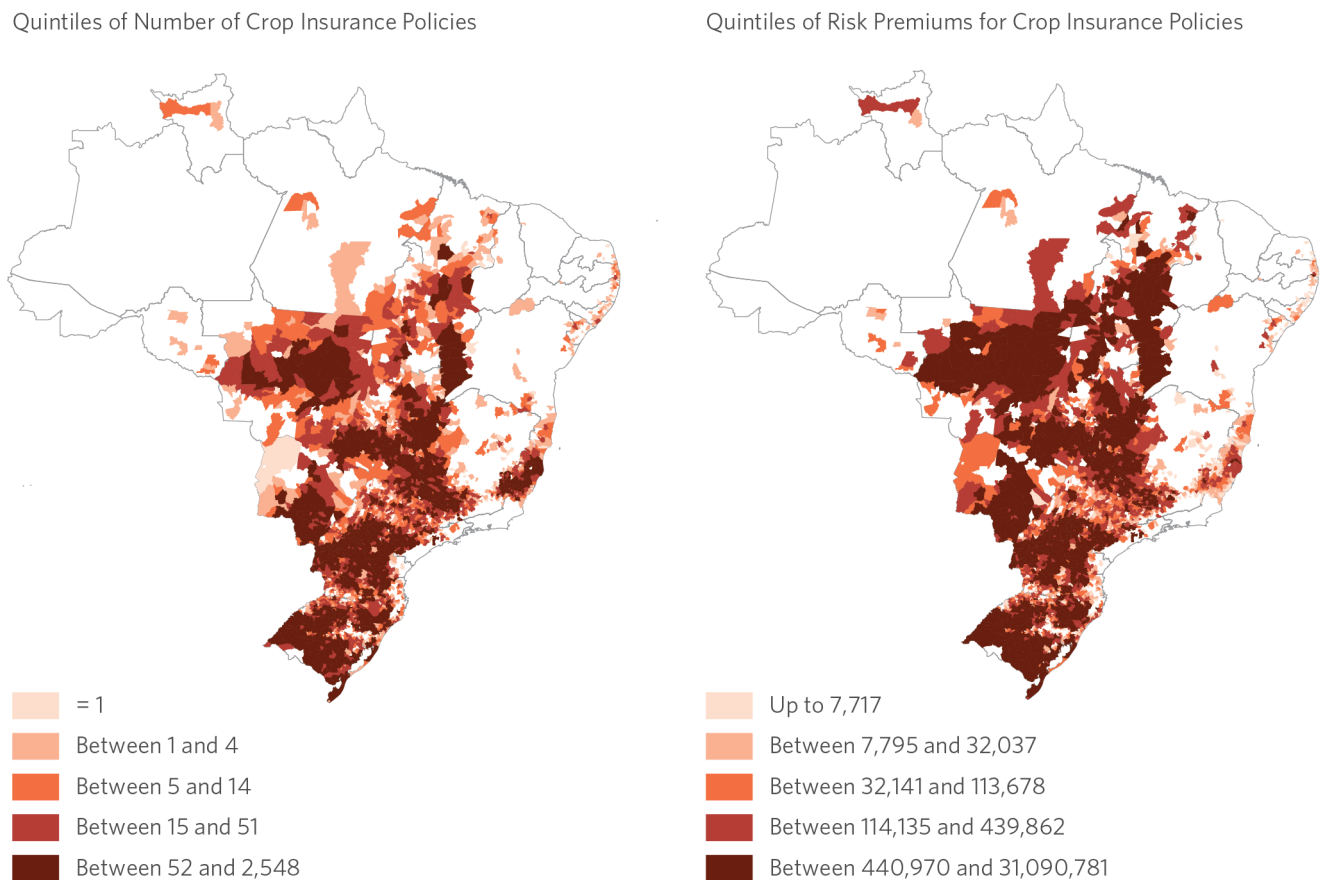
Note: Data considers crop, livestock and forestry insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from MAPA, SUSEP, and SICOR

Despite their growth, Brazil’s insurance programs receive much less funding than rural credit programs, and risk management instruments remain scarce. For the 2018/19 agricultural year, more than R\$225 billion were announced for rural credit through PAP and PRONAF (but R\$173.3 billion were, in fact, borrowed by producers). It is estimated that the government spends around R\$10 billion per year in subsidies to rural credit. Total rural insurance premiums in 2018 were around R\$5 billion. Of this value, R\$1.2 billion accounted for premiums that were subsidized either by PSR or PROAGRO. In the same period, the government spent R\$365 million in subsidies to the insurance premium in the scope of PSR. The National Treasury disbursed R\$162 million with PROAGRO and R\$47 million with PGPM in 2018. During the same period, *Garantia-Safra* had authorized benefits in the amount of R\$444 million.

Based on the analysis of the number of rural insurance policies and the risk premium amounts at the municipal level, large areas lack access to insurance products. Figure 3 shows the distribution of the number of policies and the risk premiums for crop insurance in 2018 using SUSEP data (which includes both subsidized and nonsubsidized policies). Only 41.5% of Brazilian municipalities have crop insurance contracts. Hence, producers outside the covered area may have to make inefficient decisions due to the scarcity of risk management instruments. Furthermore, even when considering only those municipalities that have at least one farmer with crop insurance, the first three quintiles (60% of the municipalities) have at most 14 insurance contracts and R\$113,678 in risk premiums.

Figure 3. Geographic Distribution of Crop Insurance in SUSEP, 2018

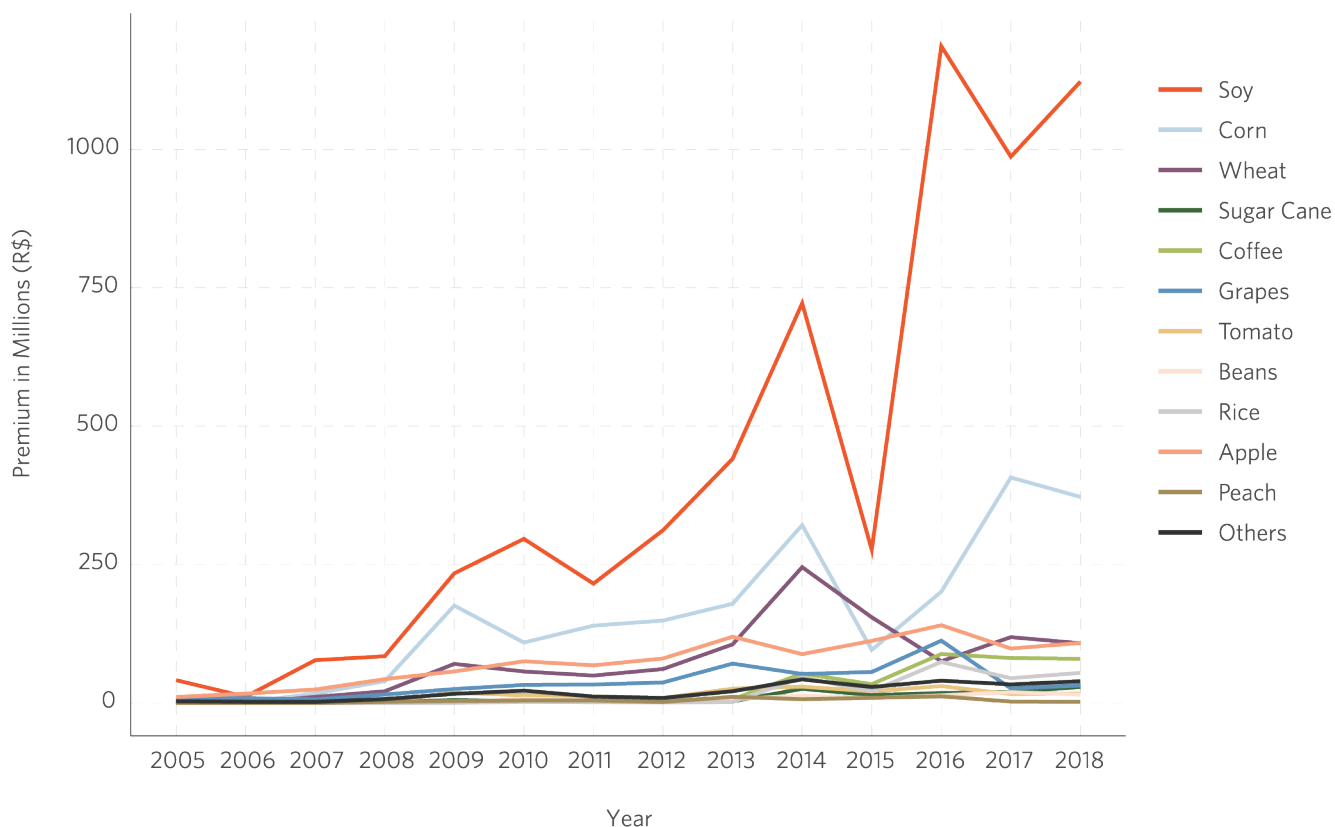


Note: Data restricted to crop insurance.

Source: Climate Policy Initiative with data from SUSEP

Figure 4 presents insurance premiums by crop and shows the growth of the market and the predominance of soy in SUSEP insurance data. Soy had the highest premiums for all years, with relevant participation of corn as well. For 2018, soy and corn comprised 37% and 11%, respectively, of the agricultural production value (PAM, 2017), while accounting for 57% and 21% of the crop insurance premium volume (SUSEP). Furthermore, of the 58 crops found in SUSEP, the eight most relevant crops represent 95% of crop insurance.

Figure 4. Evolution of Premiums by Agricultural Product in SUSEP, 2005-2018

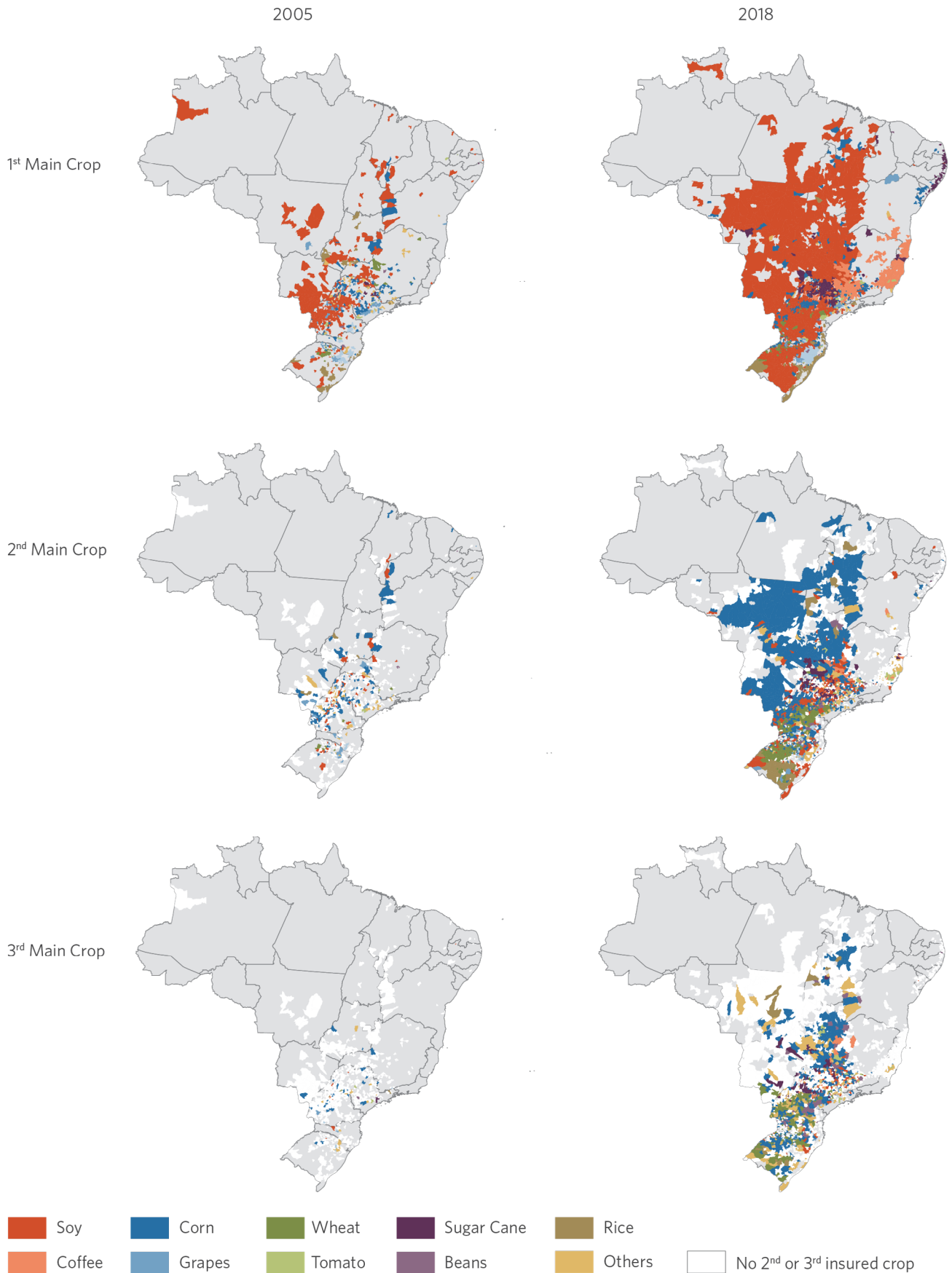


Note: Data considers crop, livestock and forestry insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from SUSEP

The geographical distribution of insurance contracts suggests relevant improvements in access in recent years. Figure 5 shows municipalities with insured crops in the years 2005 and 2018. It reveals a crucial geographical spread of the insurance market due to the expansion of the agriculture frontier toward Mato Grosso, Mato Grosso do Sul, Rio Grande do Sul, and MATOPIBA region (comprised of the states of Maranhão, Piauí, Tocantins, and Bahia). The crop insurance concentration of contracts is remarkable in most municipalities, with the majority of municipalities having at most two insured crops and a clear predominance of soy insurance.

Figure 5. Brazil's Main Crops with Insurance in SUSEP, 2005 and 2018

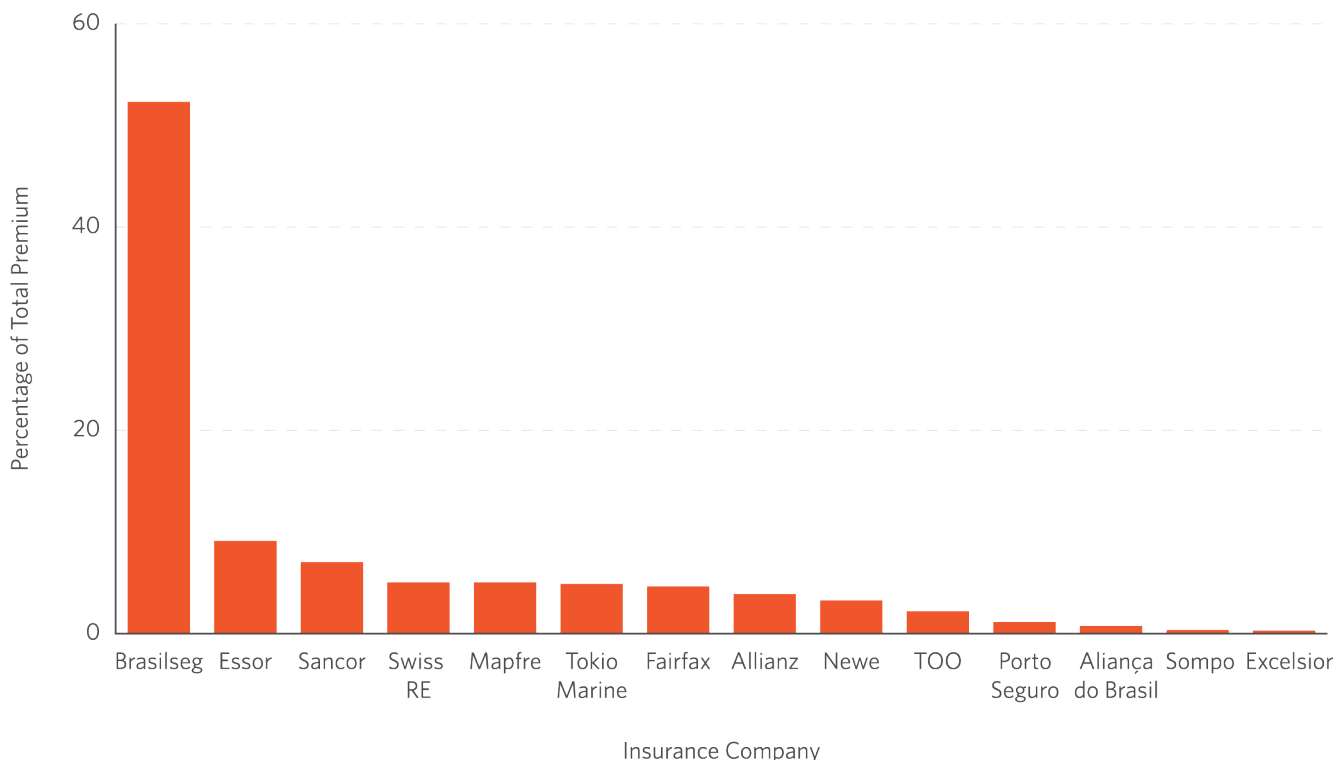


Note: Data restricted to crop insurance.

