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Security in Agribusiness: challenges and technological solutions for asset protection

Segurança no Agronegócio: desafios e soluções tecnológicas para proteção patrimonial

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Abstract

Brazilian agribusiness accounts for approximately 22.7% of the national GDP but faces growing challenges from rural crimes, such as theft of machinery, inputs, and livestock, compromising asset security. This study analyzed technological solutions applied to rural protection, as well as related public policies and private initiatives. Based on a systematic literature review and case analysis, innovative tools such as drones, smart sensors, artificial intelligence, and blockchain were identified, enhancing monitoring efficiency and response to incidents. The role of public policies and public-private partnerships in enabling access to these technologies, especially for small and medium-sized producers, is highlighted. The SWOT analysis proved useful for mapping the strengths, weaknesses, opportunities, and threats of the proposed solutions. It is concluded that the combination of technologies, financial incentives, technical training, and public policies contributes to reducing rural crime and strengthening the sustainability of the agricultural sector.

Keywords: Asset Security; Agribusiness; Technological Innovation.

Resumo

O agronegócio brasileiro responde por cerca de 22,7% do PIB nacional, mas enfrenta desafios crescentes com crimes rurais, como furtos de maquinários, insumos e gado, que comprometem a segurança patrimonial. Este estudo analisou soluções tecnológicas aplicadas à proteção no campo, além de políticas públicas e de iniciativas privadas relacionadas. A partir de uma revisão sistemática e da análise de casos, foram identificadas ferramentas inovadoras, como drones, sensores inteligentes, inteligência artificial e *blockchain*, que aumentam a eficiência no monitoramento e na resposta a incidentes. Destaca-se o papel das políticas públicas e das parcerias público-privadas para viabilizar o acesso a essas tecnologias, sobretudo para pequenos e médios produtores. A análise SWOT mostrou ser útil para mapear forças, fraquezas, oportunidades e ameaças das soluções propostas. Conclui-se que a combinação de tecnologias, incentivos financeiros, capacitação técnica e políticas públicas contribui para reduzir a criminalidade rural e reforçar a sustentabilidade do setor agropecuário.

Palavras-chave: Segurança Patrimonial; Agronegócio; Tecnologias Inovadoras.

Technological Area: Innovation and Development.

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1 Introduction

Brazilian agribusiness accounted for an average of 22.7% of the country's Gross Domestic Product (GDP) in 2023 and 2024, totaling R$2.57 trillion per year (IBGE, 2023; CEPEA/CNA, 2025). The sector is responsible not only for ensuring domestic food production but also for strengthening exports, positioning Brazil among the world's leading producers, particularly of commodities such as soybeans, corn, cotton, sugar, and meat. Despite its economic relevance, agribusiness faces increasing challenges related to asset security.

Security in rural areas is compromised by factors such as the vast territorial extension of properties, low population density, and the lack of adequate policing, which is provided by the state as a public security service. According to recent data from IBGE (2023), theft rates in rural areas have increased by 15% over the last five years, affecting the financial and operational sustainability of producers.

Among the most common crimes in rural areas are the theft of agricultural machinery, agrochemicals, and stored products, as well as cattle rustling and the theft of other livestock. These crimes generate annual losses amounting to billions of reais, as reported by Oliveira (2020). Their impact extends beyond financial losses, also affecting the psychological well-being of producers, who often become vulnerable to further criminal activity.

To mitigate these challenges, the use of security technologies has gained increasing prominence in the agricultural sector. Solutions such as drones, intelligent cameras, and AI-powered monitoring systems have demonstrated significant potential to transform asset protection in rural areas. These tools not only provide greater control over properties but also enhance threat detection efficiency, reducing response times in critical situations (Silva & Costa, 2021).

Despite technological advances, the adoption of security solutions is not uniform across the country. Small and medium-sized producers face significant barriers, including high implementation costs and limited technical knowledge. Studies indicate that government incentives and subsidies are essential for democratizing access to technology in rural areas (Almeida, 2019).

