

Maturity of risk management in agricultural supply chains

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Abstract

Purpose – This paper aims to assess the maturity level in the strategic risk management of an agricultural cooperative’s supply chain.

Design/methodology/approach – A descriptive qualitative research approach was employed for a case study. Four interview scripts were administered to 15 stakeholders within the supply chain and subjected to content analysis.

Findings – The findings reveal 23 strategic risks in the supply chain, whereas the maturity assessment identified five dimensions at the “Defined” level and two at the “Fragmented” level. To elevate the risk management maturity, this paper delineated 22 intervention actions.

Research limitations/implications – The theoretical contribution is the presentation of the various maturity assessment models and how they can be employed in studies on agribusiness supply chain risks.

Practical implications – Managerial implications underscore the formal establishment of a risk governance unit, the appointment of a Chief Risk Officer (CRO) and the constitution of an interdisciplinary risk management committee.

Social implications – Cooperatives contribute to adding value to rural production in many regions and project small and medium-sized producers in global markets. They play an economic and social role, promoting fair prices and providing services to members and the community. Efficient risk management can contribute to fostering the social role of cooperatives.

Originality/value – No maturity model for risk management in agribusiness supply chains is listed in the literature. This study can contribute to the development of such maturity models.

Keywords Agricultural cooperatives, Supply chain, Risk management, Maturity models

Paper type Research paper

1. Introduction

Brazil is widely recognized as one of the largest grain producers in the world, with agricultural cooperatives responsible for over 50% of this production, which accounts for 24.9% of the national GDP (Kureski, Moreira, & Veiga, 2020). Cooperatives also play a significant role in providing technical assistance, industrialization and marketing of rural production, which involves more than 1 million producers. Challenges and opportunities for cooperatives involve risk management across the entire supply chain, from the cooperative’s



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suppliers (*before the gate*) to the management of the rural properties by cooperative members (*inside the gate*), reception, processing, storage, sale of raw grain or transformation in industries and product delivery to the consumption point (*outside the gate*). Supply chain risk management aims to coordinate practices to identify, assess, respond to and monitor internal and external risks that may affect the performance and sustainability of the supply chain (Dellana, Rowe, & Liao, 2022).

Risk management guides organizations in defining risk appetite and tolerance in their respective businesses to enable them to achieve strategic planning objectives. Enterprise Risk Management (ERM) is understood as a *sine qua non* system for strategic planning in businesses, composed of structured and continuous processes responsible for maintaining a living and functioning system through a corporate governance structure, capable of identifying and responding to events that may affect the organization's objectives, mapping opportunities for gains and reducing the probability and effects of losses (Jean-Jules & Vicente, 2021).

The Brazilian Institute of Corporate Governance (IBGC), founded in November 1995, is an internationally renowned organization dedicated to promoting corporate governance in Brazil and the primary driver of practices and discussions on the subject in the country. IBGC observes that assessing the level of Enterprise Risk Management (ERM) maturity is crucial for the organization to evaluate its current state, determine where it wants to go, and plan the necessary actions to achieve the desired level of ERM (Instituto Brasileiro de Governança Corporativa, 2020).

However, there is a lack of maturity models to evaluate risk management broadly, considering solid theoretical and empirical bases (Bution, 2023). Existing models are typically designed for specific purposes. Concerning supply chain risks, there is also a lack of instruments in the literature to identify and manage risks despite their increasing practical and theoretical importance (Dellana et al., 2022).

This study aims to evaluate the maturity level of strategic risk management within the supply chain of an agricultural cooperative. For this purpose, we analyze an agricultural operational supply chain, the primary strategic risks agents face, the existing governance structure, ERM practices, performance strategies, the current maturity level assessment and actions to increase the maturity.

2. Theoretical framework

2.1 Agribusiness supply chain

Supply chain management (SCM) considers a sequence of buyers and sellers working together to take products from their origins to consumers. It aims to connect several links in the chain: market, distribution chains, industrialization (transformation), and purchasing to deliver a high-level and low-cost service and add value to those involved (Bowersox, Closs, & Cooper, 2024). SCM emerged as an evolution of the integrated logistics concept. While logistics is an internal integration of a firm's activities, SCM integrates external activities through the management of the upstream and downstream relationship between the flow of material and information, aiming for low costs and risks to add value to the chain as a whole. That is, the flow from suppliers through the firm to final consumers, including the reverse flow whenever it is necessary to return materials and information to the origin. Professional SCM management can lead well-positioned companies to a position of differentiation regarding risk management (Christopher & Holweg, 2017).