Source: Climate Policy Initiative with data from SUSEP

Brazil’s rural insurance market is also highly concentrated among a few companies. Figure 6 shows the market share of each insurance company in the total premiums focused only on rural insurances for agriculture, livestock, and forestry for the year 2019. Only 14 insurers were present during that year. One company - *Brasilseg Companhia de Seguros*⁷ linked to *Banco do Brasil* - represents more than 52.3% of the market share for rural insurance.

Figure 6. Brazil’s Total Premiums Percentage by Insurance Company in SUSEP, 2019



Note: Data considers crop, livestock and forestry insurance.

Source: Climate Policy Initiative with data from SUSEP

⁷ Brasilseg Companhia de Seguros encompasses Companhia de Seguros Aliança do Brasil after a corporate restructuring of the partnership maintained between BB Seguros, the holding company that concentrates Banco do Brasil’s insurance business, and MAPFRE Brasil. Brasilseg, through its insurance companies, operates in the Life, Housing, Rural, and Massified (Residential, Corporate, and Condominium) segments with products sold mainly at Banco do Brasil branches and on its digital channels.

2. BRAZIL'S PRIMARY RISK MANAGEMENT INSTRUMENTS AND POLICIES

This section describes each of Brazil's four insurance programs designed to protect producers from adverse shocks: Premium Subsidy Program (PSR), Agricultural Activity Guarantee Program (PROAGRO), *Garantia-Safra*, and Minimum Price Guarantee Policy (PGPM). Despite the important contributions of each of these programs to the marketplace, large holes remain in coverage needs.

2.1 PREMIUM SUBSIDY PROGRAM (PSR)

PSR's objective is to help farmers and producers mitigate the risks associated with their agricultural activity and ensure their financial recovery capacity in case of adverse climatic events. Through this program, the federal government subsidizes the cost of acquisition of rural insurance policy for producers. PSR is administered by MAPA. Decree No. 5,121 established the program in 2004, but it became effective in 2006. PSR is a public-private partnership program similar to the Federal Crop Insurance Program⁸ in the United States, which subsidizes the premiums to reduce the cost to farmers and encourage them to insure their crops.

PSR supports crop, livestock, and forest insurance. However, as Table 1 above shows, 99% of PSR subvention was used for crop insurance in 2018. The limits, for the year of 2018, of the subsidy were R\$72,000 for crop insurance and R\$24,000 for the others, with the possibility of producers accumulating subsidies in different categories. The proportion of the premium that can be subsidized varies according to the insurance category, type of product, and level of coverage acquired. In 2018, it ranged from 30% to 40%.

PSR allows the government to transfer the responsibility of compensation payments to the insurance companies while subsidizing the producers' premium. Private companies set the pricing for the risk, develop and sell the products, pay compensation, and insure or reinsure operations. Hence, the government is protected from moral hazard or collusion involving producers and insurance companies.

Figure 7 shows the evolution of the number of insurance policies and the average subsidy in PSR from 2006 to 2018. The number of insurance policies has increased from 21,783 in 2006 to 63,178 in 2018, despite some oscillation in a few of the years. After a significant drop during the economic crises of 2015, there was a subsequent slow recovery over the past three years. The average subsidy shows a consistent growth between 2006 and 2015, attaining its peak when the number of policies was at a historically low level.

⁸ In 2018, the Federal Crop Insurance Program directed more than USD 6.2 billion to subsidies, which comprised 63.3% of the total premiums.

Figure 7. Number of Insurance Policies and Average Subsidy Evolution in PSR, 2006-2018



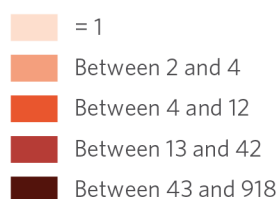
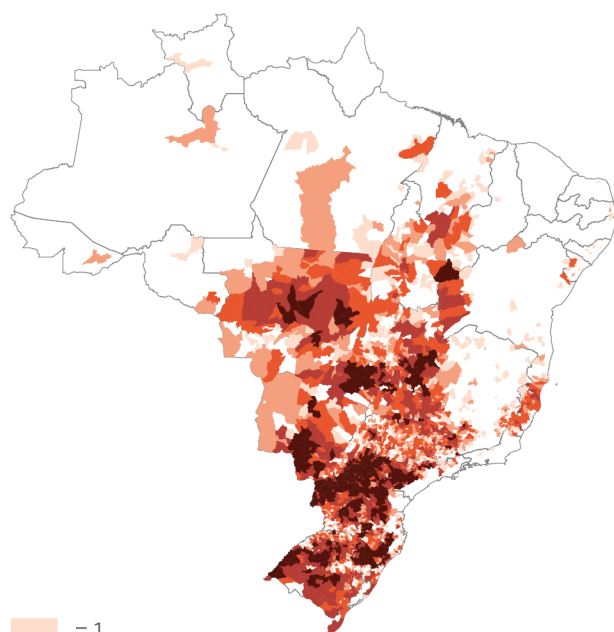
Note: Data considers crop, livestock and forestry insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from MAPA

PSR covers a limited range of municipalities, which is capped by the reach of the private companies who operate the insurance products. Figures 8 shows the geographic distribution of PSR in Brazilian municipalities, presenting the quintiles of the number of crop insurance policies and the risk premiums covered by the program in 2018. The first three quintiles (60%) have at most 12 insurance contracts and R\$144,508 in risk premiums when considering only those municipalities with at least one crop insurance contract. Therefore, there is a significant geographic concentration.

Figure 8. Geographic Distribution of PSR in Brazilian Municipalities, 2018

Quintiles of Number of Crop Insurance Policies



Quintiles of Risk Premiums in Crop Insurance

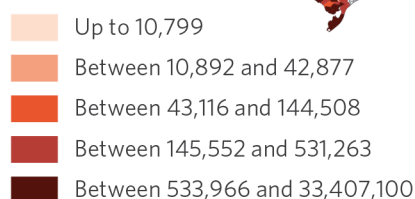
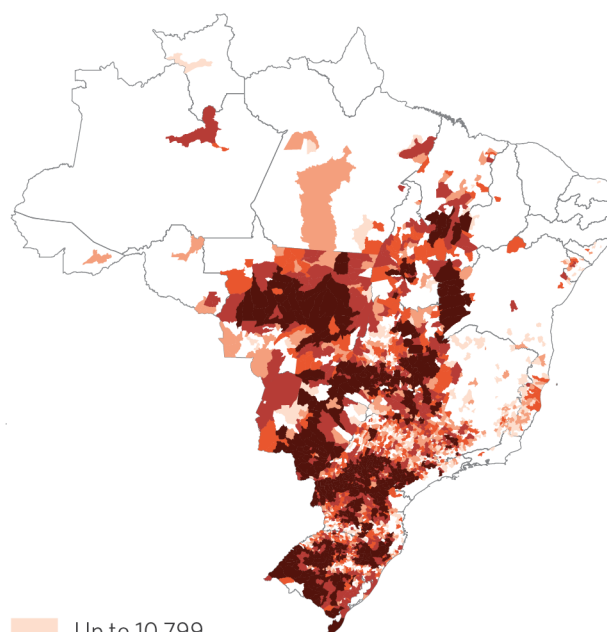
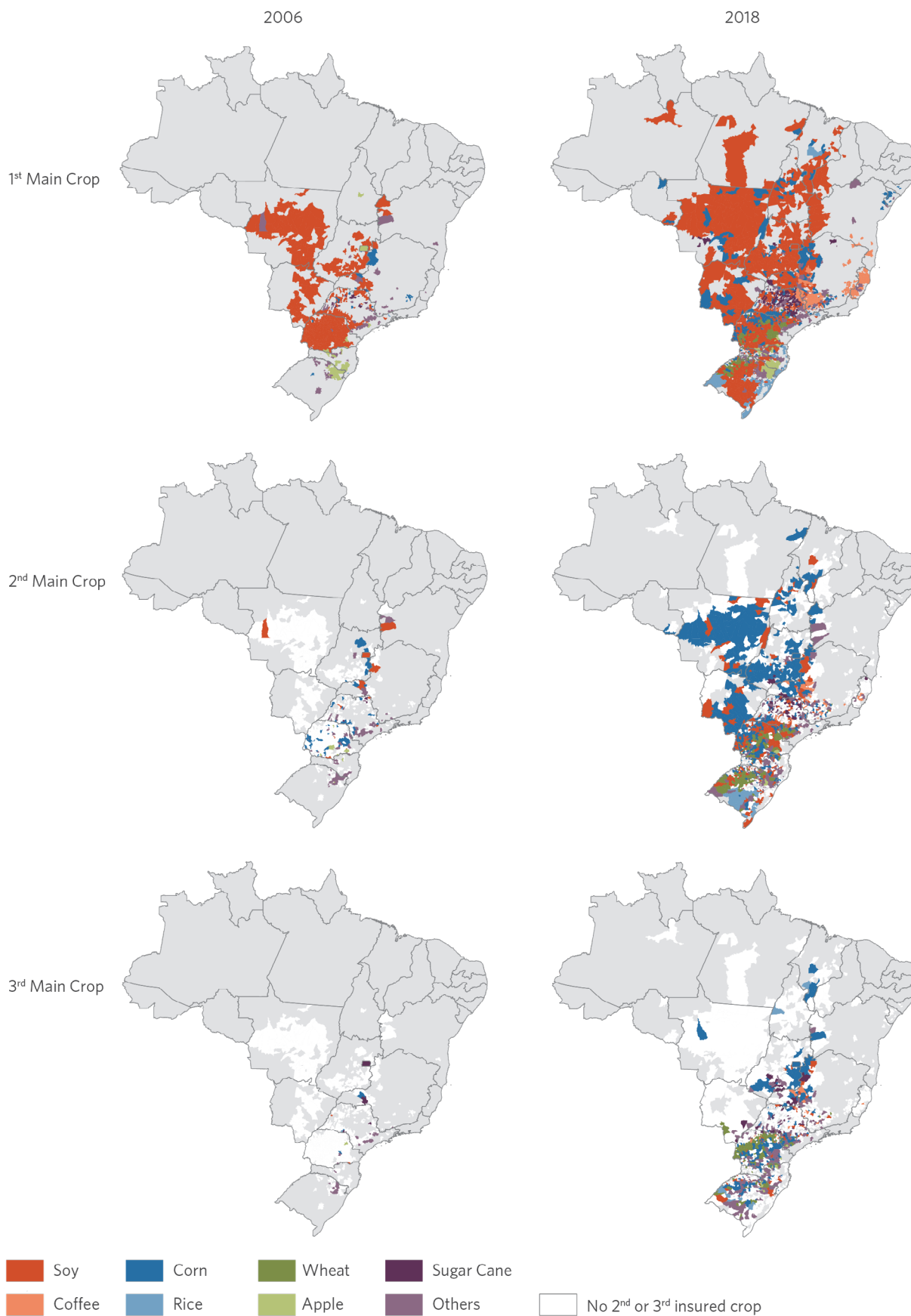
**Note:** Data restricted to crop insurance.**Source:** Climate Policy Initiative with data from SUSEP

Figure 9 shows the geographical distribution of PSR in 2006 and 2018. Similar to the insurance contracts reported in SUSEP, which include both subsidized and nonsubsidized crop insurance (see Figure 5 above), there is a prevalence of soy insurance for both years. There is also a geographical expansion, with a similar pattern linked to the agriculture frontier. In 2006, PSR directed its resources mainly to Paraná, Mato Grosso, Goiás, and São Paulo states. It also shows a rapid expansion through the Matopiba region and the states of Santa Catarina, Rio Grande do Sul, and Minas Gerais. The concentration of crop insurance for most municipalities is also noteworthy, with few municipalities having two or more crops with insurance subsidized by PSR.

Figure 9. Main Crops Subsidized in Brazil by PSR, 2006 and 2018

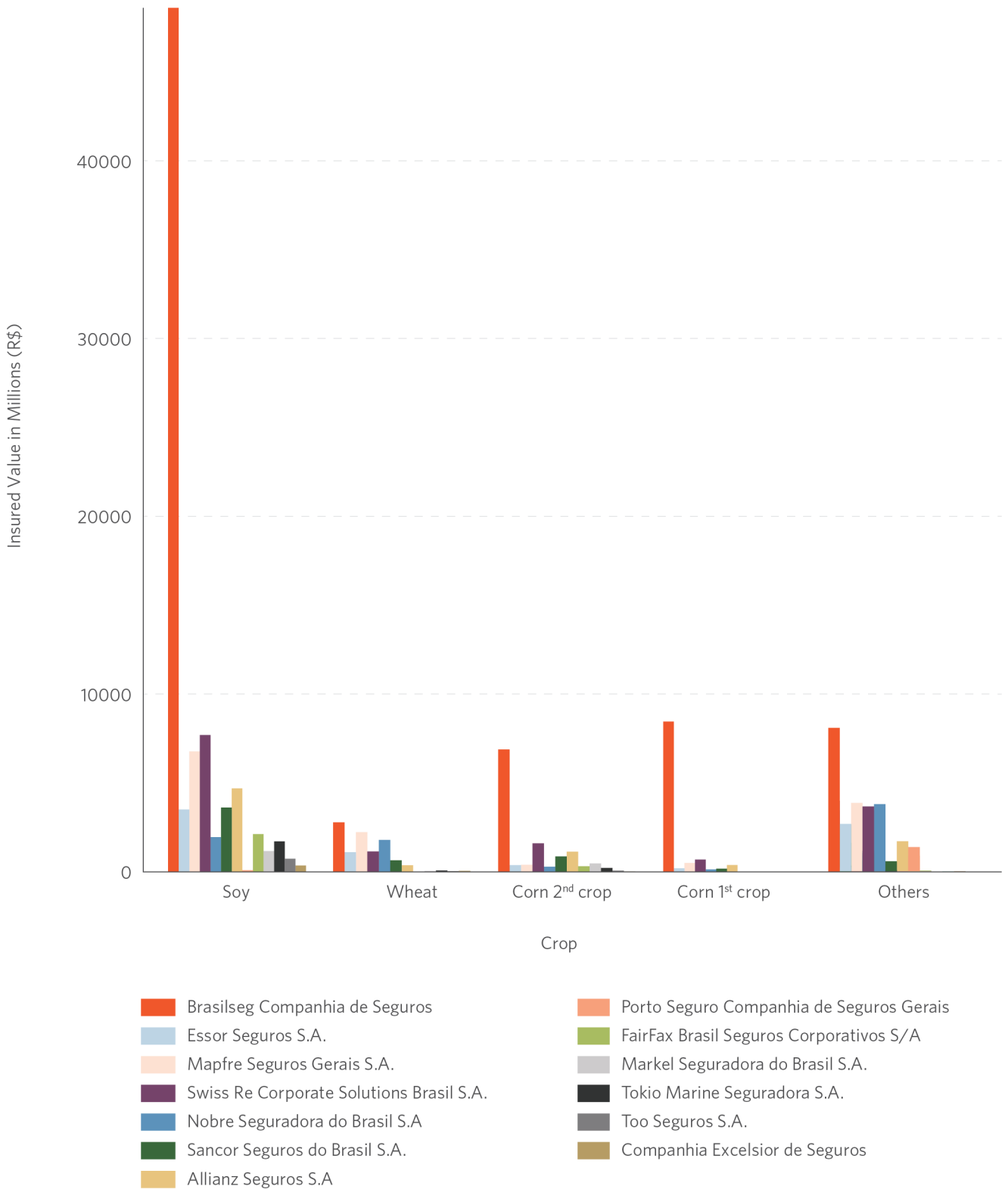


Note: Data restricted to crop insurance.

