



2025

POSITION PAPER

Positioning: Innovation and Competitiveness of Brazilian Agribusiness

Innovation Committee

1. Introduction:

This position paper analyzes the current situation and future prospects for innovation and competitiveness in Brazilian agribusiness, **based on survey data from the Brazilian Agribusiness Association (ABAG)** and pertinent observations from representatives of the sector. The aim is to identify the main challenges and opportunities, as well as ABAG's role in promoting a more sustainable and competitive sector.

2. Global Context Innovation in Agribusiness:

Today, innovation in global agribusiness is driven by a convergence of critical factors: increasing demand for food security on a planet with limited natural resources, growing awareness of the need to use these resources sustainably and the urgency of mitigating climate change. This combination is profoundly transforming the sector, driven by cutting-edge technologies and new production approaches.

Food security: In a context of scarcity of water and fertile land, with extreme weather events, the need to feed an ever-expanding world population requires innovations, both to increase agricultural productivity and to reduce post-harvest losses, with more efficient distribution and storage systems to minimize waste.

Sustainability: Farming can have environmental impacts, so the search for more sustainable practices is crucial to preserving natural resources for the present and future generations.

This fosters innovation in areas such as:

- **Efficient use of water:** Precision irrigation technologies, soil moisture monitoring and good water management practices reduce water consumption and increase efficiency.
- **Soil management:** Conservation agriculture practices, such as not plowing and no-till farming, preserving the soil's structure and fertility, reducing erosion and nutrient loss.
- **Biodiversity:** Diversified farming systems, including crop-livestock-forest integration, increase biodiversity and ecosystem resilience.
- **Reduced use of inputs:** Development and use of biopesticides, biofertilizers and other alternatives to conventional chemical products minimizes environmental impact.

Climate change mitigation: Increasingly frequent and intense natural events pose a threat to agricultural production.

Innovation contributes to more resilient systems, including:

- **Resistant crops:** Development of varieties resistant to pests, diseases, and extreme weather events.
- **Carbon capture:** Regenerative agriculture practices that sequester carbon in the soil, reducing greenhouse gas emissions.
- **Renewable energy:** Use of solar, wind and biomass energy in agricultural operations, reducing the carbon footprint.

Challenges of the international scene

Despite the transformative potential of innovation, many challenges need to be overcome. **They are:**

- **Unilateral regulations:** Trade policies, such as tariffs and restrictions, can harm developing countries' competitiveness and access to global markets.
- **Lack of dialog:** Failure to cooperate internationally in building global policies can lead to unsustainable practices and more inequality.
- **Access to technology:** The technological disparity between developed and developing countries makes it difficult to adopt innovative practices on a large scale.
- **Competitiveness:** Sustainability is increasingly demanded as a competitive advantage and for access to markets.

4.0 technologies and new production approaches are at the heart of the sector's transformation, but overcoming the obstacles of the international scenario is essential to guarantee the future of agribusiness.

3. Challenges facing the sector:

The challenges for agribusiness development are multifaceted and interconnected, requiring holistic and integrated approaches to overcome them. With regard to the main challenges observed, the result of the current survey brought about a change in perception compared to the previous questionnaire, from 2023. In first place is Infrastructure, with 88.3% of the responses, followed by Climate Change (61%) and Regulation and Public Policies (42.9%).

Here are some analyses:

3.1. Infrastructure:

The lack of adequate infrastructure, especially in rural regions, is a critical bottleneck for the development of agribusiness.

This disability covers several aspects:

- **Connectivity:** Access to high-speed internet is essential for the use of precision technologies such as remote sensors, IoT and management systems. The lack of connectivity limits the adoption of these technologies and the lack of cell phone signal affects communication on farms and in communities in producing regions.
- **Transportation:** Logistics from the field to processing and the consumer market are essential for the quality and competitiveness of products. Bad roads, lack of storage and difficulties in transportation increase losses and costs.
- **Energy:** The lack of reliable and affordable rural electrification limits the use of technologies such as irrigation and refrigeration systems, affecting productivity and competitiveness.
- **Irrigation:** The lack of investment in efficient irrigation systems limits agricultural production, especially in arid and semi-arid regions.
- **Storage:** Lack of proper storage increases post-harvest losses and forces the producer to sell agricultural products immediately, even if it is an unfavorable moment in the market, doubly damaging profitability.



