

Finance and accounting

Agricultural insurance mechanisms through mutualism: the case of an agricultural cooperative

*Mecanismos de seguro agropecuário via mutualidade: o caso de uma cooperativa agroindustrial**Mecanismos de seguro agropecuario por medio de mutualidad: el caso de una cooperativa agroindustrial*

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Abstract

The aim of this article is to verify how the mutualism model is applied in cooperatives to mitigate risks. We conducted a single, holistic case study of an agribusiness cooperative in Paraná State. The data were collected from June to September 2014. Four applications of the mutualism model were identified, specifically to mitigate risks of weather for grain (corn, beans and soybeans) farmers, death by lightning, brucellosis and tuberculosis for cattle farmers and the volatility of prices for pig farmers. Through the mutualism model, it was observed that cooperatives find solutions for their specific agribusiness sector problems. Cooperative companies are the managers and coordinators of the entire insurance mechanism to address the risks involved in their activities or/and the activities of their members. The mutualism model has been effective for covering common risks. However, like regular insurance, it proved to be ineffective in the case of catastrophes.

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Resumo

O objetivo desse artigo foi verificar como o sistema de mutualismo é aplicado em uma cooperativa para a mitigação de riscos, como opção à contratação de seguros tradicionais. Para tanto, foi feito um estudo de caso único, holístico, em uma cooperativa agroindustrial no Estado do Paraná, com dados levantados entre junho e setembro de 2014. Foram identificadas quatro aplicações do mutualismo na cooperativa estudada, especificamente para mitigação de riscos de intempéries para produtores de grãos (milho, soja e feijão); para mitigação de riscos da volatilidade de preços de suínos; e para a mitigação de riscos de morte por raio, brucelose e tuberculose (bovinos). Foi verificado que por meio da mutualidade as cooperativas constituem soluções para problemas próprios do seu meio e específicos do setor do agronegócio. As cooperativas são coordenadoras e administradoras de todo o mecanismo de seguro mútuo para atender aos riscos envolvidos em atividades desenvolvidas nelas e/ou pelos seus

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cooperados. O mutualismo se mostrou eficaz em diversas situações identificadas de sinistros. Entretanto, a exemplo das formas de seguro tradicionais, em caso de catástrofes o sistema não alcança a cobertura necessária.

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Palavras-chave: Seguro; Mutualismo; Gestão de riscos; Cooperativas

Resumen

El objetivo en este estudio fue verificar cómo se aplica el sistema de mutualismo en una cooperativa con el fin de mitigar el riesgo, como una alternativa al contrato de seguro tradicional. Para ello, se llevó a cabo un estudio de caso único, holístico, en una cooperativa agroindustrial ubicada en el estado de Paraná. Los datos fueron recolectados en el período comprendido entre junio y septiembre de 2014. Se identificaron cuatro aplicaciones del mutualismo en la cooperativa estudiada, específicamente para mitigar los riesgos de las intemperies para productores de granos (maíz, soja y frijoles/porotos); para mitigar los riesgos de la volatilidad de los precios del cerdo; y para mitigar los riesgos de muerte por rayos, brucelosis y tuberculosis (de vacunos). Se encontró que, por medio de la mutualidad, las cooperativas constituyen soluciones para problemas propios de su entorno y específicos de la agroindustria. Las cooperativas son coordinadoras y gestoras de todo el mecanismo de seguro mutuo para hacer frente a los riesgos involucrados en actividades desarrolladas en las mismas y/o por sus afiliados. El mutualismo se muestra eficaz en diversas situaciones identificadas de siniestros. Sin embargo, como en las formas de seguro tradicional, en caso de catástrofes, el sistema no alcanza la cobertura necesaria.

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Palabras clave: Seguro; Mutualismo; Gestión del riesgo; Cooperativas

Introduction

In farming activities, such as planting crops and raising animals, risks are a serious factor. According to Börner (2006), risks in agriculture stem from a number of origins: risks to production (climate, pests, sanitary factors, etc.); risks involving prices/market (fluctuating prices and/or demand, etc.); institutional risks (government actions or lack of government actions, regulations, etc.) and personal/human risks (accidents, disease, etc.). For some types of risks there are efficient means of protection, made available on the market or by the government. However, for other types, farmers become the exclusive risk takers (Moreira, Souza, & Duclós, 2014). Due to the variety of risks and their origins in agribusiness and the inherent particular conditions of each type of farmer, there is no single, common managerial strategy that can be used by all farmers to mitigate them, and a variety of tools are required to manage them (USDA, 2007).

For farmers, managing risks means determining combinations of actions that represent different levels of risk and return (Gomes, 2000). Some strategies aim to reduce risk, such as diversification of activities. Others aim to share and/or transfer risks, such as future contracts, production contracts and insurance (Moreira, 2009).