Agribusiness is a broad concept that includes rural properties, production, support and distribution activities. It comprises the manufacturing and distribution of inputs,

operations and productions in farm complexes, besides storage, processing and distribution to end consumers (Davis & Goldberg, 2021). These operations are part of a complex chain that involves numerous agents, such as suppliers of goods and services, rural producers, industry, warehouses, wholesalers and retailers. The final goal is to bring products to consumers using a wide range of services: financial, marketing, transportation, insurance and research, among others, all supported or influenced by the market, government, commercial entities and other services (Reklitis, Sakas, Trivellas, & Tsoulfas, 2021).

2.2 Maturity in risk management

As suggested by IBGC (2020), for this study, risks are classified into four categories: i) strategic, ii) operational, iii) financial and iv) external. Strategic risks are events whose materialization prevents the organization from achieving its strategic objectives and may cause lasting or substantial losses of economic value and reputation related to market, environmental, economic, social, technological, mergers and acquisitions factors. These risks are also associated with the top management's decision-making process. These events may affect the company's competitiveness and the realization of the business's value chain strategy, resulting in a competitive disadvantage compared to competitors (Lima, Crema, & Verbano, 2020; Xing, Ma, Zhao, & Liu, 2022).

Financial risks originate from factors that impact credit conditions, liquidity, cash flow, asset prices, interest rates, exchange rates or currency value, commodity prices, and guarantees, which consequently affect asset value, financial statements and the company's solvency (Komarek, Pinto, & Smith, 2020; Lima et al., 2020).

Operational risks refer to any loss arising from inadequacies, frauds, or failures of internal processes, litigation, actions of individuals and system problems that may affect information security and administrative or production processes (Xing et al., 2022; Yang, Xie, Yu, & Liu, 2021).

External risks arise when external forces significantly alter the organization's strategy or objectives without its ability to intervene, including political, legal, competition and customer behavior and natural disasters, potentially leading to discontinuation of business or even bankruptcy (Campobasso & Boscia, 2023; Cinar, Isin, & Hushmat, 2016).

Dellana et al. (2022) define risk management in supply chains as an inter-organizational collaborative process to identify, evaluate establish responses, and monitor events that may impact any link in the chain. To measure its risk management maturity level, an organization must assess its current capability to perform ERM practices. Table 1 presents a grouping of ERM dimensions according to some maturity models in the literature.

The authors use a structure of levels to assess the organization's risk management maturity in each dimension, as presented briefly in Table 2.

Hillson (1997) uses four maturity levels to assess current maturity and proposes actions to increase the level in each of the model's five dimensions. The author recommends that the goals be coherent and that the actions to increase maturity be done step by step to allow greater organizational adherence and process maturity in each phase.

The model of Poltronieri, Gerolamo, and Carpinetti (2017) was built based on the CMMI (capability maturity model integration) and the ISO 9004 standard, both aimed at assessing quality management. In all model dimensions, the focus is on integration among areas, the board's level of commitment to risk management, and constant analysis and review.

Table 1. Summary of ERM dimensions of maturity assessment models

Author/ year	Hillson (1997)	Poltronieri et al. (2017)	Oliva (2016)	Aon (2017)	IBGC (2017)	KPMG (2020)	RIMS (2022)
<i>Dimension</i>							
1	Definition	Policy	Organization	Board understanding and commitment Senior executive	ERM strategy	Risk governance	Adoption of the ERM process
2	Culture	Planning	Technicality		ERM governance	Risk assessment and measurement	ERM process management
3	Processes	Implementation	Transparency	Communication transparency	ERM policy	Risk management and monitoring	Risk willingness management
4	Experience	Execution	Involvement	Culture		Risk reports and analysis	Root cause discipline
5	Application	Proofing	–	Use of internal and external data and information	ERM process and interaction with other management cycles Risk language and assessment methods	Willingness to risk and strategy	Risk finding
6	–	Action	–	Participation of interested parties	Systems, data, and information models	Risk culture	Performance management
7	–	–	–	Financial and operational risk in decision-making	ERM culture, continuous improvement, communication and training, monitoring	Data and technology	Business resilience and sustainability
8	–	–	–	Human capital to drive performance	–	–	–
9	–	–	–	Sophisticated quantification methods	–	–	–
10	–	–	–	Risk leverage and value extraction	–	–	–