3.2. Climate change:

Extreme events such as droughts, frosts, storms, and floods are becoming more frequent and intense due to climate change, significantly impacting agricultural production and food security.

The effects of these changes include:

- **Reduced productivity:** Damage to plant growth and the quality of agricultural products.
- **Post-harvest losses:** Losses of agricultural products during storage and transportation.
- **Increase in pests and diseases:** Creation of favorable conditions for the proliferation of pests and diseases.
- **Price instability:** The impact on agricultural production also affects food prices, food security and producers' incomes.

3.3. Regulation and Public Policies:

This is a topic that also directly impacts the competitiveness of agribusiness, as well as its capacity for innovation and sustainable growth. The complexity of the system, the lack of dialog and the inefficiency in implementing policies are critical factors that need to be addressed urgently and in an integrated manner.

3.3.1. Lack of Dialogue and Participation:

The formulation of effective public policies requires a broad and transparent dialog between government bodies, at federal, state, and municipal level, and the various strategic audiences of agribusiness. However, the general perception is that

this dialogue is insufficient, leading to policies that do not meet the real needs of the sector.

The main flaws are:

- **Inadequate representation:** Without the representation of all segments of agribusiness in the formulation, policies benefit only a few groups.
- **Lack of prior consultation:** The absence of mechanisms for the effective participation of stakeholders in policymaking makes decisions less effective and increases resistance to their implementation.
- **Ineffective communication:** Noise in communication between government bodies and stakeholders leads to a lack of transparency, mistrust, and asymmetry of information.

3.3.2. Policy Inconsistency and Instability:

Frequent changes in policies and regulations create uncertainty and make it difficult to manage companies and farms.

It does:

- **Investments in innovation:** Uncertainty about the continuity of public policies discourages those who invest with the future in mind.
- **Strategic planning:** The lack of predictability makes it difficult to design strategies, compromising the ability to compete in the market.
- **Attracting investment:** Regulatory instability drives away foreign capital and hampers the development of the sector.

3.3.3. Insufficient incentives:

Incentives for innovation and the adoption of sustainable technologies are often insufficient to drive the sector's transformation.

The main deficiencies are:

- **Limited access to credit:** Many rural producers face difficulties in obtaining rural credit at favorable rates and conditions, especially the smaller ones.
- **Lack of support for research and development:** Investment in research and development of sustainable technologies for agribusiness does not fully meet the demands of the sector.
- **Incentives focused on large producers:** Incentive policies mainly benefit large producers, often neglecting small and medium-sized producers.

3.3.4. Excessive bureaucracy:

Complex and time-consuming bureaucratic processes for obtaining licenses, permits and incentives make it difficult for agricultural companies to operate. *desenvolvimento do setor, garantindo a sua competitividade e sustentabilidade no longo prazo.* **This implies:**

- **Increased costs:** The administrative costs associated with bureaucratic processes create a significant burden.
- **Delays in implementing projects:** Excessive bureaucracy makes the implementation of investment projects take longer.
- **Discouraging innovation:** Bureaucratic processes hinder and discourage the implementation of new technologies and business models.

Improving regulations and public policies for Brazilian agribusiness requires a process of modernization and simplification, with the participation of all stakeholders. It is necessary to guarantee the clarity, consistency, and effectiveness of policies, as well as increasing incentives for innovation and the adoption of



sustainable technologies. Reducing bureaucracy, simplifying administrative processes, and increasing transparency are fundamental to creating a more favorable environment for the development of the sector, guaranteeing its competitiveness and sustainability in the long term.

4. Organizational nature

Management and organization are determining factors for the success and sustainability of agribusiness companies. When the organizational nature of the institutions was analyzed, the Innovative Profile was the main strategic driver pointed out by the respondents, followed by Competitive Strategy and Organizational Culture.

Points of attention and importance:

4.1. Innovative profile:

The company's innovative profile is essential for driving adaptation and growth in a rapidly evolving market like agribusiness. Businesses with this profile are more likely to challenge the status quo, experimenting with new solutions and emerging technologies. In this way, these companies differentiate themselves from the competition and respond quickly to market changes and customer demands.