For risks associated with climate and/or sanitary problems, there are tools that help to foresee the occurrence of these risks and analyze their possible impact. However, many of the strategies and tools are often inaccessible to farmers, especially those who operate small farms. Insurance, particularly agricultural insurance, could be the right tools for addressing risks of production, but there are a number of difficulties that face both

insurance companies and farmers. These include high premiums (economically unfeasible), low involvement of government policies (subsidies), imminent exposure to catastrophes, lack of regulation agencies to guarantee legitimacy and maintain a historical and statistical database and complexity in administrative organization (experts, technicians, control mechanisms) (Ozaki, 2006).

An alternative to purchasing traditional insurance is mutual insurance. In this type of mutualism, the interested parties form groups with the same goals to establish a financial fund or seek a commitment that can compensate for future losses in their shared activities. Normally, it falls to cooperatives to organize, manage and monitor this type of insurance.

Agricultural cooperatives play a fundamental role in mitigating the risks of agribusiness (Moreira, 2009). As a cooperative becomes the agency that represents the interests of the cooperative members and works directly to organize the production chain, concern over the possible impacts of risks, both internal and external, is the frequent object of evaluation in the management of cooperatives, along with seeking solutions to mitigate them.

Therefore, the aim of this study was to verify how the mutualism system is used by a cooperative to mitigate risks. For this purpose, the case of a large agricultural cooperative in Paraná State is presented, where mutualism is organized and applied to crops (grains) and livestock (pigs and milk production). As these activities are different in nature, the forms of mutual assurance are also different and involve different sources of risks, such as climate conditions, sanitary risks and the market, as will be shown throughout the article. The next section looks at the central concepts addressed in the

article. This is followed by the case, comments on the data and an analysis, with the conclusion bringing to the article to a close.

Theoretical framework

Cooperatives and cooperativism

A cooperative is an autonomous association of people voluntarily united to satisfy economic, social and cultural needs and aspirations through a collectively owned and democratically managed company (ICA, 2013). In Brazil, cooperative societies are societies of people, with their own legal constitution, to provide services to their members. Their legal situation is currently defined by Law 5.764, enacted on 16 December, 1971.

Lago (2009) states that current agricultural cooperativism “is a form of organization for farming and the coordination of agricultural systems,” and that, through agricultural cooperativism, members seek to participate in a competitive market by uniting their production units. Thus, for those involved in Brazilian agribusiness, cooperatives function as organizations that help to form and coordinate the primary sector and act as intermediaries in the relationship between production and sale.

According to Rodrigues (1997), cooperatives, with their unique characteristics, constitute the only sector of the economy whose doctrine emphasizes the balance between the economic and the social. This is their first challenge in the face of globalization, as efficiency and competitiveness are required. This means improved management, reduced costs and differential treatment for members according to size, efficiency and reciprocation.

The capital structure of agricultural cooperatives in Brazil complies with Law 5.764/71, which in its first article defines cooperative organizations as civilian societies of people rather than capital. Thus, their capital is composed of shares, with a limited number for each member, and this value may be proportional. Shares cannot be used by third parties who are not members of the society (Krueger, 2004). At the end of the fiscal year, any surplus may be shared according to the activities of each member (this is known as a cooperative act), when deliberated and authorized by the Ordinary General Assembly (OGA) of the cooperative.

According to data from the OCB (2014), in Brazil there are 6603 cooperatives, with over eleven million members and approximately 321,000 employees. Farming and transport, respectively, account for 23.1% and 16.5% of the total number of cooperatives, followed by credit, with 15.9%, and labor unions, with 14.7%. According to OCEPAR (2014), in Paraná, a state with a tradition and vocation for rural activity, 56% of the agricultural economy is derived from farming cooperatives. There are 77 such cooperatives, with 135,000 members and responsible for 61,000 direct jobs. The gross turnover of these cooperatives in 2013 was R\$38.6 billion, with a net surplus of R\$1.3 billion. In 2013, this sector exported the equivalent of 2.36 billion dollars, representing 42% of the total exports of Brazilian exports and 13% of the total exports of the state.

Insurance and mutualism

Mutualism is one of the fundamental principles that constitutes the basis of every insurance operation. The union of a large number of people exposed to the same risks enables a balance to be established between the payments by the insured (premiums) and the guarantee of the insurer (responsibilities), as all the insured pay values that are lower than the insured asset in the certainty that those who suffer losses will receive full compensation to replace their asset (CNSEG, 2014).

According to the legal definition of insurance, as declared in the Civil Code, Article 1.432, an insurance contract is one through which one of the parties is obliged by the other through the payment of a premium, to be compensated for damage resulting from a future risk, as foreseen in the contract. In general, insurance can be defined as a mechanism for transferring the high value of a future and uncertain expense (loss) to an advanced, guaranteed payment of a relatively lower value (premium) (Ozaki, 2006). In accordance with economic and legal adaptations, the main requirements or conditions for insurability are that: (i) the expected loss should be calculable and the premium economically feasible; (ii) the loss should not be willful, i.e., it should be accidental; (iii) the loss threatens and considerable number of things, assets or people; and (iv) there should be no catastrophic loss (Gomes, 1998; Ozaki, 2006).