Another relevant issue is the need for clear legislation regulating the use of emerging technologies in agribusiness. Brazil currently faces regulatory challenges related to drone operations and data collection on rural properties. According to Carvalho and Ferreira (2021), the lack of regulatory clarity may limit the potential application of these solutions.

The impact of insecurity in agribusiness also affects the national economy. Reduced production resulting from financial and logistical losses compromises domestic supply and exports, generating negative repercussions on the country's trade balance (Brazil, 2022).

Given this scenario, this article seeks to explore technological solutions that may contribute to improving asset security in agribusiness. Furthermore, it proposes a detailed analysis of the challenges faced by the sector, addressing issues such as technological barriers, implementation costs, and regulatory frameworks.

2 Methodology

Through a systematic literature review and case study analysis, best practices were identified and implementation models for asset security in rural areas were examined, with the aim of identifying approaches that can be replicated across different regions of the country. The study followed a qualitative and exploratory approach. The research was structured to identify and analyze the main technological innovations and public policies related to asset security in agribusiness, while examining the evolution of rural protection practices in Brazil and in other international contexts.

The bibliometric review was conducted following rigorous scientific criteria for data selection, analysis, and interpretation. The methodological process was developed in three main stages: literature review, selection and analysis of studies, and the preparation of a SWOT analysis to evaluate the sector's strengths, weaknesses, opportunities, and threats.

The systematic review was conducted through the analysis of relevant academic sources, encompassing publications in Portuguese and English from January to June 2025. The databases consulted included the Brazilian Digital Library of Theses and Dissertations (BDTD), Scientific Electronic Library Online (SciELO), CAPES Periodicals Portal, Scopus, and Web of Science.

The objective was to ensure a comprehensive mapping of discussions and the most recent innovations related to asset security in agribusiness. The search terms included: "asset security in agribusiness," "rural security," "artificial intelligence monitoring in agribusiness," "drones in agribusiness," "drones in agriculture," "public policies for rural security," "violence on farms," "farm robbery," "farm theft," "violence in agribusiness," "robbery in agribusiness," "theft in agribusiness," "violence in rural areas," and "rural violence."

The time frame covered publications from 2010 to 2024, seeking relevant studies within the Brazilian context as well as in countries with advanced practices in the agricultural sector. Table 1 presents the search terms used across the main databases.

Table 1 – Search terms used in the major databases

Search Terms	Scopus	Web of Science	SciELO	CAPES	BDTD
Asset Security in Agribusiness	0	0	0	1	0
Rural Security	0	0	0	8	12
Artificial Intelligence Monitoring in Agribusiness	153	101	0	0	4
Drones in Agribusiness	1	26	0	3	0
Drones in Agriculture	72	53	1	13	2
Public Policies for Rural Security	0	36	0	1	0
Violence on Farms	2	1	0	1	0
Farm Robbery	0	142	0	1	0
Farm Theft	0	2	0	1	0
Violence in Agribusiness	0	98	0	1	1
Robbery in Agribusiness	0	9	0	0	0
Theft in Agribusiness	0	1	0	0	0
Violence in Rural Areas	11	231	0	81	90
Rural Violence	11	94	5	7	12

Source: Scopus, Web of Science, SciELO, CAPES e BDTD (2025)

The initial systematic review revealed a significant increase in academic production related to agribusiness security associated with digital technologies over the past two decades. The temporal analysis of publications conducted between 2004 and 2024 indicates substantial growth after 2015, coinciding with the widespread adoption of IoT sensors, machine learning, and drones in agricultural applications. Studies were relatively limited until the mid-2010s and were primarily focused on traditional rural surveillance topics. However, from 2016 onward, the literature increasingly incorporated approaches based on computer vision, data mining, and predictive models applied to asset security risks.

The peak in publications occurred between 2020 and 2023, as illustrated in Graph 1, a period characterized by greater digitalization of the agricultural sector and the expansion of rural automation systems. This trend reflects the maturation of the field, indicating that intelligent solutions for theft prevention, intrusion detection, and territorial monitoring have evolved from experimental applications to central topics in scientific discussions on agricultural innovation. The continued growth trend also highlights the emergence of a consolidating technological niche, reinforcing both the relevance of this study and the market potential of the solutions analyzed.