Sources: Adapted from [Hillson \(1997\)](#); [Poltronieri et al. \(2017\)](#); [Oliva \(2016\)](#); [Aon \(2017\)](#); [IBGC \(2017\)](#); [KPMG \(2020\)](#); [RIMS \(2022\)](#)

Table 2. Synthesis of maturity levels

Maturity levels	Hillson (1997)	Poltronieri et al. (2017)	Oliva (2016)	Aon (2017)	IBGC (2017)	KPMG (2020)	RIMS (2022)
1	Naive	1 Immature	Insufficient	Initial	Initial	Weak	<i>Ad hoc</i>
2	Beginner	2	Contingent	Basic	Fragmented	Sustainable	Initiate
3	Normalized	3	Structured	Defined	Defined	Mature	Repeated
4	Natural	4	Participative	Operational	Consolidated	Integrated	Managed
5	–	5 Mature	Systemic	Advanced	Optimized	Advanced	Led

Sources: Adapted from Hillson (1997); Poltronieri et al. (2017); Oliva (2016); Aon (2017); IBGC (2017); KPMG (2020); RIMS (2022)

Oliva (2016) states that assessing maturity without a prior assessment of risks in the value and business environments is impossible. The risk assessment must be systemic, considering connections among all agents. The author cites a global survey by Ernst & Young with more than 500 interviews that shows a positive relationship between the level of maturity in risk management and the financial performance of companies. In 20% of the companies with greater maturity, the economic performance (EBITDA) is three times greater than in the worst-ranked companies.

The AON Global Risk Consulting (AON), present in more than 120 countries, periodically publishes a global survey on risk management in various economic sectors. The survey shows the extent to which international companies successfully implement ERM, the effect of ERM on standardizing organizational needs, culture, and stakeholders' requirements, and how ERM is used proactively to balance risk, opportunity, and value. The Aon (2017) model is based on this research experience and was developed jointly by AON and the Wharton School of the University of Pennsylvania.

The KPMG (2020) model uses seven dimensions of risk management and an assessment that considers five maturity levels. In 2020, KPMG Consulting applied its model to assess the risk management environment among Brazilian companies. The results showed that 37% are classified as weak, 8% as sustainable, 40% as mature, 7% as integrated, and 8% as advanced level (KPMG, 2020).

The Risk and Insurance Management Society (RIMS, 2022) model is based on the CMM (capability maturity model), a methodology from the Software Engineering Institute of Carnegie Mellon of 1980. The model has 25 competence drivers with 68 indicators in seven dimensions. These dimensions aim to create value for ERM, covering planning, governance, evaluations, aggregation and risk assessment.

Most models use surveys or semi-structured interviews to collect data and measure maturity. However, they do not present the database and statistical analysis used. It suggests that some assessments are based on practical experience in a qualitative approach. Nevertheless, maturity levels are more similar to each other than dimensions.

IBGC (2020) addresses seven dimensions of ERM, notably with an emphasis on governance. This maturity model was selected to gauge the risk management maturity level in the supply chain of the studied cooperative. Despite its generic nature, the structure of the IBGC model (2020) provides a suitable framework for research applications related to cooperatives, agribusiness, and supply chains. It encompasses directives concerning board composition, ownership, guidance, executive management, audit functions, oversight entities and other stakeholders. Furthermore, the IBGC pioneered the development of a guide for best governance

practices in cooperatives ([Instituto Brasileiro de Governança Corporativa, 2015](#)). Corporate governance in cooperatives seeks to balance the relationships among members, managers and supervisory bodies to align stakeholders' interests. These aspects contributed to our decision to choose the IBGC model for the present study.