Source: Climate Policy Initiative with data from SUSEP

Figure 10 presents contracts by crop and insurance company for the 2006-2018 period, showing a considerable concentration of PSR resources in soybeans (49% of the insured value in these years). Corn and wheat crops are also a relevant part of the program.

Figure 10. Brazil's Insured Value by Company and Crop in PSR, 2006-2018



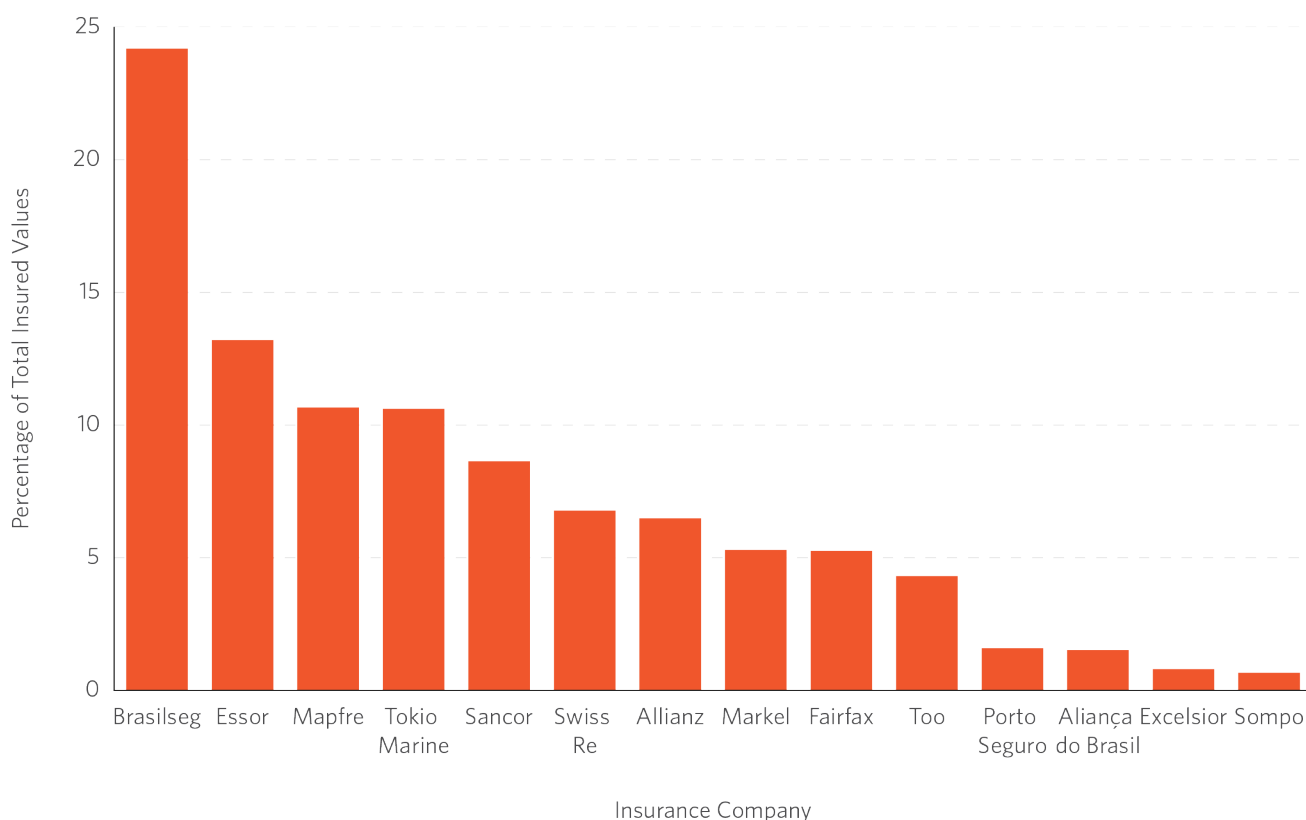
Note: Data restricted to crop insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from MAPA

Figure 11 shows the proportion that each insurance company represented of the total insured value within PSR in 2018. Figure 12 shows the main financial institutions for PSR at the municipal level for the same year. Even though insurance in PSR is more widely distributed than insurance reported in SUSEP (see Figure 6 above), the concentration remains high. The three biggest companies represent more than 60% of the insured value, and there are only eleven insurance companies for the program in that year.

PSR’s rules can explain the difference between the distribution among rural insurance companies for SUSEP and PSR. Producers interested in agricultural insurance policies supported by the PSR must contract the insurance with one of the private insurers. The insurers then apply for the subsidy to the federal government, and the policies contracted are evaluated by MAPA. The subsidy is conceded if resources are available, and the application follows the program’s requirements.⁹ Proposals are evaluated in rounds: when applying for a policy subsidy, an insurer needs to wait for all other insurers to apply for a policy subsidy until s/he can apply for a second one. This distribution process continues until the available resources are fully allocated. The insurer must deduct the amount identical to the subsidy from the premium amount charged; that is, the PSR resources must be used exclusively for the subsidy and cannot be used to cover administrative costs.

Figure 11. Brazil’s Proportion of Total Insured Value by Company in PSR, 2018



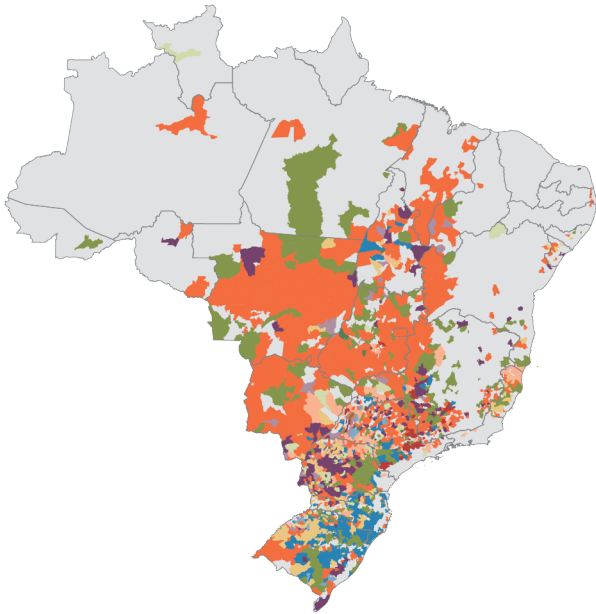
Note: Data considers crop, livestock and forestry insurance.

Source: Climate Policy Initiative with data from MAPA

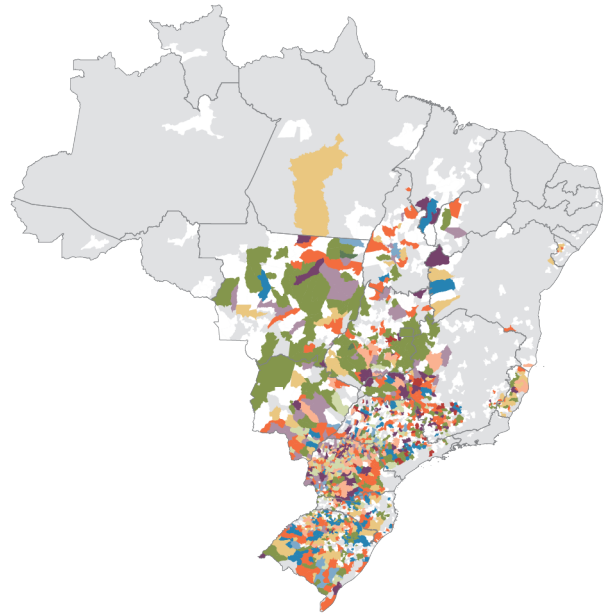
⁹ The requirements are (i) no debt with the federal government and (ii) the subsidy amount must be within the limits available for individuals / firms and the products contemplated.

Figure 12. Main Financial Institutions by Municipality in PSR, 2018

1st Financial Institution



2nd Financial Institution



3rd Financial Institution

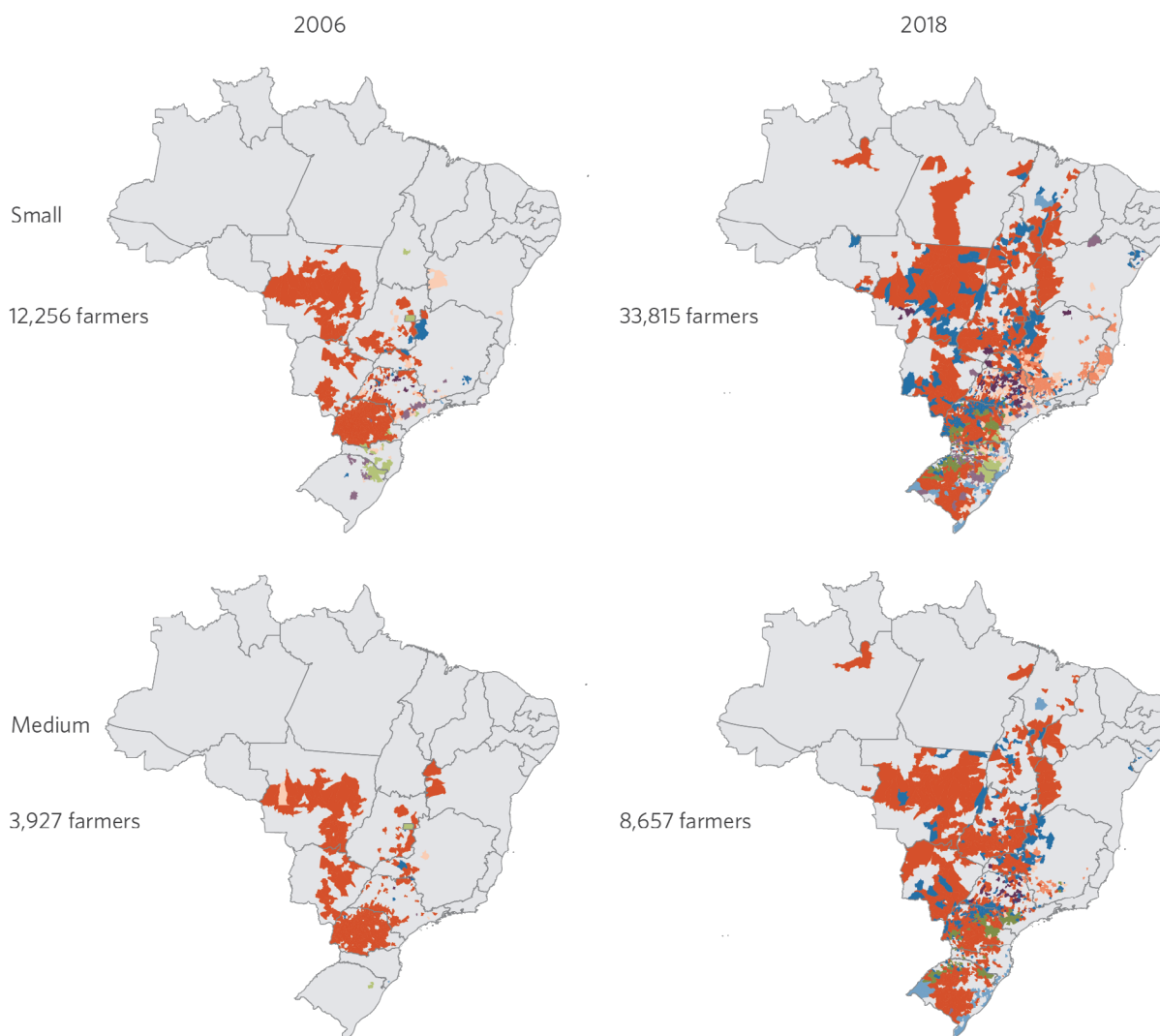


Note: Data considers crop, livestock and forestry insurance.

Source: Climate Policy Initiative with data from MAPA

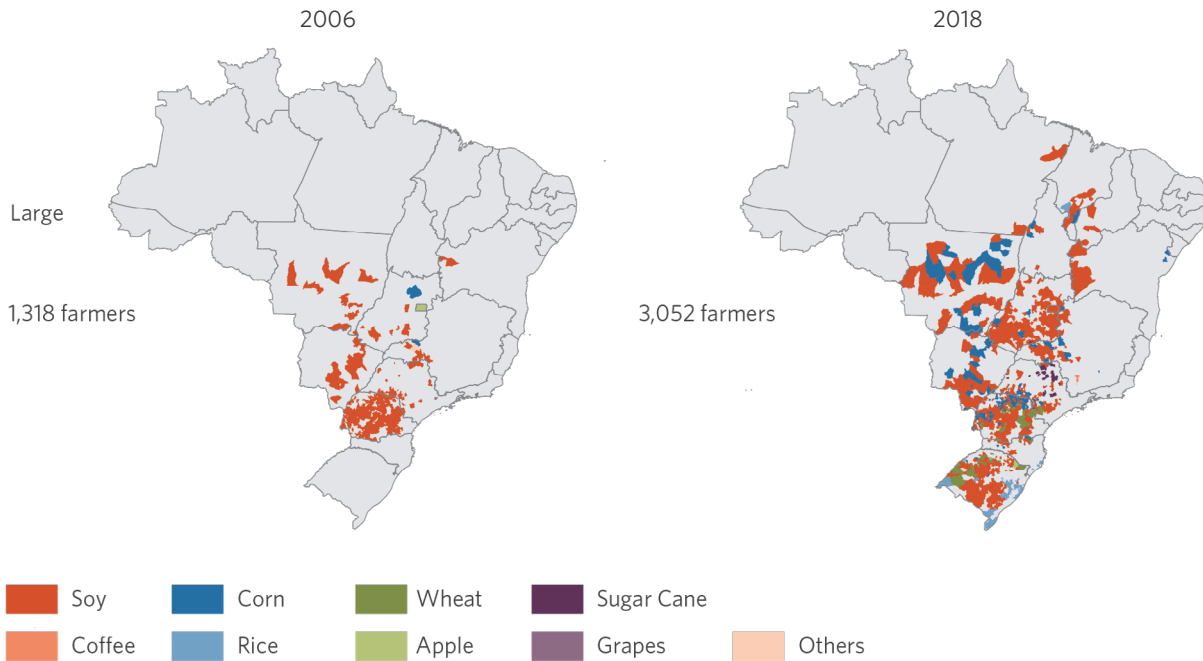
Observing PSR-subsidized insurance by the size of the rural producer gives relevant information on the program operation. Figure 13 shows the main crops cultivated in 2006 and 2018 by small producers (with lands up to four fiscal modules),¹⁰ medium producers (between four and 10 fiscal modules), and large producers (with more than 10 fiscal modules). In terms of the producers' profile, proportionally, small producers are the main program beneficiaries, with 48.5% of the total subsidy benefiting this group in 2018. For all sizes of producers, there is a great concentration in soy crops, especially in the Midwestern region of the country. In 2018, soy continued to be the predominant crop, but the diversification of crops over time is notable, becoming stronger, especially among small producers (shown by the expansion of corn, wheat, sugarcane, and coffee).

Figure 13. Main Crops Subsidized in Brazil by Producer Type in PSR, 2006 and 2018



*Figure 13 continues on the next page

¹⁰ The fiscal modules were defined by INCRA in the 1980s as “the minimum area where agricultural activity can provide, in each municipality, subsistence and social and economic progress to the families who invest their workforce in it.” There is a wide variation in the size of fiscal modules across the nation: they vary from five hectares to 110 hectares. The calculation of a fiscal module considers the prevalent type of land exploration in the municipality, the income obtained from the prevalent exploration, and other types of production in the municipality. Technology and farming practices have substantially improved productivity over the past 40 years, transforming unfertile areas into productive farms, but the size of each municipality’s fiscal module has remained the same.



Note: Data considers crop insurance.

Source: Climate Policy Initiative with data from MAPA

PSR coverage varies widely depending on the producer's profile. Figure 14 shows the evolution of the number of producers and average insured value by producer's type from 2006 to 2018. The proportion of small, medium, and large producers on the PSR program from 2018 is 74%, 19%, and 7%, respectively. The numerical concentration among small producers is evident for all observed years, but the large producers hold, on average, the highest insured value. According to the 2017 Agricultural Census (IBGE, 2017), there are 4,672,051 small rural establishments in Brazil. Therefore, less than 1% of small producers benefit from PSR. The proportion of medium and large producers in Brazil who access PSR is around 4%.