• **Capacity building and training:** Investing in continuous training for leaders and employees can transform management dynamics, introducing more efficient and effective management techniques.

• **Diversification of functions:** Companies that adopt a more professional structure are more likely to have a clear division of functions, improving accountability and operational efficiency.

4.2. Competitive strategy:

Having a clear competitive strategy is vital for guiding the organization's operations and decisions. In agribusiness, companies must assess their strengths, weaknesses, opportunities, and threats in order to develop strategies that maximize their market potential. This can include diversifying products, improving the quality of processes, investing in technological infrastructure, and strengthening supply chains. This carried out effectively helps to gain a solid position in the market and to face emerging difficulties.

4.3. Organizational culture:

Organizational culture defines the values, beliefs and behaviors that permeate a company. A culture focused on innovation, collaboration and excellence can foster a motivating and productive work environment. In the context of agribusiness, an organizational culture that supports continuous learning and adaptation is crucial for facing challenges such as climate change, environmental regulations, and market fluctuations. Employees who align themselves with this culture are better able to contribute to the company's strategic objectives.

- **Technological adaptation:** The adoption of technologies such as automation, artificial intelligence and digital solutions can result in increasingly efficient processes and boost productivity.

- **Culture of innovation:** An environment that encourages experimentation can motivate employees to propose improvements and new ideas for production processes.

- **Partnerships and collaborations:** Partnerships with research centers, universities and startups can bring new perspectives and innovative tools to agribusiness.

5. Human Nature: Points of attention and importance:

5.1. Employee commitment:

Workers in the field, as well as employees in management and administration, play crucial roles in the efficiency and sustainability of operations. **Your commitment can be influenced by:**

- **Identification with the mission:** Many agribusiness companies have a strong connection with food production and environmental preservation. Employees who identify with the importance of this work tend to show greater commitment to the company.

- **Social and economic context:** Agribusiness is one of the pillars of the Brazilian economy. Commitment can increase in regions where agricultural activity is the main source of employment, leading employees to feel part of something bigger.

- **Career development:** Commitment can be fostered by training and professional growth initiatives, offering employees a future perspective within the organization.



Lack of commitment can result in high turnover, which is costly in a sector where training is so necessary.

5.2. Motivation and Purpose:

In agribusiness, employee motivation is often linked to a clear perception of the company's purpose. **Elements that influence this dynamic include:**

- **Social reward:** Many employees feel motivated by the role they play in food safety and sustainability, which increases the perception of purpose in their work.
- **Recognizing contributions:** Farm workers often face adverse conditions and one way to increase motivation is to recognize their contributions, whether through bonuses, praise, or work safety initiatives.
- **Teamwork:** Collaboration is essential in agribusiness, whether in the field or in management. Employees who understand the value of working together and identify with a common mission tend to maintain high levels of motivation.
- **Innovation and technology:** Interest in modern technologies and methodologies that seek to improve agricultural practices can also be a motivating factor, especially among the younger generations, who are more connected to innovations.

5.3. Employee satisfaction:

Employee satisfaction in Brazilian agribusiness is multifaceted, reflecting regional and sectoral differences.

Impact factors include:

- **Working conditions:** The physical environment, access to appropriate technologies and job security are decisive. Poor conditions can lead to dissatisfaction and high turnover.

- **Benefits and remuneration:** In some areas of agribusiness, seasonality and remuneration can be challenging. Companies that offer benefits, such as healthcare, pension plans and support for education, are more likely to have satisfied employees.

- **Efficient management:** The quality of leadership and internal communication are key to satisfaction. Employees who feel listened to and have access to feedback tend to be more satisfied.

- **Opportunities for growth:** Offering development plans and promotions within the hierarchical structure are effective ways of increasing satisfaction, making employees see a career path within the company.

Overcoming these challenges is essential for agribusiness institutions to remain competitive in the global market. The adoption of more professional management practices, investment in talent and the search for innovation are key steps in ensuring long-term growth and sustainability. Implementing strategies focused on these areas can result in significant improvements in operational efficiency and the ability to adapt to market changes.

6. Tecnologias 4.0

Despite technological advances, many companies and producers still face difficulties in implementing 4.0 technologies in their processes and culture.