An insurance policy can include a fixed or variable premium in accordance with the technique employed for covering the risk (Gomes, 1998). Fixed premium insurance is done through an insurance company, and the documents of the insurer and the insured are prepared by different people. The payments made by the insured party do not vary, as they are set contractually.

Variable premium insurance is adjusted among several people who mutually assume responsibility for the loss that any of them might suffer. In mutual insurance, every interested party is an insurer of others and is also insured by them. Thus, all can benefit or lose if they are entitled to compensation or are obliged to make payments to another party. However, in this type of contract, the parties themselves do not act as the insurers as they belong to the company legally established by the association of interested parties. The insured do not pay a premium, but rather shares that are sufficient to compensate for loss or damage and the expenses incurred in administration. For this reason, contributions to mutual insurance can vary, unlike fixed premium insurance.

Mutualism is defined as the union of a group of people with common insurance interests that compete to form an economic mass for the purpose of overcoming, at a given moment, the eventual needs of some of those people. In commercial insurance, the insured party pays a premium and receives compensation when a claim is filed. In mutual insurance, instead of a premium, the insured (mutualists) pay the shares required to cover the expenses of administration and confirmed losses. The responsibility of the risk is shared by all the mutualists (Ozaki, 2006). This creates the right incentive to reduce fraud as, since all the participants share the cost of eventual damage, the insured can monitor one another (Caffagni & Marques, 1999).

Methodology

The research strategy that was adopted was the single case study, adapted when the desire is to answer “how” or “why” in relation to a given phenomenon when the researcher has little control over events and when the focus is on contemporary phenomena in a given context in real life (Yin, 2010). The case that was chosen is typical of the phenomenon in question and decisive. In other words, it represents a context in which it is believed that the propositions, in the case of the assumptions and theoretical postulations of mutualism, are true, which justifies the single case in accordance with Yin (2010). Given that the analysis unit was an agricultural cooperative in Paraná State, which is understood as unique, it is also a holistic case study. In this article, to protect the identity of the organization, it is only referred to as the “Agricultural Cooperative”.

Primary and secondary data were collected. Two sources of secondary data were used: documents and archived files. These documents and files provided an understanding of how premiums and claims are calculated, in addition to the history of applications. The financial statements and the history of the values practices were also analyzed. The primary data originated from semi-structured interviews with managers of each business unit of the cooperative. The set of data was gathered between June and September, 2014.

Qualitative analyses of the data were conducted, mainly using a document analysis technique, in addition to quantitative analyses and economic evaluations, as will be seen.

The case of the Agricultural Cooperative

The Agricultural Cooperative is located in Paraná State and was founded in 1951. Of Dutch origin, it has units in the municipalities of Castro, Ponta Grossa, Piraí do Sul, Curiúva and Ventania, in Paraná State, and also in the municipality of Itaberá, in São Paulo State. The Agricultural Cooperative has 782 members and 961 employees, who produce cereals such as corn, wheat, barley and oats on a large scale, in addition to legumes, soy, beans and forage. It also operates in the industrialization of milk, potatoes, meat, feed and seeds. The products have their own brand and those of third parties. In 2013, its gross turnover was R\$1.7 billion. According to the *Globo Rural Ranking* (2013), the Agricultural Cooperatives is one of the 500 largest organizations in the agribusiness sector, one of the 50 largest per category and one of the 10 largest in the sector.

The Agricultural Cooperative manages mutual insurance groups for grain, pig and milk farmers. For the grain (soy, corn and beans) farmers, the Agricultural Cooperative manages the Hail Mutual Insurance Group, considered the most impactful, and the agricultural Mutual Insurance Group, for other weather conditions, with coverage for soy and corn. For pig farmers, the cooperative manages the Mutual Insurance Group of for the Slaughterhouse of the Piglet Production Unit, whose purpose is to mitigate the risks of volatile prices. For the milk producers, the group that is managed is the Mutual Insurance Group for the Sanitary Conditions and Lightning. The backgrounds and main

characteristics of each group are described in the next section, where the data are presented and analyzed.

Presentation and discussion of data

In this section, the collected data is presented and a discussion and analysis for the conclusion.

As commented above, the Agricultural Cooperative manages mutual insurance groups for grain, pig and milk farmers. The participation of each group is individualized, and only the cooperative members are involved, and not their families. Companies can participate if they are cooperative members. There are two forms of admission to a mutual group occurs. The first is that it is compulsory in the case of a cooperative member financing his harvest with the cooperative. The second is joining freely. The characteristics of each group are given in detail below.