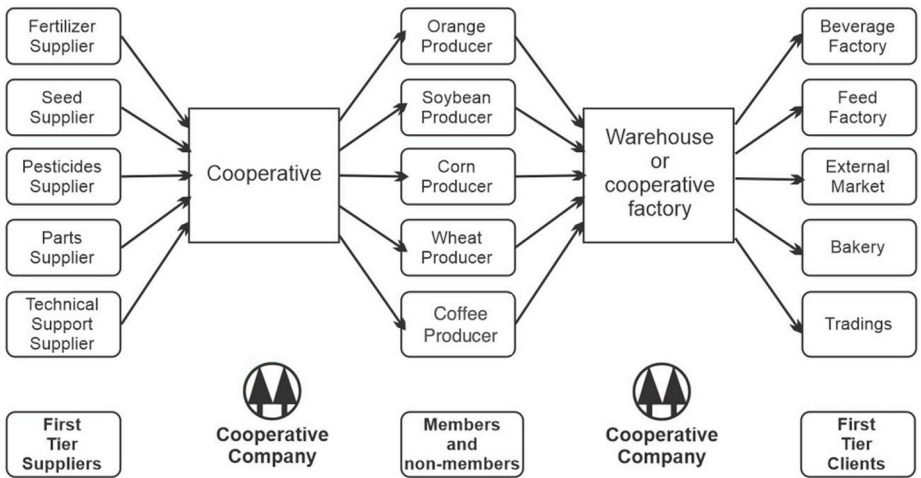
3. Methodological approach

The research focused on evaluating the risk management maturity in a single agent, named here Cooperative X. It involved assessing the current maturity level and suggesting actions within each dimension to increase maturity. The research sought insights from interviewees regarding their grasp of the cooperative's supply chain, primary strategic risks faced by chain participants, existing governance structure, ERM practices, performance strategies, assessment of the current maturity level and actions for advancement.

A qualitative approach characterizes the methodological procedures employed. Regarding the second epistemological dimension, the research is classified as both descriptive and prescriptive. On the one hand, it aims to elucidate and summarize current practices (descriptive); on the other hand, it proposes avenues for enhancement (prescriptive) due to its managerial implications.

The study centered on the grain production chain, encompassing interactions beginning with input procurement from the cooperative's first-tier suppliers. The cooperative operates with members and nonmembers, covering the supply of production inputs, reception, processing, storage, industrialization and sales of grains or derivatives to first-tier customers. However, members were not classified as suppliers or customers; this distinction was reserved for those interacting within the supply chain but lacking cooperative membership, excluding them from the cooperative's purview. This operational scope is illustrated in [Figure 1](#).

Data was collected via semi-structured interviews involving key stakeholders within the supply chain: managers, members, suppliers and customers. The interview guide underwent validation through pretests involving a panel of experts: two academic professors well-



Source: Authors' own work

Figure 1. Research delimitation

versed in the research domain, a risk specialist, an internal member of the cooperative's ERM division, a customer representative and a supplier representative.

The interviews were segmented into four parts: (i) External Supplier Interview Guide encompassing 12 inquiries; (ii) External Customer Interview Guide comprising ten questions; (iii) Internal Executive Management Interview Guide featuring 20 queries; and (iv) Internal ERM Interview Guide involving 26 questions.

Interviewees were selected through convenience sampling, which prioritizes accessibility and representation. This approach contrasts with the theoretical sampling that emphasizes selection based on anticipated contributions (Golzar, Noor, & Tajik, 2022).

To ensure a comprehensive representation of external entities (customers and suppliers), we adopted a classification system based on Brazilian reais (R\$) transactional values. The ABC categorization allocated "A" to entities responsible for 80% of the R\$ transactional value with the cooperative, while "B" encompassed those accounting for 15% of the R\$ value; finally, "C" represented those entities responsible for the remaining 5%. This stratification facilitated the assessment of perspectives from entities of varying scales (large, medium and small). Thus, aiming to represent large, medium and small customers and suppliers, one customer and one supplier of each category (A, B, C) were selected for interviews according to their availability and acceptance to participate.

Regarding internal participants, the ERM division of the cooperative was selected, along with the Grain Executive Management and Input Executive Management. These segments were chosen due to their direct daily engagement in supply chain activities and transactions. Additionally, representatives from the Business and Operation Superintendents were included due to their involvement in supply chain flow approvals. A member of the Board of Directors was also engaged to provide insights from a members' standpoint.

The interview phase resulted in 12 interviews (three customers, three suppliers and six internal agents) involving 15 participants (four ERM area members participated collectively).

A coding scheme comprising 26 codes was developed and organized into five analytical categories. Table 3 provides an overview of these categories and codes alongside their corresponding theoretical framework and descriptive details.

We adopted Bardin's (2013) content analysis methodology to analyze the interview content. This approach encompasses a set of systematic and structured techniques to identify and describe the key findings within the analyzed content. The analytical process encompassed transcription, preanalysis, materials exploration and result interpretation.

4. Findings and discussion

Cooperative X is a large-scale cooperative located in the state of Paraná, in southern Brazil, encompassing over 19,000 rural producers. Across its 115 operational units, it produces grains, seeds, meats, fertilizers, cotton yarn for weaving, animal feed, and a wide range of branded processed foods, among other businesses. In 2022, the cooperative achieved revenue of R\$11bn (compared to revenues of R\$9.6bn in 2021 and R\$7.0bn in 2020), which is a growth of 57% and a distribution of approximately R\$285m in surplus (results) to its members over two years. The grain production chain currently constitutes the cooperative's core business, accounting for about 80% of revenue and earnings generation.