Figure 14. Number of Producers and Average Insured Value Evolution in PSR, 2006-2018



Note: Data considers crop, livestock and forestry insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from MAPA

2.2 AGRICULTURAL ACTIVITY GUARANTEE PROGRAM (PROAGRO)

PROAGRO protects farmers from risks associated with weather and climate-related occurrences, as well as pests and blight. Created in 1973, PROAGRO is an insurance subsidized by the federal government. PROAGRO insurance is restricted to production costs and acts in two ways: (i) it releases producers from their financial obligations related to rural credit for operational costs; and/or (ii) it compensates producers for their own resources used in operational expenses. Beneficiaries of the program include rural producers and cooperatives with agricultural operational costs, who pay premiums to enroll in the program.

The Central Bank of Brazil is responsible for managing the program's financial resources, elaborating its rules, supervising compliance, making requests for government resources, and submitting reports. To reach the rural regions, the financial institutions that operate rural credit play a central role in providing PROAGRO insurance. The financial institutions structure the operations involved in contracting the program, collect PROAGRO's part of the premium paid by beneficiaries, and transfer it to the Central Bank. They also receive loss communications from beneficiaries in case of an adverse event, activate the proof of loss monitoring service, judge coverage requests from beneficiaries, and calculate coverages to be deferred. The financial institutions then request to the Central Bank the reimbursement of the payments to be made by the program.

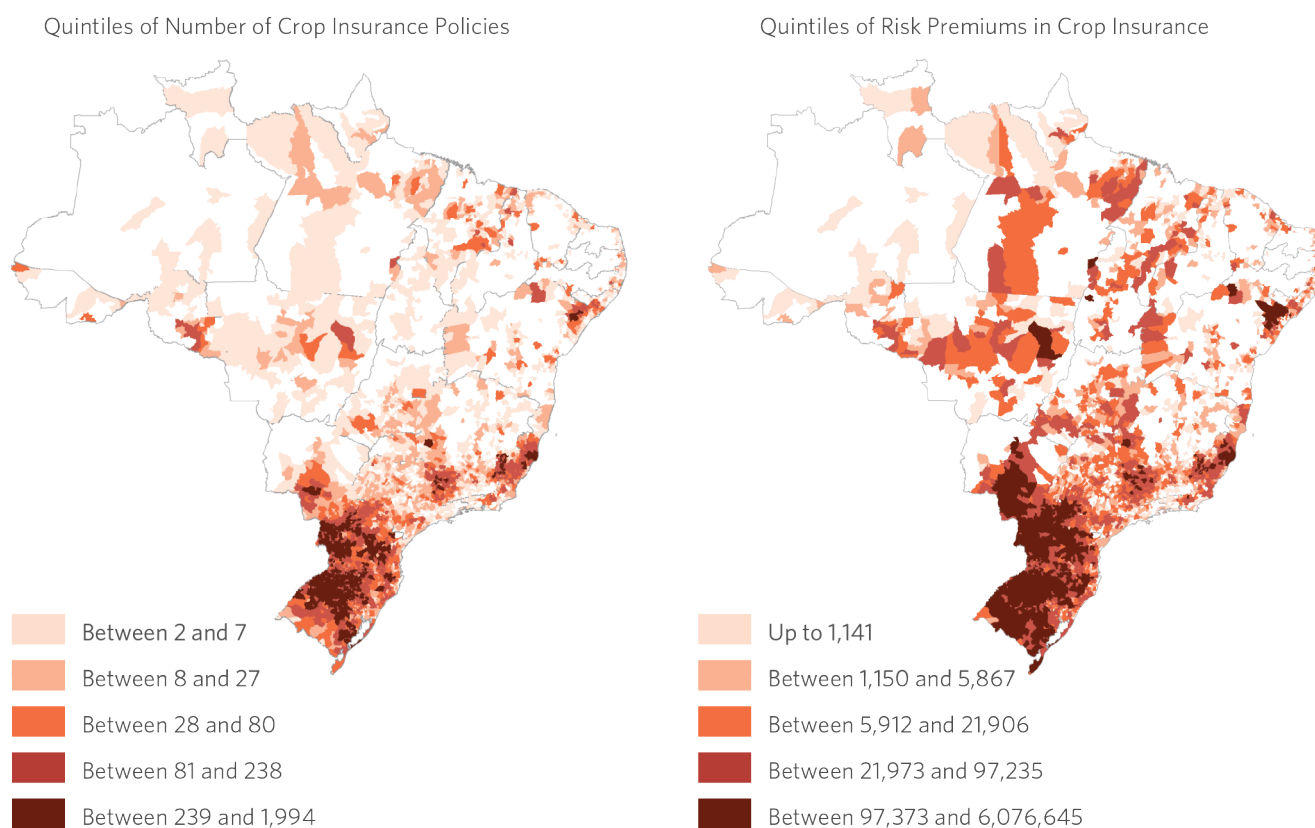
Since the government is responsible for the payment of PROAGRO's compensation, and the financial institutions receive loss communications from beneficiaries and judge coverage requests, the government is subject to information problems. There is an alignment of interests between beneficiaries and financial institutions in receiving government compensation resources and, therefore, collusion between these two agents are possible.

PROAGRO Plus, a program which acts within the scope of PROAGRO and is linked to the rural credit line PRONAF, was created in 2004 with the goal of covering both agricultural operational costs and investment operations. The differences between PROAGRO and PROAGRO Plus are related to their beneficiaries, the definition of contribution rates, and a guaranteed minimum income for beneficiaries. In the 2018/19 agricultural year, the insured value in the scope of PROAGRO Plus was around R\$10.2 billion, while traditional PROAGRO had R\$3.3 billion in the same period (Central Bank of Brazil/Sisbacen, 2020). However, PROAGRO Plus corresponded to 268,457 contracts, with an average insured value of R\$38,070, while traditional PROAGRO corresponded to only 31,000 contracts with an average insured value of R\$108,080.

PROAGRO shows a more widely spread distribution and smaller premiums when compared to PSR. Figure 15 shows the geographic distribution of PROAGRO in Brazilian municipalities, displaying the quintiles of the number of crop insurance policies and of the risk premiums covered by the program in 2018. PROAGRO covers a larger number of municipalities compared to PSR, 58.5% compared to PSR's 38.2%. Considering only municipalities with PROAGRO insurance, the first three quintiles (60%) have at most 80 insurance contracts and R\$21,973 in risk premiums. There is a significant concentration of PROAGRO contracts in the Southern Region, especially in Rio Grande do Sul. In 2018, for example, 81% of the

number of PROAGRO's contracts and 79% of its insured value were in the Southern Region. In particular, 43% of the number of PROAGRO's contracts and 33% of its insured value were only in the State of Rio Grande do Sul.

Figure 15. Geographic Distribution of PROAGRO in Brazilian Municipalities, 2018

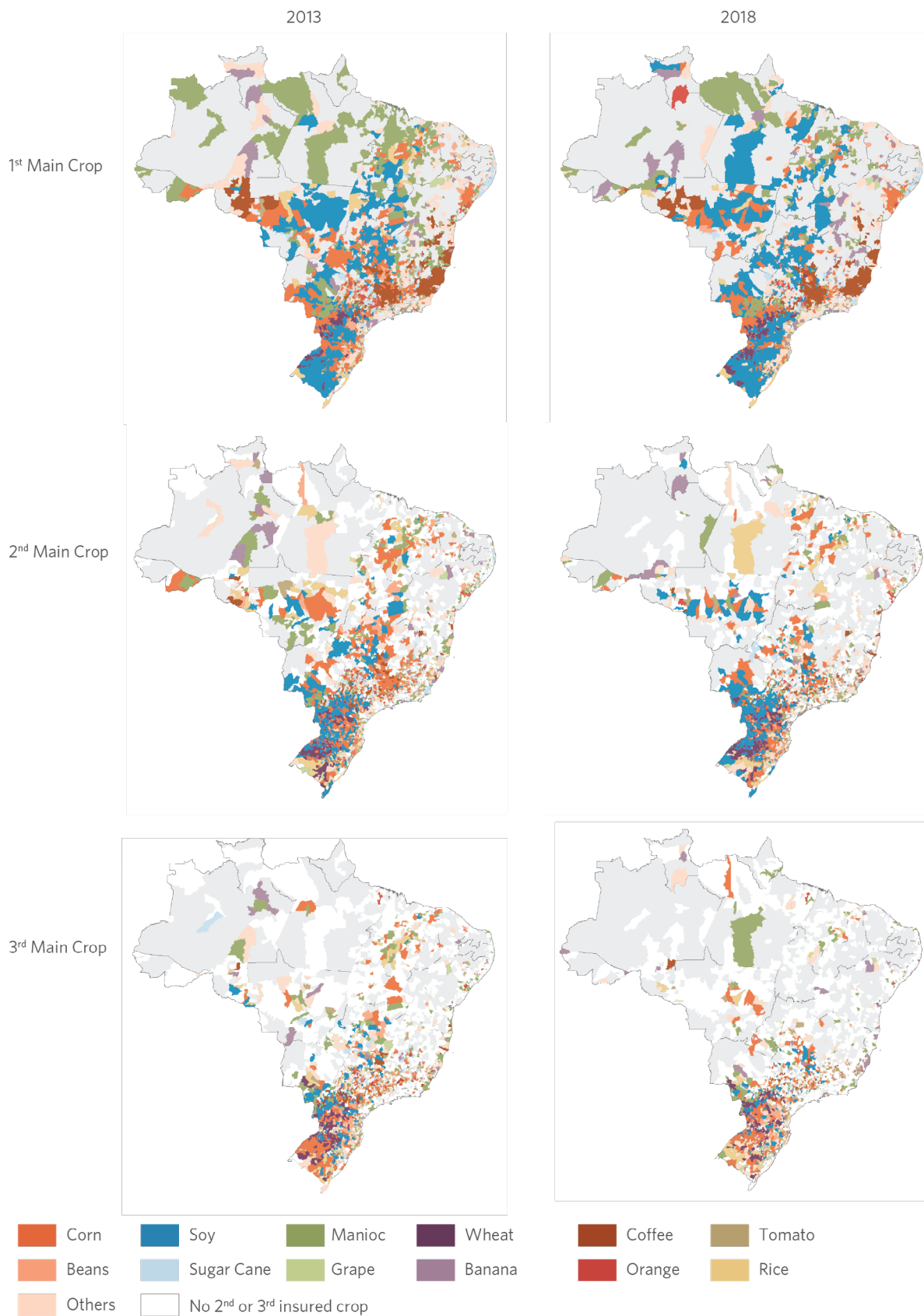


Note: Data restricted to crop insurance.

Source: Climate Policy Initiative with data from Central Bank of Brazil

A wider range of crops is covered under PROAGRO and PROAGRO Plus than under PSR. Figure 16 shows the geographical distribution of PROAGRO's main crops in 2013 and 2018. There were no significant changes in the observed period (which is shorter than the corresponding PSR figure due to data availability). Compared to PSR, there is a notable heterogeneity in crop importance among municipalities. Despite the greater diversity of insured products, fewer crops are insured in each municipality, as shown by the low frequency of municipalities with a third main crop.

Figure 16. Main Agricultural Products Subsidized by PROAGRO in Brazil, 2013 and 2018

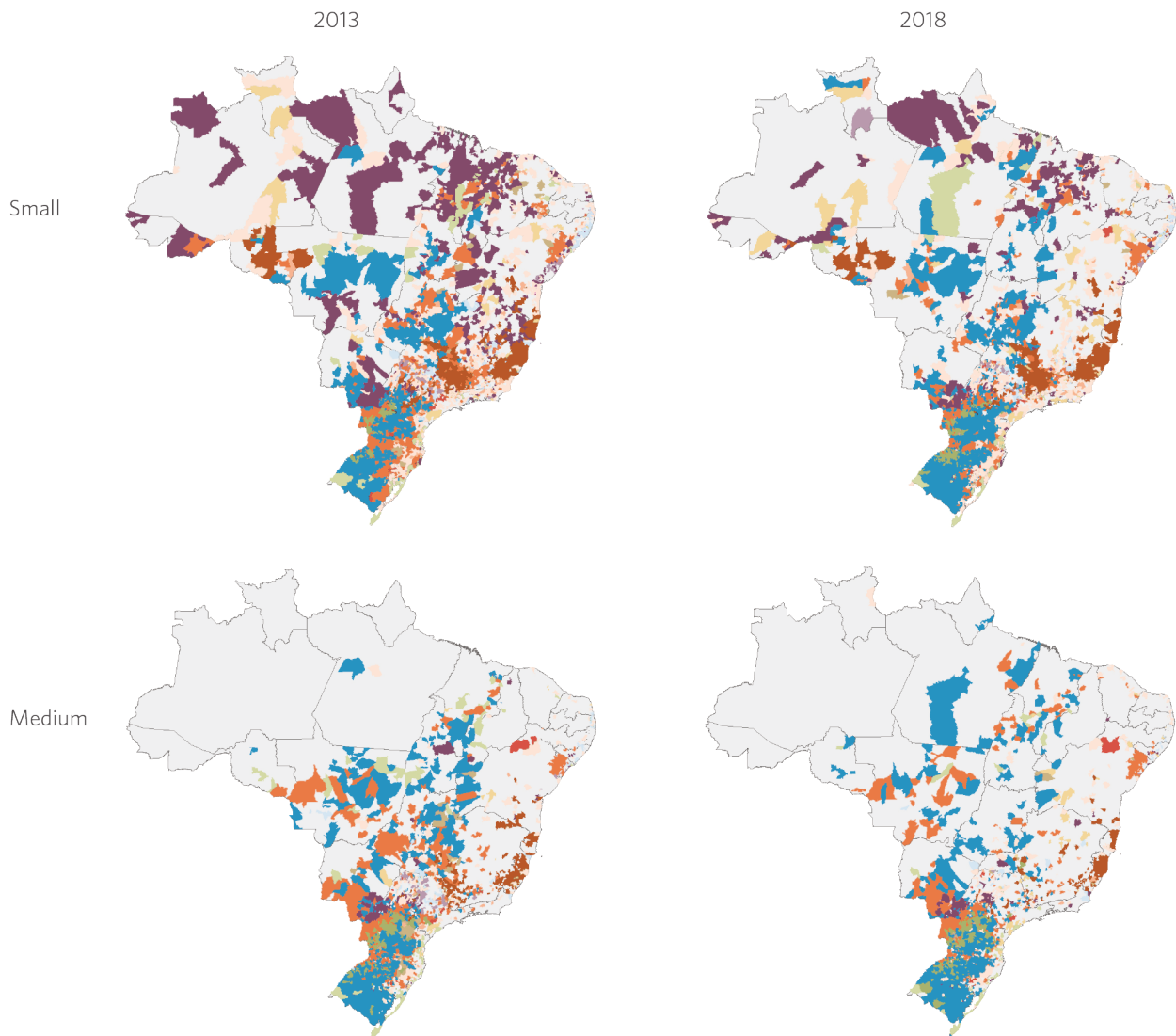


Notes: Data considers crop, livestock and forestry insurance. Products ordered by premium volume from PSR.