Based on the data obtained, a technological feasibility analysis was conducted considering factors such as implementation costs, the financial resources required for the adoption of technologies; ease of adoption, including the barriers faced by small and medium-sized producers; regulatory compliance, involving the assessment of legal standards and guidelines applicable to the use of monitoring technologies in agribusiness; and operational efficiency, defined as the ability of technological solutions to mitigate the risks associated with property-related crimes.

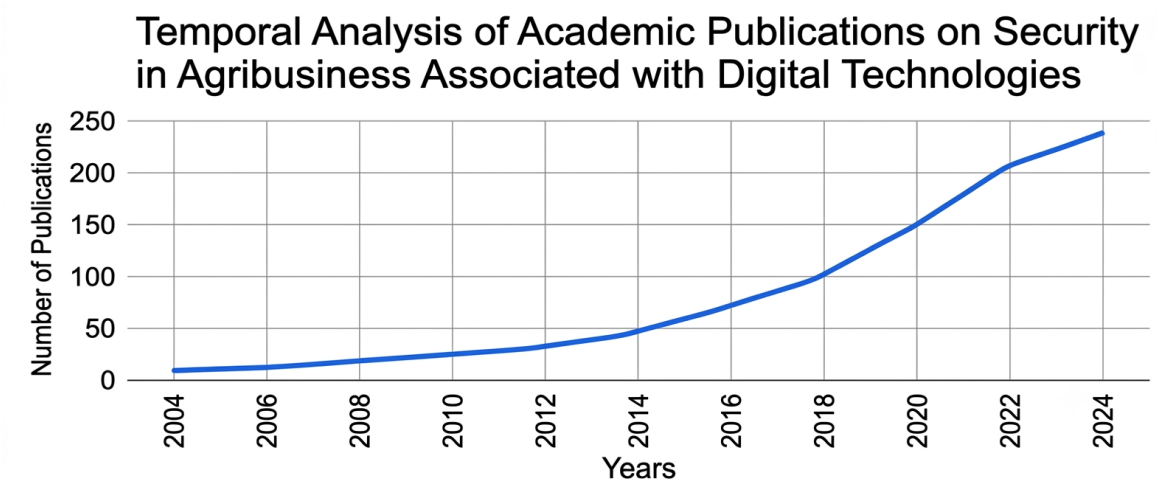
The Rural Security Handbook (FAEMG-SENAR, 2024) was used as a reference source for validating rural security practices, aligning the academic review with the actual practices adopted on Brazilian rural properties. The practical recommendations contained in the document were compared with the technological solutions and public policies identified in the literature, ensuring an integrated approach that combines theory and practice.

3 Results and Discussion

The current asset security landscape in Brazilian agribusiness is challenging, particularly due to the vast territorial extension of rural properties, the lack of specialized policing, and the vulnerability of small farms. Data from IBGE (2023) indicate a 15% increase in thefts and robberies on rural properties over the past five years, highlighting the need for a more robust and effective approach to rural security.

The most common crimes include the theft of agricultural machinery, agrochemicals, and stored products, as well as cattle rustling, which involves the theft of

Graph 1 – Temporal analysis of academic publications on agribusiness security associated with digital technologies (2004-2024)



Source: Scopus, Web of Science, SciELO, CAPES e BDTD (2025)

livestock. These crimes generate annual losses amounting to billions of reais and produce not only financial impacts but also psychological consequences, affecting the safety and well-being of rural producers (Oliveira, 2020). In addition, states such as Mato Grosso and Paraná have expanded initiatives aimed at combating property-related crimes in rural areas, reflecting growing concern regarding theft and vulnerabilities within agribusiness (Embrapa, 2023; FAEP System, 2023).

The most common security measures remain traditional approaches, such as fencing and human surveillance. However, these methods have proven insufficient in the face of increasing rural crime rates. In this context, the use of emerging technologies has emerged as a promising alternative for addressing security challenges in rural environments (Santos, 2022).