4.1 Supply chain of cooperative X and strategic risks

The interviewees' understanding of the supply chain, its characteristics and stakeholders aligns with statements found in the literature, particularly those described by Christopher (2023), Christopher and Holweg (2017) and Shi and Wang (2023). The synthesis of citations regarding the benefits of Cooperative X's supply chain goes as follows: an organization of individuals

Table 3. Analysis categories

Analysis category	Theoretical framework	Codes and description
Supply chain knowledge	Christopher (2023)	Design and features Interfaces and agents Added value
Strategic risks	Oliveira (2012)	Risks of purchasing inputs Supply risks to producers Production risks in the field Receiving, processing, and storage risks Risks of industrialization Risks of selling grains or their derivatives
Risk management practices	ABNT (2018)	Integration: Everyone in every part of the organization is responsible for managing and overseeing risk Comprehensive and structured: Consistent and comparable outcomes are achieved through a comprehensive and structured approach to risk management Assessment: This involves evaluating the effectiveness of the risk management framework and periodically measuring performance against objectives, purposes, implementation plans and indicators to determine whether they remain adequate to support the organization's goals or require revision. It encompasses the iterative and collaborative identification, analysis, and evaluation of risks, leveraging the knowledge and viewpoints of stakeholders based on available information or through investigation when necessary while defining risk appetite and tolerance Inclusive: The knowledge, viewpoints, and perceptions of stakeholders provide appropriate and timely engagement for enhanced awareness and foundation of risk management. Examining and understanding the internal and external context is fundamental to the conception of risk management Dynamic: Risk management anticipates, detects, recognizes, and responds appropriately and timely to risks that may emerge, dissipate or transform under the influence of internal and external contexts. Periodic monitoring and critical analysis of process stages, performance management activities, measurement mechanisms, and organizational reporting must be scrutinized to promote risk management process improvement and ensure effectiveness, along with clearly defined responsibilities Best available information: All information must be clear and accessible to stakeholders, as risk management considers limitations and uncertainties related to historical and current information and future expectations. Communication aims to aid stakeholders in promoting risk awareness and understanding, offering sufficient information to facilitate risk oversight and decision-making. The consultation seeks relevant responses and information at each process stage, ensuring diverse viewpoints that can contribute to new risk management actions. Documentation and reporting of risk management, its

(continued)

Table 3. Continued

Analysis category	Theoretical framework	Codes and description
		analyses, and results must be documented and reported in appropriate mechanisms. Reporting is an integral part of governance and supports senior leadership and oversight bodies in fulfilling their responsibilities and standardizing dialogue with all stakeholders
		Human and cultural factors: All aspects of risk management at each level and stage are significantly influenced by human behavior and culture
		Continuous improvement: Learning and experiences enable continuous improvement of risk management. Adapting the framework to address external and internal changes as gaps or improvement opportunities are identified is pertinent to enhancing the risk management framework and elevating the organization's value
ERM maturity	IBGC (2017)	ERM strategy ERM governance ERM policy ERM process ERM language ERM systems ERM culture
Raising the level of maturity	ABNT (2018) IBGC (2017)	Good practices Recommendations and contributions
Source: Table by authors		

seeking to unite small producers to achieve a comparable level of influence with suppliers and customers as larger producers, aiming to access markets and products to fulfill their needs at fair prices, equitably for all, culminating in year-end results that are reinvested in the cooperative's infrastructure or distributed as surpluses to contribute to the economic, social and cultural aspects of the community in which Cooperative X's supply chain operates.

Considering the initial stage of the supply chain (procurement of inputs from suppliers by the cooperative), 11 strategic risks were identified. The three most cited risks were market volatility, product flow interruption, and single supply source. Seven strategic risks were identified in the second stage (supply of inputs to producers by the cooperative). Two risks stood out: legal disputes and forecast errors in supply vs demand. The main strategic risks related to rural production were highlighted in the third stage of the supply chain, where six strategic risks were identified. Among the total of 15 occurrences, the main risk was *climatic factors*.

In the stages related to reception, processing, and storage, the four risks identified related to operational problems concerning the processing flow, logistics, product quality, contamination, preservation and fraud. When these issues occur recurrently, they can become strategic risks. Only five mentions of these strategic risks happened in this stage, and the risk of product flow interruption stood out.