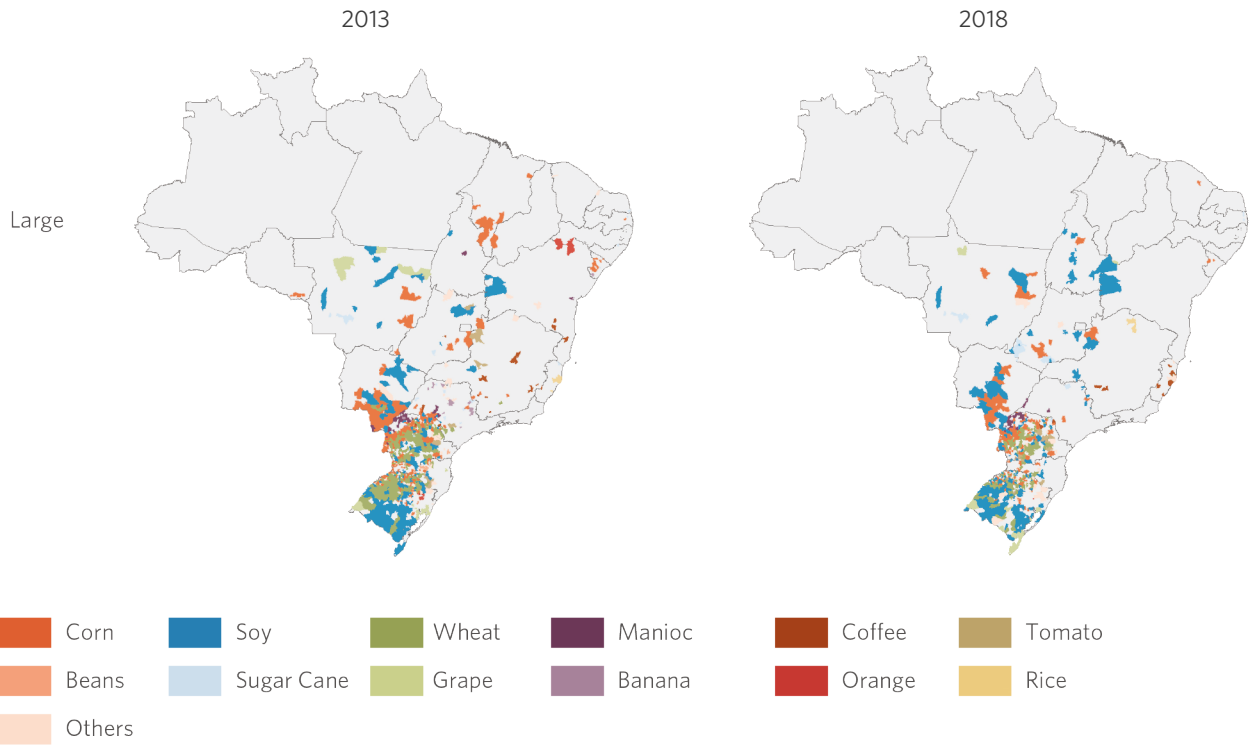
Source: Climate Policy Initiative with data from MAPA and SICOR

Figure 17 shows the main crops insured by PROAGRO for small, medium, and large producers in 2013 and 2018. Small producers have a diverse combination of crops, with soy, corn, manioc, and coffee being the most frequently insured. Small producers are also spread across municipalities in both years. Medium producers are insured in fewer municipalities when compared to small producers. The diversification pattern is similar to smaller producers but with a slightly higher prevalence of soy and corn in both years. Large producers are served by PROAGRO in a noticeably lower number of municipalities in 2013 and 2018. Also, the concentration on soy, wheat, and corn is more evident.

Figure 17. Main Agricultural Products Subsidized in PROAGRO by Producer Size in Brazil, 2013 and 2018



*Figure 17 continues on the next page



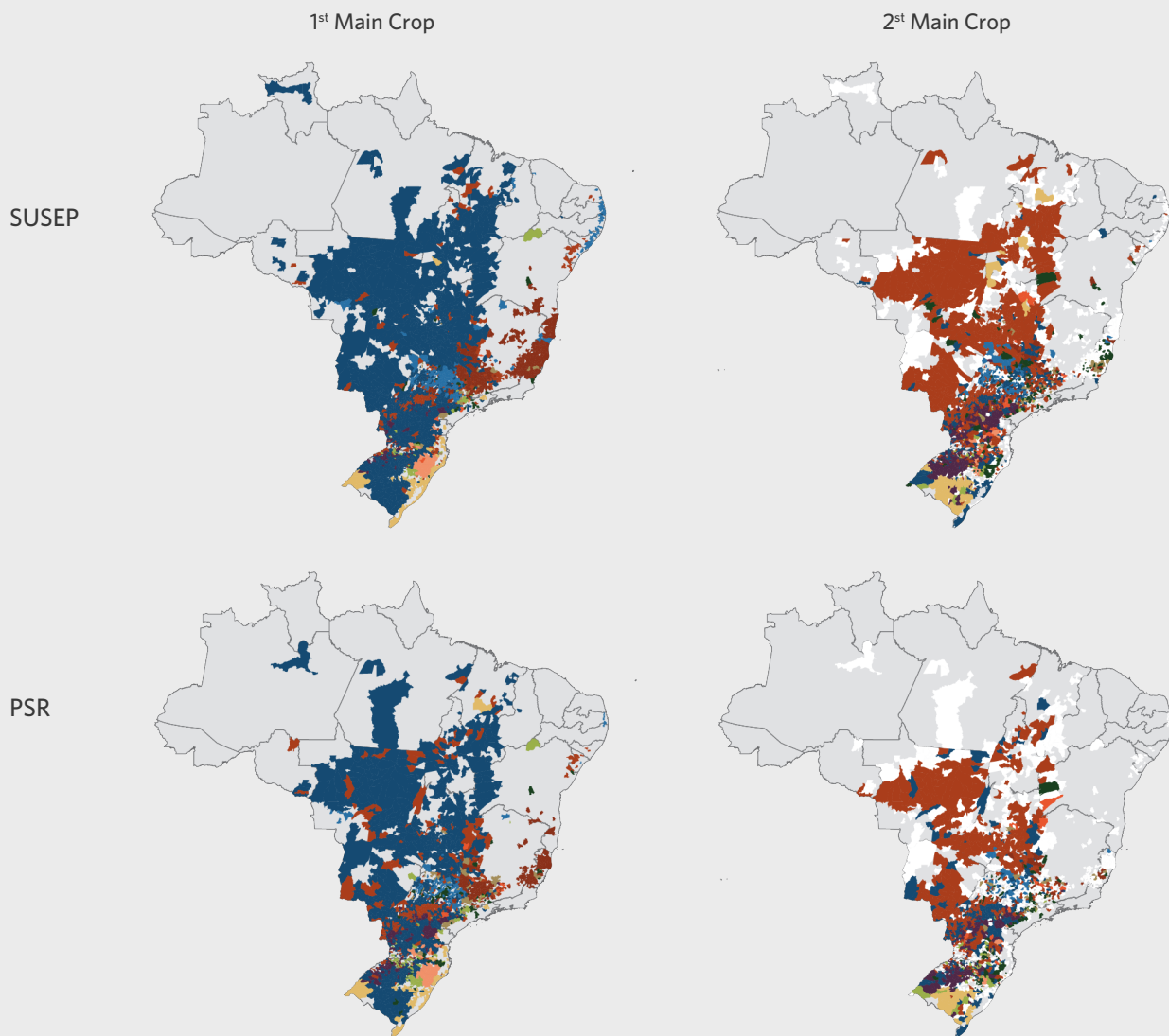
Notes: Data considers crop, livestock and forestry insurance. Products ordered by premium volume from PSR.

Source: Climate Policy Initiative with data from MAPA and SICOR

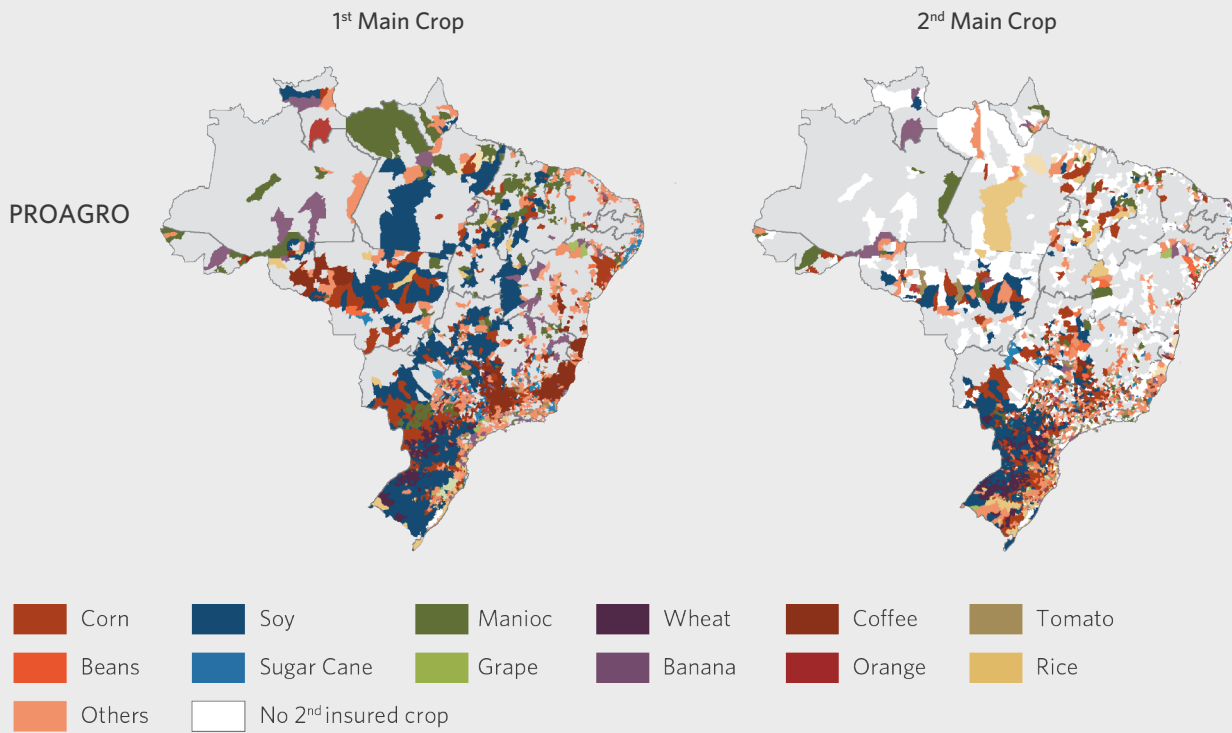
BOX 2. COMPARISON OF RURAL INSURANCE DATA: SUSEP, PSR, AND PROAGRO

Figure 18 compares the geographical distribution of SUSEP, PSR, and PROAGRO insurance for 2018. Since insurance programs subsidized by PSR are a subset of SUSEP data, as explained in the section above, their distribution is similar. PROAGRO has a much broader coverage of municipalities, reaching regions without insurance from SUSEP. Regarding insured crops, there is a significantly higher diversification in the scope of PROAGRO, which has more than double the number of different crops than SUSEP (58 from SUSEP and 125 from PROAGRO), but soy and corn remain as the products most frequently covered by agricultural insurance.

Figure 18. Main Agricultural Products in SUSEP, PSR, and PROAGRO, 2018



*Figure 18 continues on the next page

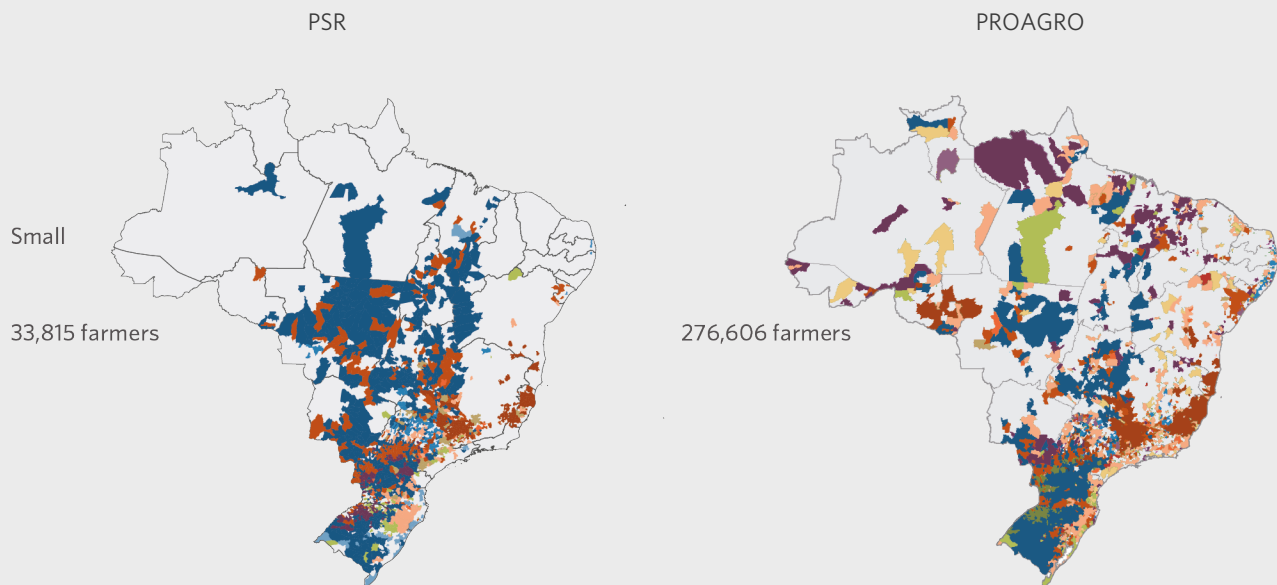


Note: Data considers crop, livestock and forestry insurance.

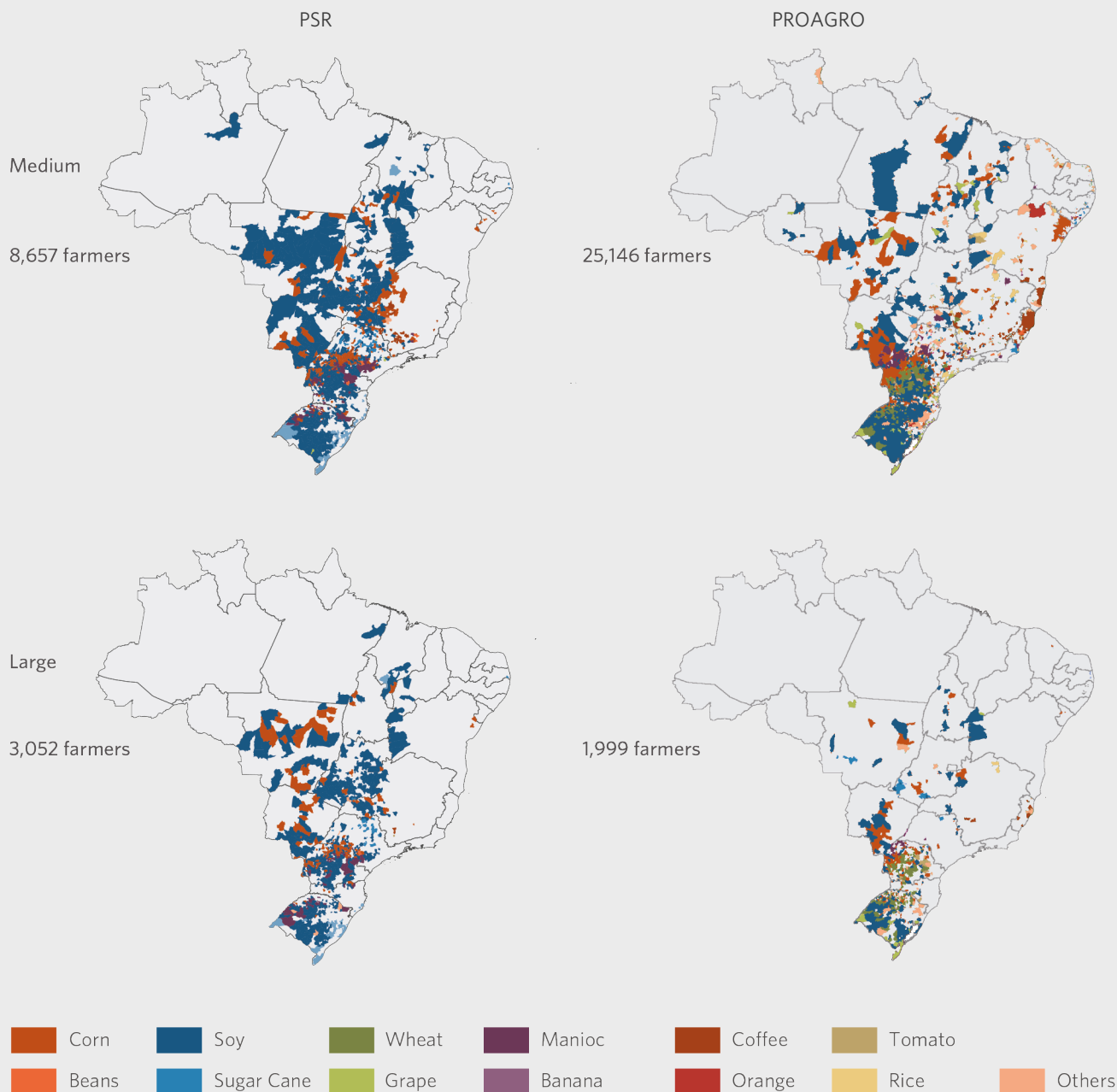
Source: Climate Policy Initiative with data from MAPA, SUSEP, and SICOR

Figure 19 shows the geographical distribution of PSR and PROAGRO by crop and producer size. Both programs have a majority of small producers. Still, PROAGRO serves a higher concentration of smaller producers (276,606), which can be seen by the significant reduction in the number of municipalities and properties covered as the size of property increases.