Hail Mutual Insurance Group

The Hail Mutual Insurance Group was founded in 1989 at the cooperative due to the need for coverage because of the most damaging natural phenomenon in the region, hail. This damage was covered by insurance, but these policies were economically unfeasible due to the high cost of the premium and the complex way that the damage was measured, which was not satisfactory to the cooperative and its members.

The group uses the pro rata mutual insurance model and is made up of members who farm soy, corn and beans. The entire planted area linked to the cooperative is included. The costs that are covered are only those raw materials used in the planting of each crop and the operations involved. This does not include other costs of profits. If a claim is made, the cost is shared in proportion to the area covered by each member. If there are no claims, only the administrative expenses (administration, reports, consultancy, etc.) are shared by the members.

In the Hail Mutual Insurance Group, the Total Gross Indemnity Value (TGIV) for soy and corn is calculated based on the average productivity per hectare (kg/ha). This productivity is defined by the lowest value calculated between the average production of the cooperative members and the productivity per hectare of the cooperative members of the group in the three years prior to the claim. The method used to calculate the total gross indemnity for soy and corn is shown in Eq. (1):

$$TGIV = \left(\frac{\bar{X}P - AP}{60} \right) \cdot a \cdot AMP \quad (1)$$

where TGIV, total gross indemnity value; $\bar{X}P$, average productivity; AP, actual productivity (kg/ha); a , size of area where the hail fell; AMP, average market price of a 60 kg sack (of soy or corn) in Brazilian reais.

For beans, at the Hail Mutual Insurance Group, the reference value for indemnity of the cost of the raw materials is Basic Cost per Hectare (BCH), including seeds, fertilizer and pesticides. When assessing the damage, it is necessary to harvest the entire affected area for weighing and classification at the Agricultural Cooperative. For the base price of the indemnity, a calculation is

Table 1
Hailfall and indemnities for soy.

Year	Harvest	Members registered	Area covered (ha)	Claims	Indemnity (R\$)	Shared cost (R\$/ha)
2009	2008/2009	184	35,269.63	3	117,924.22	3.34
2010	2009/2010	197	39,370.20	0	–	–
2011	2010/2011	201	49,239.98	17	1,554,584.13	31.57
2012	2011/2012	224	51,042.16	18	468,410.14	9.18
2013	2012/2013	110	29,281.84	6	150,237.09	5.13
2014	2013/2014	73	17,116.53	3	73,278.19	4.28
Averages		165	36,886.72	7.8	394,072.30	8.92

Source: Agricultural Cooperative.

made between the highest minimum price of the product is used as published in the Harvest Plan of the Ministry of Agriculture, Fishing and Supplies (MAPA), and the average commercial price of the month of the harvest, as practiced in the commercial sector of the Cooperative. The calculation of the Total Gross Indemnity for beans is shown in Eq. (2):

$$TGIV = \left(BCV - \left(\frac{AP}{60} \cdot BP \right) \right) \cdot a \quad (2)$$

where TGIV, total gross indemnity value; BCV, basic cost value (cost of production, i.e., fertilizer, seeds, pesticides and cultivation); AP, actual production (kg/ha); BP, base price of indemnity; a , size of area where the hail fell, in hectares. Table 1 shows the history hailfall and the indemnities paid by the fund for soy from 2009 to 2014.

Table 2 shows the historical background of hailfall and claims from the fund for corn from 2009 to 2014.

On average, during the period in question, over 7 farmers were affected and made claims of R\$394,072.30, representing an average shared cost of R\$8.92/ha, the value contributed by each member of the mutual insurance group. The highest claim per hectare was R\$31.57. It should be noted that hailfall on the soy crop is frequent. During the period in question, there was only one year without hailstones. Considering the number of occurrences and the number of members in the mutual insurance group, on average, 5% of the members made claims due to hailfall, i.e., they were also benefitted by the mutual insurance in the proportional share of the damage, showing the importance of this form of insurance.

On average, during the period in question, fewer than 2 farmers made claims, at a value of R\$98,259.45, representing an average shared cost of R\$9.96/ha, the value contributed by

each participating member of the group. The highest indemnity payment per hectare was R\$33.08. Hailfall on corn is low. During the period in question, there were 629 cooperative members and only 9 claims. The shared value for the group as a whole may be considered small, but significant for the farmers who were forced to make a claim.

Table 3 shows the history of hailfall and indemnity payments from the fund for the bean crop from 2009 to 2014.

On average, during the period in question, fewer than 2 farmers made claims, at values of R\$285,275.69, representing a shared cost of R\$27.28/ha, the value contributed by each participating member of the group. The highest claim per hectare was R\$162.31. During the period in question, damage was done in only 2 years. In 2012, the damage caused by hailfall was severe and the shared cost per hectare was high. In this case, there was a concentration of areas covered by the cooperative, i.e., cooperative members with large areas registered suffered greater damage, leading to higher costs for the other members. An analysis shows the deficiency of the mutual insurance in situations of concentration or catastrophe, where the mechanism does not benefit all those involved.