In the processing stage, four strategic risks were identified. The occurrences of low or high demand and product flow interruption were highlighted. Product flow interruption has a high impact on industry performance and, consequently, on customer service. Considering the final stage of the supply chain (sale of grains or derivatives to external customers), the most mentioned risks were market volatility, reputation and image, and climatic factors.

The overall consolidation of the 91 occurrences of the 23 identified strategic risks (some were identified in more than one supply chain stage) is presented in [Table 4](#).

According to the interviewees, the market volatility risk may be related mainly to financial risks (exchange rate fluctuations, taxes, low cash reserves) and also be connected to other strategic risks, such as seasonality, scarcity or excess of supply, low or high demand, as well as linked to the strategic risk of product flow interruption, which, in turn, may result from external risks such as climatic factors, wars, strikes, trade barriers, changes in laws, and regulations.

4.2 Risk management practices

Strategic risks of higher severity should be monitored by top management or a corporate governance committee/strategic risk management committee. In contrast, lower severity risks can be monitored by managers of lower layers of the organization, considered in the second line (The [Institute of Internal Auditors, 2020](#)).

The identification of practices to cope with strategic risks of the cooperative's supply chain focused on evaluations related to the three most frequent risks. This delimitation is justified because they represent more than 42% of the risks mentioned.

Regarding *market volatility*, especially in procuring inputs from suppliers by the cooperative and selling grains or derivatives to customers, we identified that the cooperative systematically manages its cash flow. This practice enhances its bargaining power, enabling purchases of large batches of inputs and mitigating risks related to concentrated sales (fixing) of grains by members when commodity prices rapidly appreciate or when there are sudden price drops.

Regarding *grain sales in futures markets*, the cooperative employs hedge and derivative practices to avoid exposure to exchange rate fluctuations. We also identified that the cooperative avoids open positions between the fixing for the producer and the sale to

Table 4. Occurrences of consolidated strategic risks

Strategic risks	Citations	%
Market volatility	15	16.48
Interruption of product flow	13	14.28
Climatic factors	11	12.08
Legal disputes	6	6.58
Shortage or excess supply	5	5.49
Reputation and image	5	5.49
Technological changes	4	4.40
Loss of trust in the product or brand	4	4.40
Low or high demand	3	3.30
Supply vs. demand forecast errors	3	3.30
Single source of supply	3	3.30
Uncertainty about long-term impact	3	3.30
Margin reduction and hidden costs	3	3.30
Failure to implement the strategy	2	2.20
Inability and slowness to innovate	2	2.20
Seasonality	2	2.20
Absence or failures of governance	1	1.10
Short life cycle	1	1.10
Lack of visibility across the entire chain	1	1.10
Fusions and acquisitions	1	1.10
Employee strike	1	1.10
Unavailability of raw material	1	1.10
Technological obsolescence	1	1.10

Source: Table by authors

customers. These strategies help ensure the margin between the price sold to customers and the price paid to producers, generating a net result of the operation after deducting relevant operational expenses.

Regarding the risk of *product flow interruption*, the cooperative conducts pre-sale campaigns for inputs with its members, seeking better bargaining power in negotiations with suppliers and systematic planning of the delivery flow, compatible with the producer's usage needs in all their demands. Nevertheless, although this is a risk mitigation and supply assurance practice, some producers do not purchase inputs in advance during campaigns, resulting in higher disbursements at the time of use or the risk of not having the product delivered due to the industry's capacity or events such as road strikes, port issues, or conflicts between countries, which affect the origin of inputs, mainly fertilizers and ingredients for pesticide production.

As for the risks related to climatic factors, the cooperative has faced significant losses in production due to drought and pest attacks in recent harvests. We found that in the case of *low rainfall*, the cooperative offers its producers irrigation equipment and a package of high-tech inputs. Concerning *pest attacks*, the cooperative has a qualified technical staff to control and monitor occurrences in the field with producers.

To reduce exposure to climatic risks in a single region, the cooperative has expanded its operations to other regions and diversified its business areas through vertical integration. Additionally, the cooperative has established its own insurance brokerage to encourage producers to purchase agricultural insurance. It was identified that the cooperative also has Technology Diffusion Units (TDUs) to transfer knowledge to producers and technical staff on various aspects (soil management, planting techniques, resistant cultivars, physical-chemical

characteristics of pesticides, crop diversification, etc.), which can contribute to minimizing losses resulting from climatic factors, water crises or pest attacks.