The adoption of technologies such as drones, camera-based monitoring systems, smart sensors, and artificial intelligence has demonstrated significant results in reducing criminal incidents. These solutions have been widely implemented on large agricultural properties; however, access remains limited for small and medium-sized producers due to high costs and a lack of technical training.

The timeline clearly illustrates the transition of security technologies within Brazilian agribusiness, highlighting the significant advancement of the tools employed over the decades (Figure 1). Initially, rural properties relied on basic methods such as fencing and human surveillance, strategies that offered limited coverage and efficiency but were suitable for small properties and involved low operational costs (Santos, 2022).

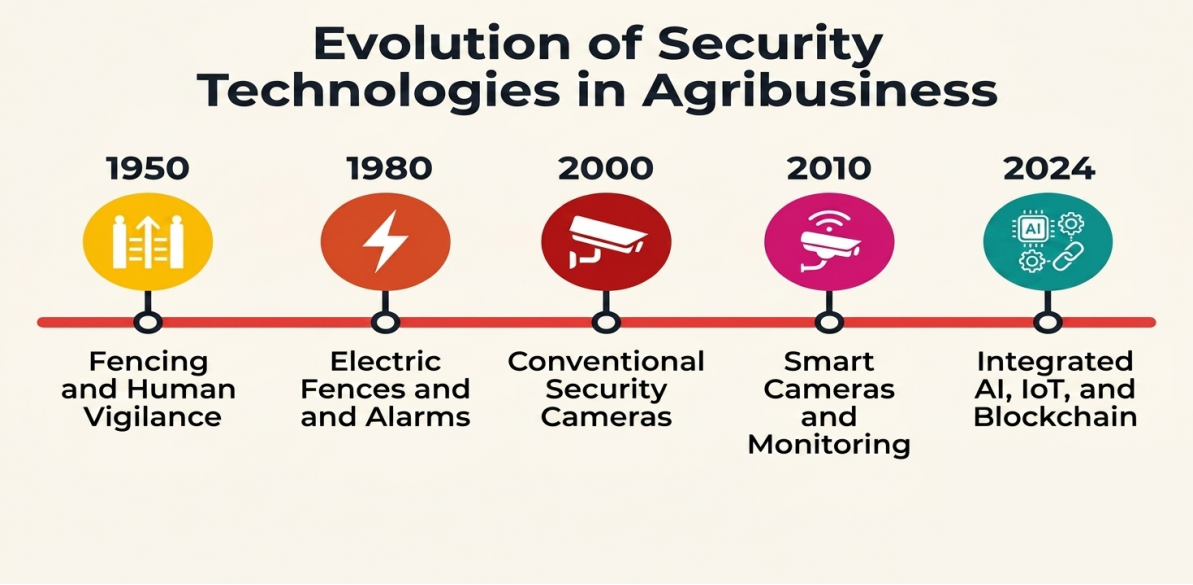
Over the years, technological advances have introduced intermediate solutions, such as electric fencing and basic alarm systems, increasing control over vulnerable areas. From 2010 onward, more sophisticated technologies, including conventional security cameras, began to be implemented, although their application remained limited in more remote regions (Silva & Costa, 2021).

The current landscape, characterized by the use of drones, Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain, represents a revolution in the way asset security is managed (Carvalho & Ferreira, 2021; Cunha, Freitas, & Oliveira, 2021). These technologies enable real-time monitoring of large properties, increasing efficiency in crime prevention and detection while also allowing for more rapid responses to risk situations.

The comparative framework of security technologies demonstrates substantial progress within Brazilian agribusiness (Box 1). Earlier technologies, based on human surveillance and simple fencing, exhibited significant limitations in terms of coverage and operational efficiency. Responses to incidents were largely reactive, requiring the presence of security personnel or direct intervention by the property owner (Santos, 2022).

With the development of emerging technologies, the sector has gained access to advanced tools such as drones and smart sensors, which have significantly expanded monitoring coverage. The introduction of artificial intelligence and automation has enabled predictive risk analysis, optimizing asset protection and reducing long-term operational costs despite the high initial investment (Silva & Costa, 2021).