Mutual Farming Insurance Group

The Mutual Farming Fund was created in 2008 to provide coverage for other events not covered by the hail group. It is made up of soy and corn farmers and provides coverage for damage resulting from extreme weather such as frost, heavy rainfalls during the harvest and drought, excluding all other climatic factors. The members must participate in the group with all their planted area, by crop, associated with the Cooperative. It is a mutual insurance model with a membership fee.

Table 2
Hailfall and indemnities for corn.

Year	Harvest	Members registered	Area covered (ha)	Claims (N°)	Indemnity (R\$)	Shared cost (R\$/ha)
2009	2008/2009	143	22,920.73	1	2888.40	0.13
2010	2009/2010	124	13,091.83	0	–	–
2011	2010/2011	126	14,255.68	1	24,734.09	1.74
2012	2011/2012	151	17,795.98	5	437,429.12	24.58
2013	2012/2013	56	6783.28	1	1372.05	0.20
2014	2013/2014	29	3722.24	1	123,133.03	33.08
Averages		105	13,094.96	1.5	98,259.45	9.96

Source: Agricultural Cooperative.

Table 3
Hailfall and indemnities for beans.

Year	Harvest	Members registered	Area covered (ha)	Claims	Indemnity (R\$)	Shared cost (R\$/ha)
2009	2008/2009	108	8542.81	0	–	–
2010	2009/2010	115	8916.00	0	–	–
2011	2010/2011	169	14,561.95	3	20,275.33	1.39
2012	2011/2012	126	10,420.81	8	1,691,378.81	162.31
2013	2012/2013	56	5661.32	0	–	–
2014	2013/2014	50	4007.86	0	–	–
Averages		104	8685.13	1.8	285,275.69	27.28

Source: Agricultural Cooperative.

Description	SOJA	MILHO
Coverage level (CL) for a farmer with a history	60%	65%
Coverage level (CL) for a farmer with no history	1800 kg/ha	5500 kg/ha
Indemnity ceiling (BCV)	R\$ 1610.00/ha	R\$ 2406.00/ha
Membership fee	2.50%	3.00%

Fig. 1. Rates of coverage of the mutual farming fund.

Source: Agricultural Cooperative.

The need to create this group was seen when severe damage during two consecutive harvests as a result of heavy rainfall in 2004/2005 and a drought in 2005/2006, leaving cooperative members heavily in debt and forced to renegotiate debts. A solution was sought through official insurance, but this did not meet the needs of the members, the main barriers being: (i) high insurance premiums; (ii) average productivity based on the Brazilian Institute of Geography and Statistics (IBGE), which are beyond the reality of the cooperative, although it is the recognized benchmark in technology with high averages of agricultural productivity; (iii) and the methods for measuring damage (in official insurance, the value is determined by the farmer when, on average, there are large and highly productive areas to offset losses, i.e., to have an average product, the proposal would include measurement by size of plot of land or glebe). Faced with these difficulties with regular insurance, the Mutual Fund was formed to cover the costs of raw materials up to the cost of financing the planting of the crop.

The reference value for indemnity is the value of the inputs of the BCV, such as seeds, fertilizers and pesticides. If there is damage (claims), the value is covered by the membership fees collected for the fund throughout the period, and the limit on the value of coverage for damage is set by the current balance

of the fund, as shown in Fig. 1. If there is not damage, any administrative expenses (administration, reports, consultancy, etc.) will be paid by the fund.

The maximum indemnifiable limit, the maximum indemnifiable price and the total gross indemnity for soy or corn are calculated using the following equations:

$$MIL = \frac{\bar{X}PCoop \cdot CL}{60} \quad (3)$$

$$MIP = \frac{BCV}{MIL} \quad (4)$$

$$TGIV = \left(\frac{(\bar{X}PA3years \cdot CL) - AP}{60} \right) \cdot MIP \cdot a \quad (5)$$

where MIL, maximum indemnifiable limit (R\$/ha); $\bar{X}PCoop$, average general productivity of the cooperative for the period (kg/ha); CL, coverage level; MIP, maximum indemnifiable price (R\$/sack); BCV, basic cost value (cost of production: fertilizers, seeds, pesticides and cultivation); TGIV, total gross indemnity value; $\bar{X}PA3years$, average productivity of cooperative member in the last 3 years (kg/ha); AP, actual productivity (kg/ha); a , area (ha) where the damage was done.

Table 4
Events and indemnities from the mutual farming fund for soy.

Year	Harvest	Members registered	Coverage (R\$)	Premiums (R\$)	Claims (N°)	Indemnity (R\$)
2009	2008/2009	163	26,699,280.00	552,074.24	1	73,833.84
2010	2009/2010	170	35,737,005.60	893,425.74	4	97,336.31
2011	2010/2011	130	36,346,560.00	904,946.51	–	–
2012	2011/2012	131	32,561,828.00	814,045.70	1	64,802.27
2013	2012/2013	92	26,836,277.00	670,907.42	–	–
2014	2013/2014	39	12,581,924.60	314,548.12	5	123,577.41
Averages		121	28,460,479.20	691,657.96	1.83	59,924.97

Source: Agricultural Cooperative.