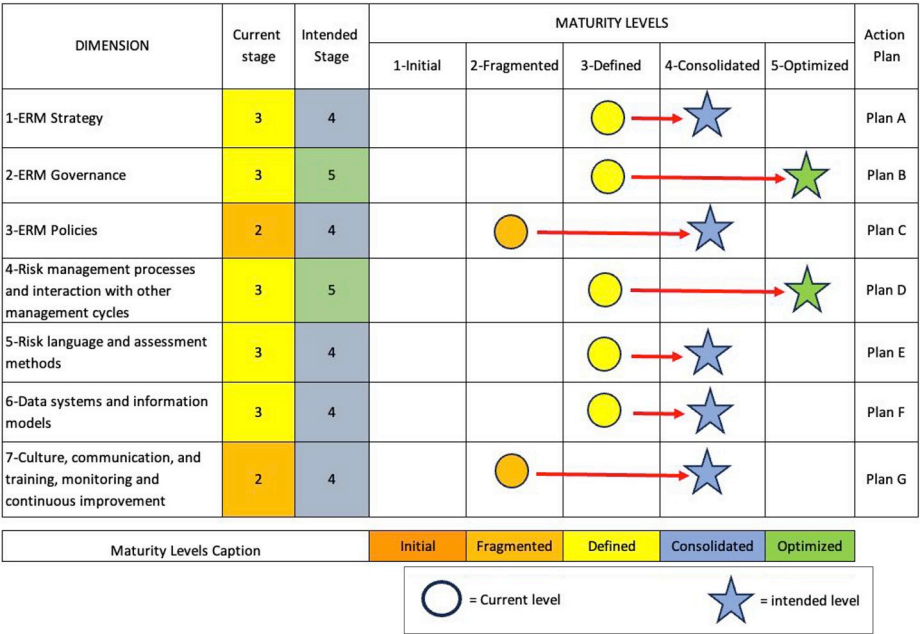
Concerning the ERM structure, the cooperative has a sector integrated with other management activities, a governance manual and common practices, tools, and techniques to monitor strategic risks. This structure has been considered effective, even though the cooperative lacks some essential elements considered best practices, such as a constituted strategic risk management committee, a specific position of Chief Risk Officer (CRO), the presence of professionals dedicated exclusively to risk management and a specific budget for ERM activities. It also does not address the management of strategic risks together with its customers, suppliers and members.

4.3 Maturity in strategic risk management of cooperative X

Figure 2 presents the current and intended maturity levels regarding ERM practices in each dimension proposed by IBGC (2020).

The first step to elevate the maturity level in managing strategic risks in each dimension is identifying and improving mechanisms, tools and practices that allow for risk control and prioritization. This can enhance the establishment of response strategies to reduce the probability of occurrence or minimize their impacts. Additionally, it is crucial to determine mechanisms to define risk appetite and tolerance in decisions that expose the supply chain.

Table 5 presents propositions of actions that contribute to elevating the maturity level in each of the seven dimensions. All respondents demonstrated that the cooperative is