Figure 1 – Timeline of the evolution of security technologies in agribusiness



Source: Prepared by the authors (2025)

Box 1 – Comparative Overview of Security Technologies in Agribusiness

Aspect	Traditional Technologies	Current Technologies
Monitoring	Human Surveillance and Basic Fencing	AI, Drones, Smart Sensors, and IoT
Incident Response	Manual Response (Contacting Authorities)	Automated Response and Remote Monitoring
Area Coverage	Limited to Visual or Auditory Range	Extensive Coverage Through Drones and Remote Sensors
Initial Cost	Low	High
Operational Efficiency	Moderate, Dependent on Human Presence	High, Enabled by Automation and Real-Time Analytics
Ease of use	High, Requiring No Specialized Training	Moderate, Requiring Technical Training

Source: Prepared by the authors (2025)

These innovations have also enhanced operational efficiency and threat response capabilities by integrating different security systems and facilitating remote property management. The use of blockchain technology, for example, has increased transparency and security in transactions and asset traceability (Cunha, Freitas, & Oliveira, 2021).

Emerging technologies have revolutionized asset security in agribusiness. The implementation of drones equipped with thermal cameras, motion sensors, and artificial intelligence systems enables real-time monitoring of vast areas, significantly increasing efficiency in combating rural crime (Silva & Costa, 2021). These technologies provide faster responses to incidents, allowing the early detection of intrusions and other suspicious events. The use of smart sensors connected through the Internet of Things (IoT) has enabled continuous monitoring, reducing response times for both authorities and property owners.

In addition, blockchain-based platforms have been explored to track and ensure the authenticity of agricultural products, contributing to the reduction of fraud and theft (Cunha, Freitas, & Oliveira, 2021). Recent studies indicate that the integration of blockchain and artificial intelligence can enhance traceability, reduce vulnerabilities, and strengthen the security of agribusiness operations (Cunha, Freitas, & Oliveira, 2021).

Despite technological advances, the adoption of these solutions still faces significant challenges, including high implementation costs, the need for technical training, and infrastructure limitations in remote rural areas. These barriers particularly affect small-scale producers, limiting their access to advanced digital asset security technologies.

The territorial heterogeneity of Brazilian and international agribusiness directly influences both the type of security technology adopted and the degree of impact perceived by producers. To systematize these differences, Box 2 was developed to present a geographic and sectoral mapping of the impacts of emerging asset security technologies in agribusiness..

The expanded geographic mapping demonstrates that Brazil presents a mosaic of production profiles and asset security risks that vary significantly across regions. While the Central-West and MATOPIBA regions are characterized by extensive agricultural properties with greater vulnerability to intrusions and theft, the South and Southeast regions face distinct risks associated with the theft of agricultural inputs, machinery, and high-value livestock.

The irrigated Northeast incorporates specific environmental monitoring requirements, whereas the North region faces connectivity challenges and remains dependent on hybrid solutions and satellite-based internet services. This detailed assessment reinforces the need for flexible and scalable technologies capable of adapting to the diverse territorial realities of Brazilian agribusiness.

The SWOT analysis of Security in Agribusiness enabled the identification of the main challenges and opportunities related to asset protection in the rural sector. This strategic assessment evaluates strengths, weaknesses, opportunities, and threats, providing a foundation for the development of more effective and sustainable solutions(Box 3).

The SWOT analysis highlights a challenging landscape for asset security in agribusiness. Among the key strengths are the advances in emerging technologies, such as drones, smart sensors, and artificial intelligence, which provide greater control and efficiency in the protection of rural properties. In addition, the establishment of Rural Police Units and state-level security programs has strengthened governmental responses to rural crime, making law enforcement actions more agile and effective.