In a comparative analysis between the surveys conducted in 2023 and 2025, the respondents mentioned Artificial Intelligence and Corporate Management as challenges, in addition to Cybersecurity, which was already identified in the last version of the Position Paper:

- **Cybersecurity:** As agribusiness companies adopt digital technologies, the protection of sensitive information and operations becomes paramount.

Cybersecurity ensures that critical data, such as supply chain information, intellectual property, and financial records, is protected from attacks and breaches. Investing in robust cybersecurity measures helps protect the integrity of systems and ensure business continuity, as well as building the trust of customers and partners.

- **Corporate management:** Effective corporate management, supported by 4.0 technologies, allows companies to improve their decision-making processes, achieving greater transparency and operational efficiency. Digital platforms and integrated systems allow managers to access data in real time, improve performance monitoring, and adjust strategies quickly. This results in better alignment with strategic and regulatory goals, as well as facilitating audits and compliance.

- **Artificial intelligence (AI):** AI offers immense opportunities to innovate and optimize agribusiness processes. From automating repetitive tasks to analyzing large volumes of data, AI can help make more informed and effective decisions.



Applications such as crop forecasting, predictive equipment maintenance and product customization are just a few ways in which AI can add value. AI can also contribute to better management of natural resources, helping with business sustainability.

The implementation agenda for the above technologies calls for some short-term actions, but there are some challenges:

Investment in innovative technologies:

- **High initial investments:** Many technologies, such as monitoring systems, automation, and modern machinery, require substantial initial investments, which can make it impossible for small and medium-sized producers to adopt them.

- **Return on investment (ROI):** Uncertainty about the timing and form of financial returns from technologies can discourage investment, especially in a sector that already faces narrow profit margins.

- **Financing and incentives:** A Lack of access to favorable financing conditions or government subsidies can further limit the adoption of new technologies.

Lack of training:

- **Training programs:** The absence of structured and accessible training programs prevents farmers from acquiring the necessary skills to operate modern technologies.

- **Diversity of technologies:** The wide range of technologies available can create confusion about which are best suited to meet the specific needs of each producer, making it difficult to prioritize learning.

- **Continuous training:** The rapid pace of technological innovation means that farmers need continuous education to keep up with updates and new features.

Digital literacy:

- **Basic education:** Many farmers come from backgrounds where educational training is limited, resulting in low fundamental skills in digital technologies.
- **Community support:** The lack of community initiatives to promote digital literacy can increase the marginalization of farmers in relation to the use of digital technologies.
- **Complex tools:** The complexity of some digital platforms can be an additional obstacle, requiring technical support that is often not available in the field.

Overcoming these challenges requires a holistic and integrated approach, involving investments in infrastructure, effective public policies, training for producers, the promotion of innovation and a broad and continuous dialog between the different players in the agribusiness ecosystem. Creating a favorable environment for innovation, sustainability and competitiveness is key to ensuring the sustainable and inclusive development of the sector.

7. Environmental nature:

Analyzing the environmental nature of Brazilian agribusiness institutions involves understanding the several factors that impact their functioning, including the economic, technological, and competitive environment, as well as the formation of alliances. Each of these aspects plays a significant role in the way these companies operate and develop.