Figure 19. Main Agricultural Products Subsidized by PSR and PROAGRO in Brazil, 2018



*Figure 18 continues on the next page



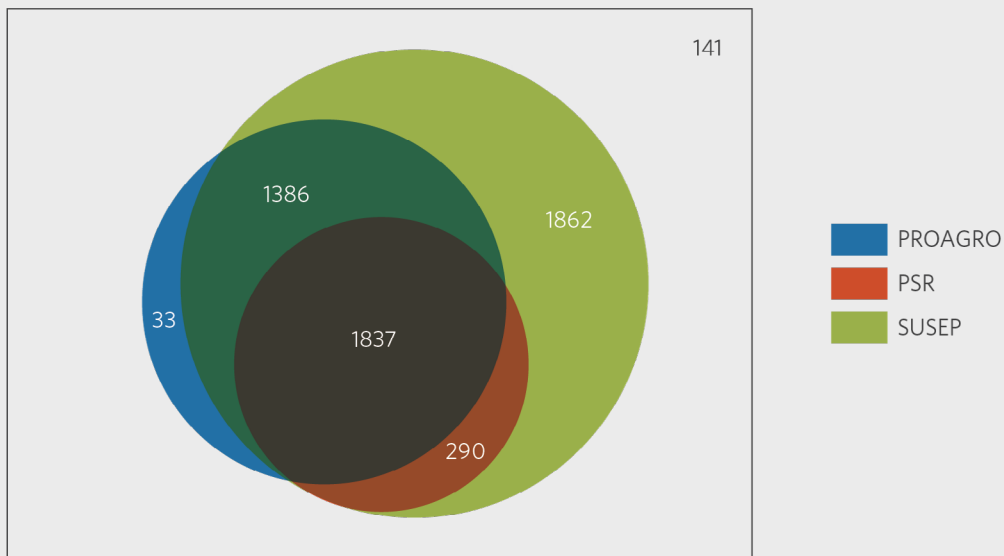
Notes: Products ordered by premium volume from PSR + PROAGRO. Data considers crop, livestock and forestry insurance.

Source: Climate Policy Initiative with data from MAPA and SICOR

Figure 20 shows the number of municipalities reported in PROAGRO, PSR, and SUSEP in 2018, considering all insurance types described in Table 1.¹¹ SUSEP has contracts in almost all Brazilian municipalities (5,375 of the 5,570 Brazilian municipalities). Of those, 2,127 municipalities have contracts subsidized by PSR (which can only benefit crop, livestock, and forest insurance). PROAGRO covers 3,256 municipalities and has a relevant superposition with PSR coverage. Overall, 141 Brazilian municipalities did not have any rural insurance contracts in that year.

¹¹ Crop insurance, livestock insurance, forest insurance, rural pledge insurance, farm owners' multiple peril, and rural producer life insurance.

Figure 20. Number of Municipalities Reported in SUSEP, PSR, and PROAGRO, 2018



Note: Data considers all types of rural insurance.

Source: Climate Policy Initiative with data from MAPA, SUSEP, and SICOR

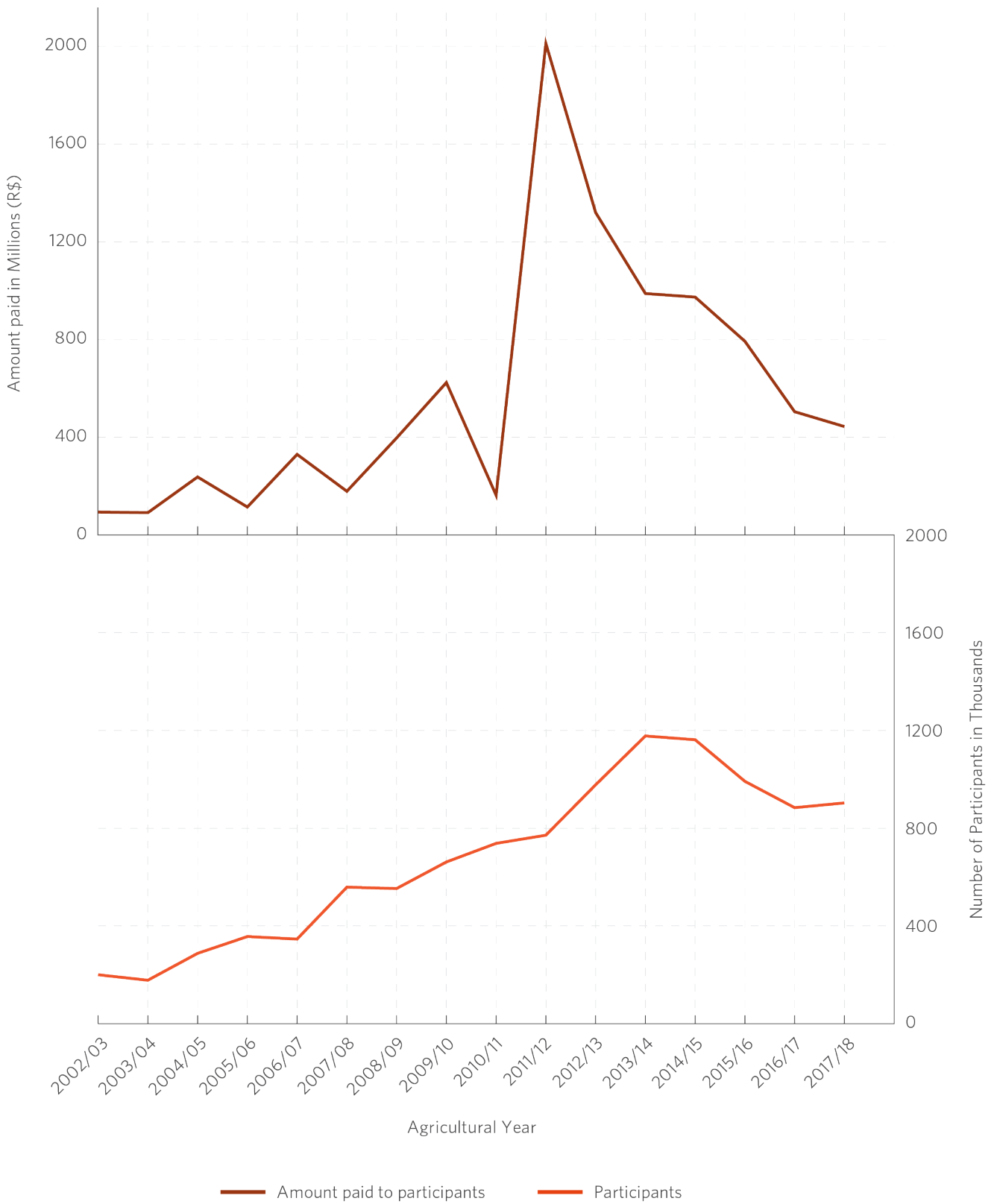
2.3 GARANTIA-SAFRA

In 2002, the federal government created *Garantia-Safra*, a public policy aimed at family farmers in the Brazilian semiarid region and integrated with the PRONAF credit line. *Garantia-Safra* is a conditional benefit to promote minimum security for the population's survival. To receive the benefits, the producers must (i) have a family income of less than 1.5 minimum salaries; (ii) cultivate between 0.6 and 5 hectares of cotton, rice, beans, manioc, or corn or other agricultural activities that coexist with the semiarid region; and (iii) reside in a municipality that lost at least 50% of this group of crops due to drought or excessive rainfall.

The Agricultural Policy Secretariat (*Secretaria de Política Agrícola - SPA*), at MAPA, executes *Garantia-Safra*. In the ordinary meetings of the management committee, it is deliberated the number of quotas made available to each state in the harvest year, that is, the maximum number of farmers that can benefit from the program, the benefit amount and the number of installments.

Garantia-Safra has increased in the past two decades. Since the agricultural year 2013/14, the program pays R\$850, divided into five installments of R\$170 to small farmers that fulfilled the program conditions. In the agricultural year 2016/17, *Garantia-Safra* had 903,452 participants, and a total value of R\$444.1 million was paid to 522,425 producers who suffered losses. Figure 21 presents the program's evolution from the agricultural year 2002/03 to the agricultural year 2017/18 in amounts paid and new admissions. According to MAPA (2019), despite the increase in quotas made available, the number of participants of the program has not yet reached the maximum possible adhesions. The peak of adhesions occurred in the 2013/14 harvest when around 87% of the available quotas were accessed. There is a stabilization trend around 1,200 adhered municipalities and 900,000 participating farmers.

Figure 21. Evolution of Amount Paid to Producers and Participants of *Garantia-Safra*, 2002/03 to 2017/18



Note: Data restricted to crop insurance. December 2018 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from MAPA

Municipal, state, and other public entities that aim to protect their farmers with *Garantia-Safra* seek to maximize the number of beneficiaries and continue to participate even without presenting losses for several consecutive harvests.

The creation and maintenance of the *Garantia-Safra* Fund make it possible to pay benefits to family farmers based on the farmers' contributions (a small membership) and municipal, state, and federal contributions. The calculation for the payment of the contribution by the municipal and state governments is linked to the number of participating farmers in the respective municipalities and states. The federal government makes it available annually 20% of the annual forecast of the total benefits to be paid (defined in the meeting of the management committee). The federal government is also the guarantor of the fund. In case there are not enough resources in the fund to cover the amount to be paid to the beneficiaries, the federal government must supplement the necessary amount.

Garantia-Safra focuses on benefiting low-income family producers, which are more vulnerable to adverse shocks. However, there is room for improvement in the program. The use of a specific loss index to determine the payment of compensation - based on rainfall measures, for example - could avoid moral hazard and other information problems. A loss index could also be used to provide producers with higher payments depending on the magnitude of the production loss.

2.4 MINIMUM PRICE GUARANTEE POLICY

PGPM is an insurance policy that helps correct distortions in prices so that producers are ensured a fair income. Through this policy, the federal government invests in supporting, maintaining, and guaranteeing minimum prices for producers and cooperatives. The policy aims to reduce fluctuations in agricultural income, balance the food supply, and guarantee the regularity of national supply. PGPM mechanisms include direct purchasing, equalization of prices, and lines of credit for product storage. PGPM only covers the most drastic price variations. Minor fluctuations - that can still substantially affect a business's profitability and return on investment - remain outside the policy scope. The policy is linked to MAPA through the National Supply Company (*Companhia Nacional de Abastecimento* - CONAB).

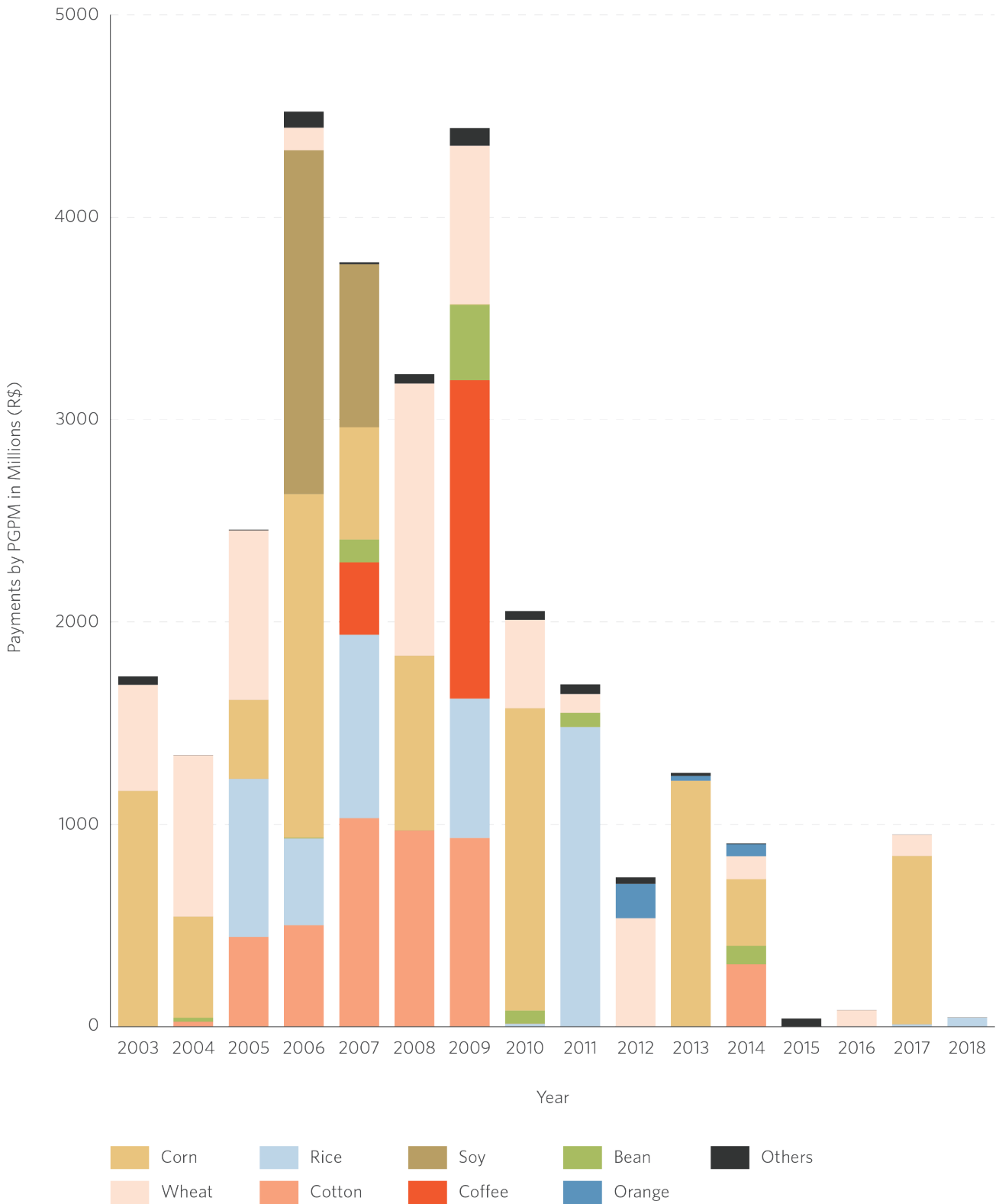
The policy expenditures vary significantly each year. Figure 22 presents the evolution of the values spent in PGPM between 2003 and 2018 by type of culture. The PGPM average amount for this period was R\$1.2 billion, and the maximum was R\$4.4 billion in 2009. In recent years, PGPM values have markedly decreased: in 2018, the value was R\$47 million.

The federal government is responsible for the policy and guarantees the price stipulated by the National Monetary Council (*Conselho Monetário Nacional* - CMN) for agricultural and extractive products.¹² There are important differences in the covered products among years, as well as in the values paid for each of the products. The price decision is updated for each agricultural year and is based on MAPA proposition, taking into account several factors that influence domestic and foreign market prices, and production costs. The Brazilian currency depreciation since 2011 - which has accelerated since 2015 - increased agricultural output prices in local currency. This has contributed to the decrease in PGPM amounts in recent years.

¹² The council is composed by three members: the Ministry of the Economy, the Special Secretary of Finance (who is linked to the Ministry of the Economy), and the President of the Central Bank of Brazil.

The absence of monitoring and verification costs in PGPM is an advantage. However, minimum price policies include costly and inefficient actions for public agents to handle, such as direct purchases and management of production stocks.

Figure 22. Evolution of PGPM Amounts Paid by Agricultural Product, 2003-2018



Note: Data considers crop, livestock and forestry insurance. December 2018 constant values (inflation adjusted by IPCA).
Source: Climate Policy Initiative with data from MAPA

3. AGRICULTURAL CLIMATE RISK ZONING

The sharp growth of Brazilian agriculture - with the country turning from a net importer of food to the largest net agricultural exporter in the world in a few decades - was supported by significant advances in research and development (R&D). In Brazil, investments in agriculture R&D are mostly associated with the National Agricultural Research System (*Sistema Nacional de Pesquisa Agropecuária* - SNPA), which was created in 1992. SNPA consists of the Brazilian Agricultural Research Corporation (*Empresa Brasileira de Pesquisa Agropecuária* - EMBRAPA) State Agricultural Research Organizations (*Organizações Estaduais de Pesquisa Agropecuária* - OEPA), universities and research institutes, as well as other public and private organizations.¹³

The reduction of production risks is an essential aspect of agricultural R&D. MAPA, EMBRAPA, and partners started developing Agricultural Climate Risk Zoning (*Zoneamento Agrícola de Riscos Climáticos* - ZARC) in 1996 to assist decision-making in farming activities and reduce losses. ZARC indicates the planting periods by crop and municipality, giving consideration to the climate, the type of soil, and the cycle of cultivars, to prevent climatic adversities.