Another relevant factor has been the partnership between producers and private security companies, which

Box 2 – Geographic and sectoral mapping of the impacts of emerging asset security technologies in agribusiness

Region/ Country	Agribusiness Segments	Level of Impact of Technologies (AI, Drones, Sensors, Computer Vision)	Observations
Brazil – South (PR, SC, RS)	Grain Production, Swine Farming, and Poultry Farming	Medium/High	High risk of theft of agricultural inputs and machinery; smaller properties facilitate hybrid monitoring (ground-based systems and drones).
Brazil – Southeast (SP, MG, ES, RJ)	Sugarcane, Coffee, Horticulture, and Dairy Farming	Medium	Growing adoption of AI-based systems and sensors; heterogeneous properties require modular solutions.
Brazil – Central-West (MT, MS, GO)	Soybean, Corn, Cotton, and Extensive Livestock Farming	High	Large territorial extensions; greater vulnerability to intrusions and unauthorized movements.
Brazil – MATOPIBA (MA, TO, PI, BA)	Grain Production, Cotton, and Livestock Farming	High	Agricultural frontier region with high rates of rural property-related crimes; strong demand for aerial monitoring.
Brazil – Northeast (Outside MATOPIBA)	Irrigated Fruit Production and Beef Cattle Farming	Medium	Irrigated areas require continuous monitoring; increasing adoption of environmental sensors.
Brazil – North	Livestock Farming, Horticulture, and Extractive Activities	Low/Medium	Connectivity limitations and structural challenges; significant growth potential through satellite-based technologies.

Source: Prepared by the authors (2025)

Box 3 – SWOT Matrix of Asset Security in Agribusiness

Factors	Positive Factors	Negative Factors
Internal Factors	**Strengths**	**Weaknesses**
	- Advancement of technologies applied to asset security in agribusiness (use of AI, drones, and sensors).	- High implementation costs of security technologies.
	- Public-private partnerships strengthening rural security.	- Limited technical training among producers and rural workers.
	- Creation of Rural Police Units and programs specifically designed for rural areas.	- Deficient communication infrastructure in remote areas, hindering the use of technologies such as IoT and blockchain.
	- Growing awareness among producers regarding the importance of security.	- Lack of standardization in the adoption of security measures across states and municipalities
	- Partnerships between producers and private security companies, expanding monitoring capabilities and enabling faster responses to rural crimes	
External Factors	**Opportunities**	**Threats**
	- Expansion of financing programs for rural security.	- Growth of organized crime targeting the theft and robbery of agricultural inputs, livestock, and machinery.
	- Integration of monitoring systems (IoT, blockchain, and AI) to enhance the efficiency of asset security.	- Bureaucratic barriers and inadequate regulations for the implementation of new technologies.
	- Greater incentives for training producers and rural workers in new technologies.	- Cultural resistance to the adoption of technological solutions among more traditional producers
	- Possibility of establishing more stringent legislation for asset protection in rural areas.	- Lack of uniformity in state-level public policies for rural asset security.
	- Expansion of affordable technologies for small and medium-sized producers, democratizing access to security solutions.	

Source: Prepared by the authors (2025)

has expanded as a viable alternative for the continuous monitoring of rural properties. This collaboration enables the adoption of advanced systems, such as smart electric fencing and tracking platforms, reducing farm vulnerability. However, these advances are constrained by the high cost of technologies, making their implementation inaccessible to many small and medium-sized producers.

Among the weaknesses, the precarious infrastructure in rural areas stands out, compromising the connectivity required for the operation of modern security systems. Furthermore, the limited technical training of producers and rural workers hinders the proper use of these tools. The lack of uniformity in state-level public policies also represents an obstacle, as some regions receive greater governmental support for rural security than others.

Opportunities include the expansion of financing programs for rural security, enabling more producers to gain access to monitoring and asset protection technologies. In addition, the increasing availability of technological tools may facilitate the adoption of affordable solutions by small and medium-sized producers. The integration of artificial intelligence, blockchain, and IoT further strengthens preventive strategies, promoting a safer environment for agricultural production.

Despite these advances, organized rural crime continues to grow, requiring more efficient and integrated public policies. Excessive bureaucracy and inadequate regulations governing technologies such as drones and electric fencing remain challenges for the sector. Moreover, the cultural resistance of traditional producers to the adoption of new

technologies limits the implementation of innovative solutions, making training and awareness programs on the benefits of these tools essential.