Table 4 shows the history of events that led to claims from the mutual farming fund for the soy crop from 2009 to 2014.

In the period in question, an average of R\$691,657.96 was collected in premiums, with fewer than 2 claims and an average of R\$59,924.97 in indemnity payments. The highest indemnity per harvest was R\$123,577.41. The total value of premiums collected during the period was R\$4,149,947.73 for a total of R\$359,549.83 in indemnity payments, i.e., 9% of the total collected was used. If the total coverage of R\$170,762,875.20 is considered, the balance of the fund would be insufficient, as the indemnities are limited to this amount. This aspect is addressed in the “Norms for the Functioning of the Mutual Farming Fund and the Mutual Hail Fund”, which were drafted by the cooperative and agreed upon by all the members of the group. In Item 2, “Adaptation of the Functioning of the Mutual Farming and Mutual Hail Fund Groups”, Letter (c) the value of coverage for damage is limited to the existing balance of the fund.

Regarding the number of members registered and the frequency of claims, there was an average of 1.52%, showing the low frequency of damage. Therefore, the relationship between the low levels of occurrence of damage and the values paid in indemnities show how significant the fund is, as the values indemnified were expressive.

Table 5 shows the history of events that led to indemnity payments from the mutual farming fund for corn from 2009 to 2014.

On average, for the period in question, R\$530,931.43 were collected in premiums, with fewer than 2 claims on average and indemnity payment of R\$41,561.17 on average. The highest amount of indemnity payments per harvest was R\$202,654.80. Judging by the conditions of the mutual fund, the value collected would be insufficient to cover a catastrophe. The total coverage for the period was R\$107,829,532.90, and the payment for damage would cease when the balance of the fund was exhausted.

The balance of the fund is administered in accordance with the “Norms for the Functioning of the Mutual Farming Fund and the Mutual Hail Fund”, drafted by the cooperative and agreed upon by the members of the group in Item 2, “Adaptation of the Functioning of the Mutual Farming and Mutual Hail Fund Groups”, Letter (b) Individualization of the Fund: the individual monitoring of the Mutual Farming Fund is authorized, and the percentage contributed by each farmer over time can be inspected”. Thus, the cooperative hopes to keep records of the balance of the fund and be able to know which members have contributed to it. In cases of claims, if the balance of the member

is negative, it is possible to charge higher rates to compensate for using it or even charge lower rates from those who have never used it to cover damage. If there is a better situation or adequate conditions in the official insurance system, the fund can be liquidated and the balance returned to the members. It could also be incorporated into the reserve funds of the cooperative.

Mutual Insurance Group of Slaughterers at the Piglet Production Unit

This insurance was created in 2006 for the purpose of minimizing the risks of volatile pig prices on the market. It was created in the wake of an outbreak of foot and mouth disease in Paraná State in 2005. In 2006, there was a fall in the price of pork, which lasted until mid-2007. This led to debts and renegotiation the debts of members.

The fund was constituted by cooperative members who are slaughterers at the piglet production unit. The members include their entire breeding stock. The system ensures that when pork is sold the price will cover the direct production costs. The difference between weekly sale prices and the standard cost that will be paid to the member forms the fund, which can be either negative or positive, and at the end of the lot it is shared proportionally to the volume of pork that is sold.

In the mutual fund of the slaughterers at the piglet production unit, the mutual insurance mitigates the risks of volatile pig prices. The system was established by the cooperative members at the piglet production unit and was designed to ensure that when the slaughtered animals are sold the members will receive a price that covers the direct costs of production. The difference between weekly sales prices and the standard cost that will be paid to the member forms a fund that can be either positive or negative and, at the end of the lot (period in days of the cycle between delivery of a pig that weighs between 20 and 24 kg and the pig achieving a weight of 100 kg), is shared proportionally to the volume of pork sold. The indemnity is based on the results of the fund. At the time of delivery of the product for sale, a “mutual standard price” is set. At the end of the lot, when the entire group of pigs is delivered, the real average sale price is calculated and the result is shared.

The value of the reserve fund of the mutual insurance, the total value of the mutual fund, the average price of pork on the market, the entitlement value, the value received by the member

Table 5
Occurrence of damage and indemnities from the mutual farming fund for the corn crop.