Initially, ZARC aimed to mitigate climate risks in agriculture, especially in Cerrado, where EMBRAPA supported a sizable expansion in the cultivation of grains even in the face of serious water deficit problems. In the first year of ZARC, the zoned crop was wheat. Currently, 40 crops are contemplated (15 with annual cycles and 24 permanent), and publication occurs through the Federal Register (*Diário Oficial da União*) and on the MAPA website.¹⁴

The economic benefits of agricultural zoning include the cost reductions in agricultural insurance, risk reductions in agricultural production with associated increases in productivity and total crop production, and assessment of agricultural aptitude at the municipal level. According to EMBRAPA, ZARC has enabled a significant reduction in agricultural activity risks in Brazil, and the impacts associated with the zoning brought savings of about R\$16.8 billion for agribusiness in 2018.¹⁵

The government insurance programs PSR, PROAGRO, and PROAGRO Plus require farmers to follow ZARC recommendations. For producers who depend on these insurance programs to provide a guarantee for loans, following ZARC is also a way of accessing rural credit. Besides, some financial institutions condition the granting of rural credit on the use of zoning. EMBRAPA estimates that only PROAGRO had savings of over R\$2.5 billion in 2018, thanks to the greater security of investments provided by the zoning information (EMBRAPA, 2019a). Therefore, investing in agricultural research and development and improving ZARC makes production less risky and insurance policy less costly.

13 See <https://www.embrapa.br/snpa>

14 See <https://bit.ly/31RONYU>

15 See EMBRAPA's website at <https://bit.ly/3fRCERd>

4. REINSURANCE

4.1 REINSURANCE MARKET

Reinsurance operations function as insurance for insurers. With this type of contract, insurers' risks can be, totally or partially, shared with reinsurance firms, who commit to indemnify the insurers in case of losses related to issued policies. The importance of reinsurance firms lies in their potential to protect insurers from massive losses caused by catastrophes. Since reinsurance operators usually act both at national and international levels, they are able to diversify the geographic risks of their activities.

For example, when a local insurer focused on a specific state is unable to financially compensate clients for a catastrophic climate event that occurs in that state, the reinsurance firm with operations in other parts of the country will be able to guarantee the coverage of the local insurer's costs. Thus, reinsurance firms contribute to expanding risk coverage, ensuring that rural producers will be indemnified and that insurers manage to offset expenses and revenues.

In 2019, reinsurance firms' risk premiums in rural insurance contracts reached the value of R\$1.23 billion, according to data from SUSEP. Figure 23 shows that these premiums have been gradually increasing since 2013. The same occurred with claim values of rural reinsurance for most years.

Figure 23. Evolution of Risk Premiums and Claims for Reinsurance, 2010-2019

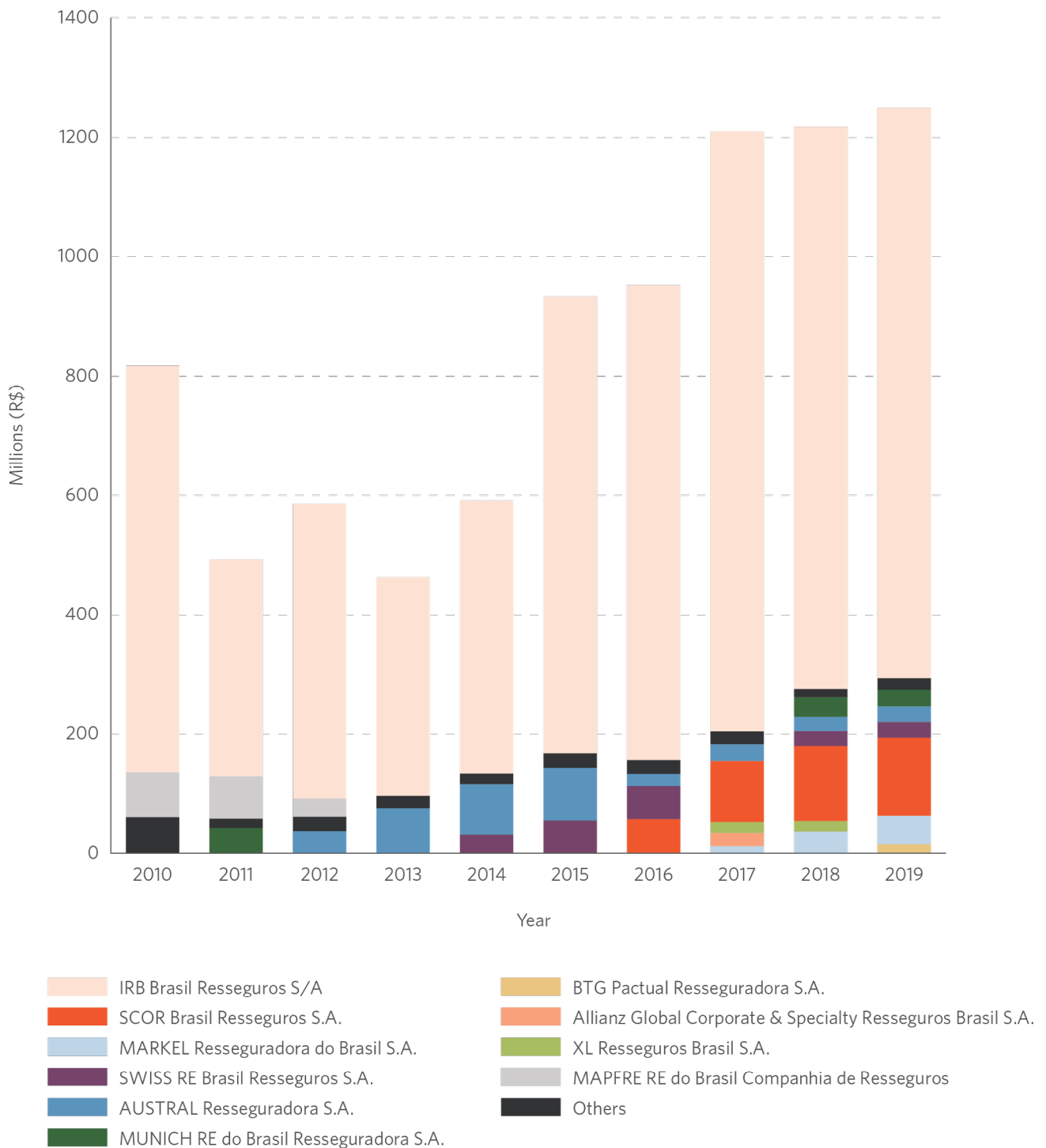


Note: Data considers all rural insurances. December 2019 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from SUSEP

Figure 24 shows the evolution of risk premiums by reinsurance firm in Brazil for the period 2010-2019. The importance of IBR Brasil Resseguros S/A concerning reinsurance premiums is notable (69% of market share in 2019). In 2019, there are 13 reinsurance firms, but only two companies hold more than 80% of the market (IBR Brasil Resseguros S/A and SCOR Brasil Resseguros S/A). The low availability of reinsurance options, as indicated by the low number of firms in the market, inhibits the expansion of rural insurance for farmers.

Figure 24. Evolution of Risk Premiums by Reinsurance Firm in Brazil, 2010-2019



Note: Data considers all rural insurances. December 2019 constant values (inflation adjusted by IPCA).

Source: Climate Policy Initiative with data from SUSEP

4.2 RURAL INSURANCE STABILITY FUND

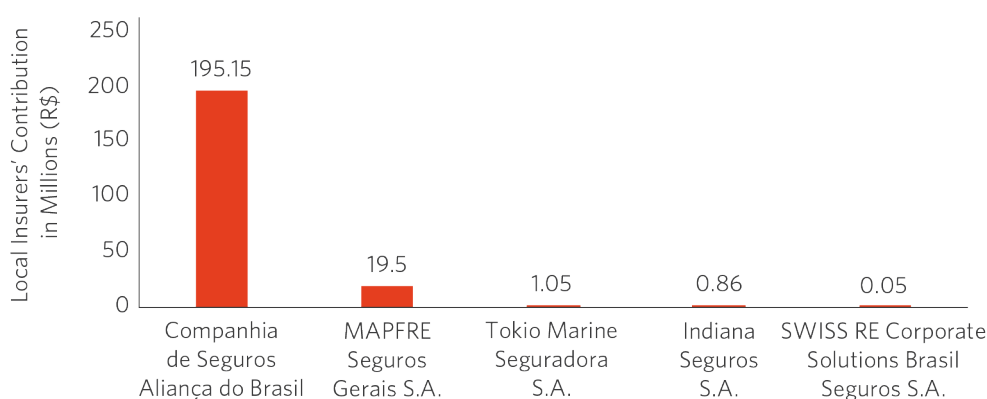
The Rural Insurance Stability Fund (*Fundo de Estabilidade do Seguro Rural* - FESR) was created in 1966 to preserve insurance operations' stability and enhance protection against risks from catastrophes in rural activity. FESR works as a special public fund administered by the Brazilian Guarantees and Fund Management Agency (*Agência Brasileira Gestora de Fundos Garantidores e Garantias* - ABGF), a public enterprise linked to the Ministry of the Economy that manages guarantee funds and provides guarantees to risky operations in areas of social and economic interest.

FESR functions as reinsurance, working with insurance and reinsurance providers that operate crop, livestock, aquaculture, forest, and rural pledge insurance. Insurance and reinsurance firms contribute to FESR when they have positive results at the end of their fiscal years. FESR also receives special credit from the federal government in case of resource scarcity. Contributions are 30% of the collected premiums for crop, livestock, aquaculture, and forest insurance, and 50% for rural pledge insurance.

Insurance companies can access FESR when their loss ratio is larger than 100% (that is, when costs exceeds revenues). The insurance company receives the quota of its insurance claims that are between 100% and 150% of the loss ratio, and the part that is beyond 250%. FESR does not assist with the part between 150% and 250%, which can be supported by a reinsurance contract. The exception is for firms that work with rural pledge insurance for which FESR covers any quota of insurance claims above 100%. The same rules for accessing FESR also apply to reinsurance firms in the case of proportional reinsurance.¹⁶

Figure 25 shows received values from insurance and reinsurance firms' contributions for the 2017/18 agricultural year (ABGF, 2018). Companhia de Seguros Aliança do Brasil was responsible for 90% of the R\$216.60 million contributed value in the period.¹⁷

Figure 25. Contributions of Local Insurance Companies to Brazil's FESR, 2017/18



Note: Data considers crop, livestock, aquaculture, forestry, and rural pledge insurance.

Source: Climate Policy Initiative with data from Agência Brasileira Gestora de Fundos Garantidores e Garantias S.A., 2018

¹⁶ Reinsurance agreements can be structured on a "pro-rata" (proportional) or "excess-of-loss" (nonproportional) basis, depending on the arrangement by which losses are apportioned between the two insurers. In the first case, the premium and the losses are shared by the reinsurer and the direct insurer. In the other case, the direct insurer assumes part of the liability for losses, and the reinsurer receives a fee for coverage above that amount.

¹⁷ Companhia de Seguros Aliança do Brasil, after a corporate restructuring of the partnership maintained between BB Seguros, the holding company that concentrates Banco do Brasil's insurance business, and MAPFRE Brasil, is now part of Brasilseg Companhia de Seguros. Brasilseg, through its insurance companies, operates in the Life, Housing, Rural and Massified (Residential, Corporate and Condominium) segments with products sold mainly at Banco do Brasil branches and on its digital channels.

5. HOW RISK MANAGEMENT INSTRUMENTS IMPACT AGRICULTURAL ACTIVITY AND LAND USE

Access to rural insurance is still a challenge for Brazilian farmers, creating potential difficulties for production decisions and technology adoption. This section reviews the evidence on how market failures related to agricultural risk management affect producers' decisions, leading to underinvestment and, consequently, to less efficient production and adverse land use impacts.

Assunção, Souza and Souza (2018) find that the failures in insurance coverage in Brazil reported in the previous sections lead producers to use credit instruments to deal with the impacts of weather shocks. Empirical measurements show a significant increase in the provision of rural credit in response to drought events. This increase suggests that rural credit plays a role in agricultural shock mitigation, despite the fact that it is not the most efficient instrument for risk management.

Even though credit instruments can enable investments in practices and technologies that reduce agricultural risks, rural credit is not efficient in managing important types of risk - such as climate hazards or price fluctuations. Therefore, a more integrated and complete set of instruments is needed, and there is a significant growth potential for the insurance and risk mitigation markets in Brazil.

Price risk is a major concern for farmers since it not only can result in low income, but also restrict their ability to access credit, which can impact agricultural production more broadly (Assunção, Gandour and Hemsley, 2015). When price risk is properly mitigated, farmers can retain a lower safety net and use more of their resources for consumption or investment. Assunção, Gandour and Hemsley (2015) find that price risk mitigation policies in Brazil - mostly executed through government purchases of agricultural production - generate substantial public spending, are not cost-effective, and bring important inefficiencies. The authors suggest these purchases could be replaced by incentives to market-based instruments, such as subsidies to sell options in the private market.

The economic literature presents vast evidence on the underinvestment caused by the uncertainty of agricultural activity. Karlan et al. (2014) show that incomplete insurance can limit investment in activities with high-expected profits. Therefore, insurance against catastrophic risks allows producers to increase expenditures on their farms. This result of inefficient agricultural production is consistent with Rosenzweig and Wolpin (1993) finding that bullocks are sold off in India when profit realizations are low, thus being used as a consumption smoothing mechanism to mitigate income shocks when insurance markets are incomplete. In a related context, Rosenzweig and Binswanger (1992) show that farmers in riskier environments select portfolios of assets that are less sensitive to rainfall variation and less profitable, with a significant loss in efficiency associated with risk mitigation.

Udry (1995) identifies a pattern of dissaving and increases in borrowing by agents confronted with adverse shocks to their incomes and, conversely, more savings and lending by agents in positive scenarios in northern Nigeria, realized through changes in grain stocks. Kazianga and Udry (2006) find that there is almost no inter-household risk sharing during a period of severe drought in Burkina Faso, and the producers rely almost exclusively on self-insurance to smooth out consumption. Therefore, exogenous shocks and incomplete insurance markets lead producers to inefficient decisions to reduce their risks.

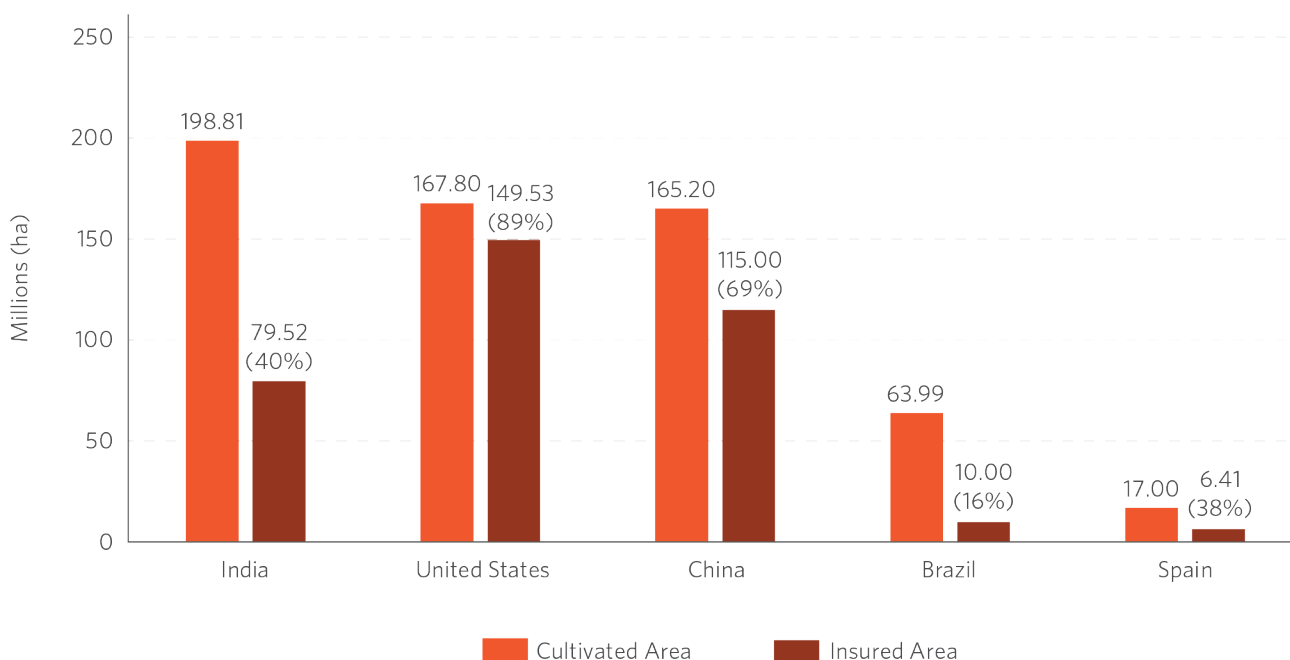
Government investments and incentives to agricultural risk management have been driven by evidence of failures in the insurance market. The presence of positive externalities can justify subsidies, such as when the insurance allows farmers to adopt new technologies to increase productivity and improve land use. When farmers or insurers are initially uncertain about the real risks and benefits of insurance products, the subsidy may also encourage a wide range of producers to adopt better risk management practices (Hazell, Sberro-Kessler and Varangis, 2017). Governments also direct public resources to insurance programs to increase food production and security, extend coverage for equity reasons, or support farmers' incomes.