Source: Authors' own work

Figure 2. Current and intended maturity levels of cooperative's ERM

Table 5. Actions to increase maturity level in strategic risk management

Dimensions	Action plan	Proposals for actions
(1)	A	<ul style="list-style-type: none"> • Define a mechanism so that the ERM strategy, objectives and goals have performance targets clearly monitored; • Integrate ERM performance goals with business area goals; • Disseminate the ERM strategy, objectives and goals across all hierarchical levels and all cooperative sectors
(2)	B	<ul style="list-style-type: none"> • The ERM organizational structure needs to be clearly defined with roles and responsibilities for ERM practices, aligned with business strategy and objectives; • Consolidate the ERM organizational structure, becoming a reference organizational model for the sector; • Effectively consider the role of the board of directors, the executive board, the administrative body, the risk committees and the audit so that all three lines are distributed in the ERM governance structure without overlaps and uncovered points; • Direct the various functions of the 2nd line of defense to promote value for the organization in line with the other lines
(3)	C	<ul style="list-style-type: none"> • Establish a constant update of the ERM policy following changes in business strategies; • Create consistent communication of the new ERM policy at all levels and sectors of the organization and external stakeholders in the business areas
(4)	D	<ul style="list-style-type: none"> • Carry out activities integrated with strategic business objectives to identify risks, assess, control, monitor, respond and communicate; • Monitor ERM activities in an efficient and systematically coordinated manner, aligned with the cooperative's other control practices, decision-making processes and management cycles; • Make the ERM standard robust and concrete to be a reference for the sector
(5)	E	<ul style="list-style-type: none"> • Carry out activities integrated with strategic business objectives to identify risks, assess, control, monitor, respond and communicate; • Monitor ERM activities in an efficient and systematically coordinated manner, aligned with the cooperative's other control practices, decision-making processes and management cycles; • Make the ERM standard robust and concrete to be a reference for the sector
(6)	F	<ul style="list-style-type: none"> • Take advantage of the use of emerging and integrated online technologies; • Ensure that information about risk exposure, as well as the organization's objectives for managing risks, are understood at all levels of the cooperative
(7)	G	<ul style="list-style-type: none"> • The assessment of the risk and control culture must be inserted into the organization's daily activities, identifying whether strategic risks are being proactively addressed at all process and function levels, providing a reasonable guarantee that strategic objectives are achieved; • A governance area with a CRO (chief risk officer) must be formally designated to manage strategic risks and support business area managers. • A risk management or risk governance committee must include members from all three lines. The CRO needs to frequently monitor ERM practices and meet with the committee to seek validation, dissemination, and continuous improvement of processes, aiming to increase maturity in strategic risk management throughout the supply chain; • Clear ERM training programs and communication channels for reporting ERM strategies need to be created to cover all audiences, especially when there are changes to ERM; • ERM must be considered in the cooperative's decision-making process, day-to-day management, programs and training for consistent incorporation into the cooperative's culture

Source: Table by authors

concerned about managing the supply chain effectively. They acknowledged that if one of the chain's participants is affected, all may suffer consequences. The cooperative is perceived as robust in the market. Still, negligence in addressing any of the identified strategic risks could lead to the downfall of the cooperative society and create a ripple effect

on all other stakeholders. Consequently, all respondents unanimously perceived the need to elevate the maturity level of strategic risk management in the cooperative's supply chain.

The managerial implications of the findings indicated the starting point as the formal establishment of a governance area, the appointment of a CRO, and the constitution of a strategic risk management committee. The findings demonstrated a deep understanding of the supply chain agents, particularly when pointing out over ninety strategic risk occurrences, highlighting market volatility, product flow interruption and climatic factors.

5. Conclusion

Amid highly dynamic contexts involving supply chains, this research sought to assess the maturity of strategic risk management in the supply chain of an agricultural cooperative. To this end, some intermediate objectives were achieved: (i) mapping of cooperative X's supply chain; (ii) identification of the main strategic risks in the supply chain; (iii) identification of the risk management practices and responses to strategic risks; (iv) assessment of the current level of maturity in risk management; (v) proposal of actions to increase the maturity level.

It was possible to confirm the interviewees' extensive knowledge of the supply chain, its characteristics and its agents, as described in the literature (Bowersox et al., 2024; Christopher & Holweg, 2017).

The interviewees were able to describe the broad scope of the cooperative's supply chain and identify the strategic risks to which it is exposed. A total of 23 strategic risks were identified, emphasizing the importance of elevating maturity to avoid catastrophic consequences that could affect all chain participants. Regarding current risk management practices at Cooperative X, there is no specific risk management sector, CRO, or risk committee to deal with risk appetite and tolerance. Most of the time, risk management practices are used reactively. Among the main strategies identified for increasing maturity level, the formal establishment of a governance area, the appointment of a CRO, and the constitution of a strategic risk management committee are essential for implementing other recommended actions. These measures will enable improvements in defining risk appetite and tolerance, particularly for the three primary strategic risks identified: market volatility, product flow interruption and climatic factors.

This case can be considered a typical one, as other sector organizations can use the findings. The supply chain practices of agricultural cooperatives are similar. Thus, other agricultural cooperatives could use different methods to assess and improve risk management maturity.

In addition to the specific contributions to the cooperative's supply chain, this study is expected to stimulate further analyses due to the importance of advancing the maturity level in risk management for the entire cooperative system. Cooperatives contribute to adding value to rural production in many regions, as well as to project small and medium-sized producers in global markets. They play an economic and social role, promoting fair prices and providing services to members and the community. Efficient risk management can contribute to fostering the social role of cooperatives.

Finally, we suggest similar assessments be done in cooperatives of other branches, such as credit, health, structure, etc. This assessment can improve risk management and the resilience and perpetuity of the cooperative sector.

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