Therefore, the challenges and opportunities associated with asset security in agribusiness demonstrate the need for an integrated approach involving the public sector, private sector, and rural producers. Financial incentives, technical training, and greater investment in infrastructure can enable more effective solutions, ensuring not only asset protection but also the sustainability and growth of Brazilian agribusiness.

Public policies, governmental initiatives aimed at rural asset security, and private-sector actions have sought to promote greater integration between rural producers and security forces. State and federal programs have invested in rural patrol operations and the establishment of specialized police units, as observed in states such as Minas Gerais and Paraná (Minas Gerais, 2024; SSP-PR, 2023).

The analysis of the integrated framework of policies and regulatory milestones reveals a structural transformation in security approaches applied to rural areas in Brazil (Box 4). Historically, reactive and fragmented models predominated, characterized by sporadic patrols, limited institutional integration, and minimal incorporation of technology, reflecting the state's limited capacity for crime prevention and response in rural areas (MJ; SENASP, 2008).

With the consolidation of new legal frameworks such as the National Public Security and Social Defense Plan (Law No. 13,675/2018), the New Legal Framework for Science, Technology and Innovation (Law No. 13,243/2016), and the National Innovation Policy a transition toward preventive, integrated, and intelligence-driven strategies can be observed, with increasing use of drones, sensors, IoT systems, and AI-based data analytics solutions.

Currently, there is a growing effort to develop more integrated and effective policies. Programs such as the Rural Police Units in Minas Gerais (Minas Gerais, 2025) and the Community Rural Patrols in Bahia (Bahia, 2024) reflect significant progress in the specialization of security forces, promoting more agile and effective responses to the demands of the agribusiness sector.

In addition, integration among federal, state, and municipal levels has intensified, fostering broader and more effective cooperation. Specialized patrol operations, the use of monitoring technologies, and the establishment of cooperation networks among producers and public authorities are clear examples of the evolution of public policies in response to contemporary challenges (Brazil, 2023).

Regional differences are also evident, with states such as Mato Grosso and Paraná investing heavily in asset security initiatives, driven by their strategic importance within the national agribusiness sector (Embrapa, 2023; FAEP System, 2023). In contrast, states such as Bahia face challenges related to logistics and territorial extension, requiring specific adaptations in security strategies (SEAGRI, 2024).

These advances reflect a continuous effort to modernize asset security in agribusiness by adapting public policies to emerging demands and the challenges imposed by the expansion of the sector in Brazil.

Therefore, the viability of emerging technologies for asset security in agribusiness depends on factors such as cost, market acceptance, and operational effectiveness. Although technological solutions present significant potential for reducing rural crime, large-scale adoption still faces financial and structural challenges. One of the main obstacles is the high initial cost associated with acquiring and implementing these technologies, which limits access for small and medium-sized producers. Furthermore, the lack of technical training and cultural resistance also hinder the widespread adoption of these solutions (Santos, 2022).

The adoption of artificial intelligence on rural properties still faces barriers related to high implementation costs and the need for adequate technological infrastructure. On the other hand, government incentive programs and public-private partnerships may contribute to democratizing access to security technologies, enabling a greater number of producers to benefit from these tools (Brazil, 2022). Moreover, the creation of dedicated financing funds for rural security may represent an important mechanism for expanding access to technologies applied to agribusiness, particularly among producers with limited investment capacity.

With this updated perspective, the study reinforces the need for integration among technological innovation, financial incentives, and effective rural security strategies to ensure the protection of producers' assets and the continued growth of the Brazilian agricultural sector.

4 Final Considerations

Asset security in Brazilian agribusiness is a topic of critical importance, particularly in light of the expansion of agricultural activities and the challenges posed by the increase in rural crime. The need to protect properties, machinery, and agricultural production has become a strategic factor for the sustainability of the sector, requiring innovative and effective approaches.