Year	Harvest	Members registered	Coverage (R\$)	Premiums (R\$)	Claims (N°)	Indemnity (R\$)
2009	2008/2009	168	29,214,522.00	780,574.89	5	202,654.80
2010	2009/2010	120	23,832,386.00	714,965.58	–	–
2011	2010/2011	75	16,187,215.50	494,816.78	–	–
2012	2011/2012	90	22,010,805.10	668,126.16	1	4916.11
2013	2012/2013	42	10,280,291.22	318,926.65	–	–
2014	2013/2014	20	6,304,313.08	208,178.50	1	41,796.09
Averages		86	17,971,588.82	530,931.43	1.17	41,561.17

Source: Agricultural Cooperative.

and the indemnifiable value are calculated using the following equations:

$$MRf = (PMSw - SSP) \cdot QSs \tag{6}$$

$$TVRf = MRf1 + MRf2 + \dots + MRfn \tag{7}$$

$$PSMI = \frac{(PMSw1 \cdot QSs1) + (PMSw2 \cdot QSs2) + \dots + (PMSwn \cdot QSsn)}{QSs1 + QSs2 + \dots + QSsn} \tag{8}$$

$$EVm = PSMI \cdot QSs \tag{9}$$

$$VRc = SSP \cdot QSs \tag{10}$$

$$Vind = EVm \cdot VRc \tag{11}$$

where VRc, value received from cooperative member; SSP, standard mutual swine price; QSs, quantity sold; MRf, mutual reserve fund; PSMw, price of swine on the market that week; PSMI, price of swine lot on the market; TVRf, total value of reserve fund; EVm, entitlement value for members; Vind, indemnifiable value.

Table 6 shows a survey of the claims from 23 lots over a period of eight years of the commercialization of slaughtered animals.

As shown, during the period in question, an average of 5.2 farmers made claims for 656,250 kg of pig and received an average restitution from the mutual fund as the equalization of prices of R\$139,597.50. These values show situations in which farmers obtained a sales price below the average cost of the group. Considering the shared values, the high volatility of pig prices is evident, in comparison, the maximum shared value was six times

higher than the minimum value. In the period in question, a comparison between the number of participations and the number of claims demonstrates the relevance of this mutualism group to the swine farmers in the cooperative.

Mutual Insurance for Sanitary Problems and Lightning for Milk Farmers

The mutual insurance for sanitary problems and lightning was created in the early 1980s to support a program to eradicate brucellosis and tuberculosis in the herds of the members of the cooperative. Another aim was to minimize the losses caused by lightning, a common phenomenon in the region, affecting the mortality of the herd. These factors meant that it was necessary to assume debts with the cooperative to replace the livestock and the lost volume of milk. In the case of disease, when the claim for indemnity helps the farmer to avoid selling the herd and the possible spread of diseases, this reduces the risk of compromising the institutional brand of the cooperative.

In the mutual fund for sanitation and lightning, the coverage is for losses resulting from the death of animals caused by lightning, natural phenomena that are very common in the region, and brucellosis and tuberculosis. The principle aim of the mutual insurance is to ensure compensation for farmers who have lost their herd due to these diseases or as the result of lightning. The value of indemnity per animal unit corresponds to 60% of the average total annual production of cows on the property. This value is obtained by calculating the volume of milk supplied in the last 12 months, the number of cows in the herd (milk cows

Table 6
Composition of volumes claimed for the commercialization of pigs.

Year	Lot	No. of participations	Coverage (kg)	Coverage (R\$)	No. of claims	Claims (kg)	Claims (shared in R\$)
2006	1st	16	1038.87	2,493,842.06	5	630,000	144,900.00
	2nd	16	1028.16	2,658,067.78	5	630,000	170,100.00
2007	3rd	16	1019.08	3,103,852.02	3	378,000	79,380.00
	4th	16	1009.19	2,679,764.18	6	756,000	120,960.00
	5th	16	1082.16	1,991,636.43	3	378,000	86,940.00
2008	6th	16	1092.46	2,081,723.71	2	252,000	80,640.00
	7th	20	2164.31	4,113,925.20	4	504,000	70,560.00
	8th	20	2186.63	4,828,942.65	2	252,000	45,360.00
2009	9th	20	2124.15	4,660,243.49	7	882,000	202,860.00
	10th	20	2250.89	5,106,132.62	6	756,000	151,200.00
	11th	20	2274.09	5,673,281.67	9	1,134,000	283,500.00
2010	12th	20	2206.46	6,480,188.02	4	504,000	115,920.00
	13th	28	4769.86	10,706,589.02	5	630,000	176,400.00
	14th	28	4807.30	9,926,709.99	5	630,000	119,700.00
2011	15th	28	4953.31	11,305,150.10	3	378,000	83,160.00
	16th	28	4902.77	12,573,000.15	7	882,000	246,960.00
	17th	28	4997.05	11,736,930.47	9	1,134,000	260,820.00
2012	18th	28	4801.68	8,991,357.38	4	504,000	105,840.00
	19th	28	4953.31	11,975,692.04	4	504,000	65,520.00
	20th	28	4945.54	15,453,810.89	2	252,000	60,480.00
2013	21st	28	5091.34	16,147,712.85	6	756,000	128,520.00
	22nd	28	4855.63	12,334,978.38	8	1,008,000	191,520.00
	23rd	28	4997.05	14,521,370.73	7	882,000	132,300.00
2014	24th	28	5038.85	18,430,938.04	9	1,134,000	226,800.00
<i>Averages</i>					5.2	656,250	139,597.50

Source: Agricultural Cooperative.