6. INTERNATIONAL COMPARISON OF AGRICULTURAL RISK MANAGEMENT

This section highlights how countries use risk management tools to promote agricultural productivity. Currently, Brazil occupies an important position among global agricultural producers; only China and the United States have larger productions (FAO, 2017). Understanding rural insurance policies in major agricultural countries is crucial for guiding improvements in Brazil’s agricultural policy.

Figure 26 gives an international comparison of cultivated and insured areas for crops. The United States is an important reference point for agriculture risk mitigation, given that near 90% of the country’s crop area is insured (U.S. Department of Agriculture, 2017).¹⁸ In China, this proportion approaches 70% (Agroinsurance, 2017), while in India, around 40% of the cultivated area is insured (Pradhan Mantri Fasal Bima Yojana, 2016). In Brazil, only 15% of the crop area is insured (SUSEP, 2017), indicating that Brazil’s rural insurance market is less developed. Hence, the market concentration and the fact that insurance in Brazilian agriculture is a market still in need of development are challenges for proper risk management, keeping the country distant from major agricultural producers such as United States, China, and India.

Figure 26. International Comparison of Crop Insurance - Cultivated vs. Insured Area



Source: Pradhan Mantri Fasal Bima Yojana (2016), National Aeronautics and Space Administration, United States Geological Survey (2017), United States Department of Agriculture (2017), Agroinsurance (2017), Superintendência de Seguros Privados e Ministério da Agricultura, Pecuária e Abastecimento (2017), Entidad Estatal de Seguros Agrarios (2017)

¹⁸ National Aeronautics and Space Administration, United States Geological Survey, and United States Department of Agriculture (USDA), 2017

A brief overview of key public policies related to agricultural risk management in several countries is presented below.

UNITED STATES

In the United States, crop insurance is available from both private and public sources. The Risk Management Agency (RMA) of the U.S. Department of Agriculture (USDA) is a federal agency that aims to help agricultural producers address management risks through market-based tools. RMA runs and operates the Federal Crop Insurance Corporation (FCIC), which underwrites crop insurance for agricultural products in the United States and is the most important government policy in this area. RMA provides policies for more than 100 crops and offers 17 different insurance plans (USDA RMA, 2019).

The United States has two types of crop insurance: Crop-Hail and Multiple Peril Crop Insurance. Crop-Hail policies are not included in the Federal Crop Insurance Program because they are well-provided by the private market. The Federal Crop Insurance Program is a public-private partnership, which comprises 18 private companies and provides coverage for other perils. The purpose of this program is to combine the private sector's involvement with the financial support and the regulatory role of the government to provide crop insurance across the country. Private institutions and the federal government share the risks.

The U.S. federal government subsidizes the premiums to reduce the cost to farmers and encourage them to insure their crops. In 2018, more than USD 6.2 billion was directed to subsidies through the Federal Crop Insurance Program, which comprised 63.3% of the total premiums (USDA RMA, 2018). For comparison, PSR spent R\$367.4 million (USD91.6 million) in premium subsidies in the same year, which accounts for 18.2% of SUSEP's total crop, livestock, and forest premiums (MAPA and SUSEP, 2018). This comparison highlights the large difference between rural insurance policies in Brazil and the United States.

Income stabilization programs are another cornerstone of U.S. agricultural policy. The 2014 Farm Bill introduced changes that affected farmers' risk management decisions and provided income protection. The Price Loss Coverage (PLC) program provides payments to producers if the national average market price of a covered commodity, reported by the USDA National Agriculture Statistical Service (NASS), is lower than its reference price in a specific year. In the Agricultural Risk Coverage (ARC) program, farmers can choose between the county and individual coverage. In the county option, payment occurs when the county's actual crop revenue is below the county revenue guarantee, while the individual option triggers payment when the actual revenue is lower than the individual guarantee. Thus, eligible farmers choose between one of these alternatives based on their expectations of price or revenue fluctuations. These programs are fully subsidized, and no premium is charged. In return, farmers must comply with conservation requirements to become eligible for these programs. This association between agricultural subsidies and environmental conservation generates public goods that are beneficial to society and increase social welfare. This beneficial aspect is present in other agricultural policies and should be encouraged. Additional subsidy programs also include disaster assistance, in which the eligibility criteria are not coupled with the need for purchasing an insurance product.

CHINA

China's rural insurance model is based mainly on an agricultural insurance premium subsidy program that began in 2007. Government support significantly increased agricultural insurance adoption, making it the primary risk mitigation tool for farmers. The subsidized agricultural insurance program covers all Chinese provinces and 211 agricultural products. The Chinese central government also occupies the role of providing rural insurance through the People's Insurance Company of China, which accounted for 54% of the market share in the sector in 2016 (Agroinsurance, 2017).

EUROPEAN UNION

Given the differences in agricultural risks and legal and economic backgrounds of member states, the EU does not have harmonized EU-wide agricultural risk management. The types and extent to which risk management tools have been adopted differ widely among member states, including the level of coverage and subsidies. The EU offers a flexible regulatory framework to support risk management instruments delineated by the Common Agricultural Policy (CAP) and by the rules applicable to state aids in the agricultural sector. National programs, developed within the broad limits defined by the state, aid regulation in the agricultural sector, and exist together with other tools horizontally implemented within the CAP. Risk management is supported through financial contributions to insurance premiums, mutual funds, and an income stabilization tool (Bardají and Garrido, 2016).

FRANCE

The French government created the first component of its insurance system in agriculture in 1964, the National Guarantee Fund for Farming Calamities (*Fonds National de Garantie des Calamités Agricoles* - FNGCA). The FNGCA was a public indemnity mechanism financed jointly by the government and by taxes on the compulsory standard insurance policies taken out by farmers to cover damages caused by natural disasters. It was replaced by the National Fund for Risk Management in Agriculture (*Fonds National de Gestion de Risques en Agriculture* - FNGRA) in 2010, with similar goals. In 2005, the French government extended its presence in the rural insurance market by introducing premium subsidies to multiperil crop insurance, subsidizing up to 35% of premiums. In 2010, the European Commission, in the scope of CAP, allowed for pushing subsidies up to 65% of premiums paid by farmers, providing 75% of the subsidy by the European Agricultural Guarantee Fund (EAGF), with the remaining 25% coming from the FNGRA (Enjolras and Sentis, 2011). According to Agridata (2017), 12.3% of farms in France are insured.

SPAIN

The case of Spain is interesting for focusing on private insurers and leaving the regulation and subsidies to the government. According to Figure 27, Spain has 38% of its cultivated land insured. The current insurance system in Spain - Spanish Combined Agricultural Insurance System - was created in 1978. It established a public-private partnership between the government and insurance companies, and determined the structure of the market, emphasizing each institution's role. Based on private insurers, the Spanish insurance system covers a wide range of risks, while the regulation, coordination, and subsidizing are left to the

public administration. The participation of rural professional organizations and cooperatives is important, and the system balance also relies on private reinsurers and the existence of a public reinsurer. The State Agricultural Insurance Entity (*Entidad Estatal de Seguros Agrarios* - ENESA) - linked to the Ministry of Agriculture, Fisheries and Food - elaborates the annual insurance plan, provides subsidies for producers, collaborates with state governments, and coordinates the insurance system. For 2017, more than € 250 million¹⁹ was directed to subsidies for rural insurance premiums, comprising 28.6% of the total premiums (ENESA, 2017).²⁰ Comparing to Brazil, PSR's share of SUSEP's total premiums is 9.2%.

ITALY

In Italy, government support for farmers began in the 1970s with the creation of a fund that sought to compensate them for losses caused by natural disasters and was singular risk. Only in the early 2000s, did the policies started to cover multiple risks, and subsidies for insurance started to be offered. Currently, the country has its insurance policies subsidized by European Union funds, which have a limit of 65% of the insurance premium for natural disasters and 50% of the premium cost in cases where the insurance covers other losses. The Italian agricultural insurance system is structured among private insurers, cooperatives, and public entities. However, the country has low participation of farmers in agricultural insurance programs (around 15%), mainly due to the high bureaucratic costs and lack of experience with insurance contracts. (Santeramo, 2018).

GERMANY

Germany provides emergency funds and measures to compensate for losses caused by natural disasters and climate risks, however, the government does not support or subsidize agricultural insurance premiums. The government supports farmers by (i) making payments for natural disasters and adverse weather risks; (ii) providing post-disaster financial support; and (iii) approving the usage of ecological conservation areas in case of extreme drought (Palka and Hanger, 2019). The German insurance market is highly concentrated, with most insurers offering hail insurance and only one insurer offering multiple peril crop insurance. Livestock insurance is very important for the country, with more than half of farmers insured (Reyes et al., 2017).

TURKEY

The current rural insurance system in Turkey was established in 2005 by the Agricultural Insurance Act managed by the Agricultural Insurance Pool. The Agricultural Insurance Pool is a private corporation comprised of insurance companies to set up an agricultural insurance system to protect producers against natural disasters. In this system, the government gives subsidies for premiums to the Agricultural Insurance Pool. If the reinsurance cover provided by domestic and international reinsurance markets is insufficient, the government provides catastrophe stop loss protection (Bora, 2010; Uçak and Berk, 2009).

¹⁹ The exchange rate used was USD 1= € 0.89, from 01 January 2020.

²⁰ See: <https://bit.ly/3kBiBMB>

RUSSIA

The National Association of Agriculture Insurers was established in Russia in 2007, but the government only started to support the agricultural insurance system in 2012, covering crop and perennial plants. In 2013, it started insuring livestock and in 2019 aquaculture. The subsidies are 50% of the insurance premium (Bizhdov, 2018).

JAPAN

The agricultural insurance market in Japan relies on a network of cooperatives at the local, regional, and national levels. Each cooperative creates a fund where farmers contribute through premiums to insure almost all major crops. The government's role is to provide approximately 50% premium subsidies and act as a reinsurer of last resort for the whole agricultural insurance system. The voluntary or compulsory nature of the Japanese agriculture insurance system depends on the type of product and farm size. The main agriculture products, such as wheat, barley, and rice, are insured on a compulsory basis. However, farmers who do not meet the criteria for the compulsory cover (such as minimum insured area) can voluntarily purchase a policy (Stutley, 2011).

INDONESIA

Since 2015, the Ministry of Agriculture in Indonesia has implemented an agricultural production cost insurance to guarantee the farmers' production. In this program, the indemnity equals the costs of production. The insurance is limited to rice (the main agricultural product in the country) and is equally applied to all provinces. The premium is directly determined and highly subsidized by the government, but farmers' participation is low (Mutaqin and Usami, 2019).

MEXICO

The Mexican government supports the agricultural insurance market in several ways. First, it offers premium subsidies for insurance policies sold by mutual insurance funds (*Fondos*). *Fondos* are non-profit organizations constituted by farmers as civil associations and were initially supported by the government to allow farmers to pool risks and access credit by obtaining insurance. Another important policy is the promotion of the public basic crop insurance program (*Seguro Agrícola Básico - SAB*). SAB was administrated by AGROASEMEX, a former government crop insurance company that transitioned in 2001 to become a reinsurance company. In 2003, the government created the Natural Disaster Assistance program for the agricultural and fishing sector (*Componente de Atención de Desastres Naturales en el Sector Agropecuario y Pesquero - CADENA*), initially designed for the most vulnerable farmers, to be a safety net to assist farmers after natural disasters. The program expanded to finance premiums for the commercial insurance products sold under the SAB program (Iturrioz and Arias, 2010).

7. IMPROVING RISK MANAGEMENT AND AGRICULTURAL EFFICIENCY IN BRAZIL

Brazil has a large potential for improving risk mitigation opportunities for its producers, which will be even more essential in the face of climate change. It is well documented that inadequate management instruments and failures in the rural insurance market lead to underinvestment in agriculture, less efficient production, and adverse land use impacts. The next steps require thoughtful action toward improving and integrating Brazil's agricultural risk management instruments and policies to ensure that they meet rural producers' needs.

Brazil experienced a strong growth in the number of insurance policies from 2007 to 2018 and a greater geographical diversification brought by the expansion of the agricultural frontier. It is important to strengthen this recent expansion of the Brazilian insurance market. The number of insurance policies should increase, the geographical distribution should be broader, and the variety of instruments available should be amplified. This will help ensure that producers have the tools they need to increase their efficiency, improve decision making, and adapt to changes in their environment.

Based on the evidence that uninsured risk is a binding constraint on farmer investment (Karlán et al., 2014) and that credit instruments are used in Brazil to accommodate the impact of production shocks (Assunção, Souza and Souza, 2018), a reorganization of the nation's agricultural public policy could reduce inefficiencies. Most of the agriculture public subsidies currently go to rural credit; the public budget spent on rural credit in Brazil could be redirected to insurance policies, and, more specifically, to increase the subsidies in rural insurance premiums in the scope of PSR.

The reframing of financial instruments, in which public resources migrate from the credit channel to the promotion of risk management instruments and financial derivatives, should adopt a long-term perspective. Credit instruments play a significant role in supporting the rural sector (Assunção, Fernandes, Mikio and Souza, 2019), and the process of disintermediation must be gradual to avoid a disruption in agricultural production.

Brazil's insurance market is highly concentrated, with few companies operating and one of the companies with a large market share. Increasing the number of companies in the market will not only reduce market concentration but provide broader and diversified risk management options for farmers. The role of private insurers should be reinforced, and the reinsurance options should be expanded and developed.

It is also necessary to address the lack of strong demand for insurance products by farmers. Risk management instruments should meet agriculture's needs, and farmers' knowledge of these products must be expanded. Tailoring instruments and deepening farmers' understanding of their role in mitigating risks should increase farmers' demand for insurance and related financial instruments, as well as improve their production decisions.

An integrated data system with detailed information on agricultural potential, soil types, agricultural and producer risks, and other relevant information should help tailor insurance

products and expand insurers' operations. These data should help assessing risks for each farmer, product, and area, providing the basis for calculating the operation's risk.

Brazil has been expanding agroclimatic zoning (ZARC) in recent years by including more products and municipalities. ZARC supports producers by indicating crop variations and planting timing by product and by municipality, taking into account the climatic characteristics, soil, and cultivation cycles. Investing in ZARC and agriculture R&D can help farmers to make better production decisions and reduce agricultural losses.

In Brazil, price risk mitigation is largely executed in the form of government buyouts, despite evidence that this policy is unable of entirely mitigating price risk volatility. Furthermore, when the government buys farmers' output and decides its final destination, it creates market inefficiencies, and places a large burden on public expenditures. Alternatively, farmers may go to the private market to acquire sell options for output or buy options for inputs, but Brazil's markets for mitigating agricultural output price risk are not well developed. Public policy should promote the expansion of the agricultural price insurance market by incentivizing market-based instruments through subsidies such as sell options specifically targeted at price risk.

The pathways outlined here should strengthen the rural insurance market and expand risk management options for Brazilian farmers. As a consequence, producers should be able to make more efficient decisions, boost agricultural investments, increase productivity, and improve land use.

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