The analysis conducted throughout this study demonstrated that technological advancement plays a crucial role in the modernization of rural asset security. The use of drones, smart sensors, and artificial intelligence has shown considerable potential to minimize risks and improve the efficiency of property monitoring. However, the implementation of these solutions still faces challenges,

Box 4 – Evolution of policies, regulatory frameworks, and security approaches in rural Brazil

Thematic Axis	Legal Framework / Public Policy	Previous Approaches	Current Approaches	Relevance to Asset Security in Agribusiness
Innovation and Technology	Law No 10.973/2004 and Law No. 13.243/2016 (Legal Framework of CT&I)	Limited integration among Science, Technology, and ICTs, universities, and companies; fragmented and slow innovation processes.	Facilitated partnerships, incentives for R&D, and more agile technology transfer processes.	Promotes the development of AI, sensors, drones, and intelligent monitoring systems in rural areas.
Telecommunications and Connectivity	Law No 13.116/2015 (Antena Law)	Limited rural connectivity; dependence on radio communication and local networks	Expansion of shared infrastructure and facilitation of antenna deployment.	Enables the operation of IoT sensors, drones, smart cameras, and continuous telemetry systems.
Government Innovation	National Innovation Policy (Decree No. 9,854/2019) and the Brazilian Artificial Intelligence Strategy (EBIA, 2021)	Limited application of AI in the public sector; absence of guidelines for emerging technologies.	Incentive frameworks for AI and automation applied to agribusiness and security.	Supports risk detection algorithms, predictive analytics, and data integration.
Public Security	National Public Security and Social Defense Plan (Law No. 13,675/2018) and the Unified Public Security System (SUSP)	Reactive and sporadic policing; lack of a rural-specific focus.	Integration among governmental levels, proactive prevention, and specialized rural patrol units.	Reduces theft, intrusions, and rural crime through coordinated actions.
Agricultural Inspection and Enforcement	National Agricultural Defense Policy (MAPA)	Manual inspection processes with low levels of digitalization.	Growing use of sensors, georeferencing technologies, and remote monitoring systems.	Protects assets (livestock, agricultural inputs, machinery) and rural properties.
Drone Operations	RBAC-E No. 94 / ANAC	Restricted and non-standardized use of technologies.	Clear regulations for BVLOS (Beyond Visual Line of Sight) operations, surveillance, and monitoring.	Enables aerial surveillance, incident identification, and rapid response capabilities.
Territorial and Environmental Protection	Forest Code (Law No. 12,651/2012) and the National Policy on Protection and Civil Defense (PNPDEC) (Law No. 12,608/2012)	Manual monitoring and on-site inspections	Use of satellites, drones, and sensors for continuous monitoring and inspection	Contributes to the prevention of fires, intrusions, and environmental damage affecting rural assets.

Source: Prepared by the authors (2025)

including high initial costs, infrastructure limitations in remote areas, and the need for technical training among producers.

In addition to technology, well-structured public policies are essential for ensuring security in rural areas. In recent years, governmental programs and state-level initiatives have been established to strengthen rural patrol operations and provide support to producers, promoting greater integration between security forces and the agricultural sector. Nevertheless, regional disparities continue to represent an obstacle, requiring tailored strategies to address the specific needs of each locality.

The SWOT analysis highlighted the importance of encouraging the adoption of security technologies, strengthening the technical training of producers, and promoting public-private partnerships to expand the reach of innovative solutions in rural areas. Although technological advances have produced promising results, structural and financial challenges must still be overcome to ensure broader access to monitoring and asset protection tools.

Given this context, it is essential to expand incentives for the adoption of new technologies and strengthen public-private partnerships that facilitate access to security solutions for small and medium-sized producers. Training professionals within the sector should also be prioritized, ensuring that available tools are used effectively and in an integrated manner.

5 Future Perspectives

As a recommendation for future research, an in-depth analysis of the economic impact of adopting security technologies on rural properties of different sizes is suggested, as well as a more detailed investigation of the cultural and educational barriers that hinder the implementation of these innovations. Future studies could also explore the role of new financing models and the impact of more inclusive public policies on the modernization of rural security.

Finally, this study reinforces the importance of integrating technology, public policies, and private-sector initiatives to ensure asset protection within Brazilian agribusiness. Overcoming the challenges identified will be essential to ensuring the sustainability of the sector and fostering a safer and more productive environment for all stakeholders involved in the agricultural value chain.

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