Table 7
Composition of volumes of claims for dead animals.

Year	Semester	No. of participations	Coverage (heads)	Coverage (R\$)	No. of claims	Claims (heads)	Claims (shares in R\$)
2008	1	248	18,290	64,015,000.00	1	11	22,032
	2	232	18,150	63,525,000.00	0	0	0
2009	1	235	18,388	64,358,000.00	2	45	155,257
	2	239	19,050	66,675,000.00	1	20	69,003
2010	1	241	18,420	73,680,000.00	0	0	0
	2	246	18,338	73,352,000.00	2	91	367,806
2011	1	246	18,416	82,872,000.00	1	24	89,477
	2	250	18,774	84,483,000.00	3	18	67,108
2012	1	256	18,846	84,807,000.00	1	15	58,178
	2	276	19,458	87,561,000.00	0	0	0
2013	1	288	20,120	100,600,000.00	1	10	46,141
	2	292	21,292	106,460,000.00	1	12	55,369
2014	1	294	21,324	106,620,000.00	2	179	836,420
Averages					1.2	32.7	135,907

Source: Agricultural Cooperative.

and dry cows) and the average price paid to the farmer over the same period.

The average total cow production per year on the property and the indemnifiable value are calculated using the following equations:

$$TCp = \frac{Tp}{UA} \cdot TPind \cdot QtAc \quad (12)$$

$$Vind = TCp \cdot 60\% \cdot Pr \quad (13)$$

where TCp, average total annual cow production; Tp, total delivered production in the last 12 months (L); \overline{UA} , average annual number of cattle in animal unit; TPind, technical parameter for indemnity of an adult cattle unit, as described in Fig. 2; QtAc, quantity of animal claims; Vind, indemnifiable value; Pr, base milk price for the month.

The claims made in 13 semesters are shown in Table 7.

In the period in question, there was an average of 1.2 farmers with an average claim of 32.7 heads of dead cows. The average values of restitution in the form indemnities from the mutual fund was R\$135,907. An analysis of the amplitude of the shared values, with a minimum of zero and maximum of 836,420 shows that the risks involved in this activity are linked to conditions that can be monitored but not controlled and can happen to any cooperative member.

Animal	Months of age	Parameter
Female	≤ 6	0.3
	> 6 and ≤ 12	0.5
	> 13 and ≤ 24	0.7
	> 24	1.0
Male	Not indemnifiable	–

Fig. 2. Parameters for indemnifying adult bovine units.

Source: Agricultural Cooperative.

Conclusion

In all the cases presented, there was at least one recurring condition of insurability and the effectiveness of the mutual system was evident. It was also observed that, like regular insurance, the system is not efficient in situations of catastrophe, either in the form of sharing the cost of damage or with a guarantee fund.

In this article, the main characteristics, forms of calculation and histories of the values of claims of the mutual groups managed by the cooperative in question were presented. The groups were made up of milk, grain and pig farmers.

The mutual hail group, which is the most traditional group managed by the cooperative, has for some time been an important safety net for soy, corn and bean farmers in case of damage. The mutual farming fund, which is complementary to the mutual hail fund, has also worked effectively in the coverage of damage and has seen its balance grow over the years.

In the case of the system implemented for the slaughter house at the piglet production unit, this system minimizes the risks from the market that result from varying sales prices. The cooperative also benefits from this protection because it reduces the credit risk of the cooperative members and helps to guarantee that they can honor their commitments. Nevertheless, the system does not guarantee prices, but is an equalizer that adjusts the sales price to that of the average pig commercialized within a given period. In extreme situations, where losses can affect everyone in the group, the system is not capable of covering all the financial needs incurred.

The mutualism system implemented by the milk farmers minimizes the risks of the members when they are exposed to sanitary problems and lightning bolts. In critical situations when these risks occur, there is a definite possibility of the destruction of the breeding stock, meaning that it is no longer possible for the farmer to continue in this activity. This can increase the exposure of the cooperative member to the risk of lacking supplies for his milk production. However, like the other mutual funds of the cooperative, although the system meets the needs of members of the groups, as a financial guarantee for the member to remain operational, in catastrophic situations with high mortality rates,

the system would not have sufficient resources to meet all the financial needs of the group.

Due to the high frequency rate of damage in farming activities, protection systems such as insurance and mutualism provide greater security for farmers. This article demonstrated the importance of the mutualism systems practiced by an agricultural cooperative by analyzing practical cases of several types of risk.

Conflicts of interest

The authors declare no conflicts of interest.

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