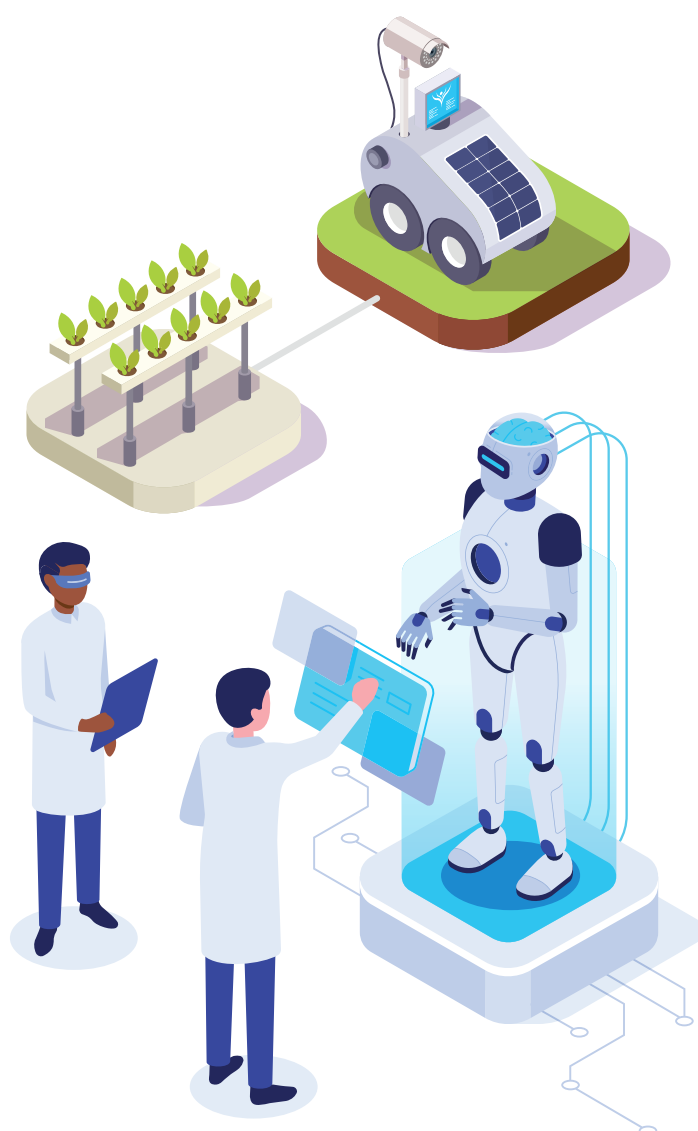
7.1. Economic and Technological Environment

- **Economic growth:** Brazilian agribusiness is one of the driving forces behind the country's economy, contributing

significantly to GDP and exports. The constant arrival of investments, both domestic and foreign, has a positive effect on infrastructure and technological innovation.

- **Technological innovation:** The adoption of 4.0 technologies, such as automation, artificial intelligence, and the use of big data, is becoming increasingly prevalent in the sector. These technologies have transformed agricultural practices, enabling more efficient, sustainable, and profitable production. Research, for example, results in new crop varieties that are more resistant and high yielding.

- **Access to finance:** The availability of rural credit and tax incentives also has a positive influence on agribusiness institutions. Government policies that favor access to financing for modernization and expansion of operations are crucial for the sector's growth.



7.2. Competitive environment

- **International competitiveness:** Brazilian agribusiness competes with producers from different regions of the world. Institutions that, in addition to guaranteeing the quality and safety of products, improve efficiency and reduce costs stand out. This includes meeting strict international standards, which may require investment in production processes and certification.
- **Market diversification:** The ability to diversify markets and products is a key strategy for competitiveness. Brazil exports a variety of agricultural products but also faces challenges such as price volatility and growing competition. Developing new market niches is fundamental, as is adapting to consumer trends, such as organic and sustainable products.
- **Sustainability:** With increasing awareness of environmental issues, companies must adopt sustainable practices as part of their competitive strategy. This not only responds to consumer and investor demands but also improves institutional image and acceptance in foreign markets.

7.3. Forming alliances.

- **Public-private partnerships:** Alliances between the public and private sectors are essential to promote the development of infrastructure, research and policies that favor agribusiness, while also providing a more favorable environment for technological innovations and the advancement of sustainable practices.
- **Collaboration between companies:** Agribusiness institutions often form strategic alliances with other companies, either through consortia, cooperatives, or joint ventures. This is the case, for example, with small producers' cooperatives. These collaborations allow for the sharing of resources, know-how and access to new markets.

- **Knowledge networks:** The establishment of research and innovation networks between universities, research centers and agribusiness companies are crucial for the advancement of the sector. This facilitates the dissemination of knowledge and innovation, promoting the development of solutions that meet market needs.

- **Partnerships and innovation ecosystems:** Cooperation between companies, research institutions, universities and the government is vital for creating a favorable environment for innovation.

This collaboration makes it possible:

8. Global Value Chains:

Integration into global value chains requires competitiveness, sustainability, and quality. To enter these chains, agricultural companies need to consider:

- **International standards:** Agricultural products need to meet the quality and safety standards demanded by international markets.
- **Competitiveness:** Companies need to be competitive in terms of price and quality.
- **Sustainability:** The growing demand for sustainable agricultural products requires companies to adopt correct practices throughout the value chain.
- **Agricultural research:** Plays a key role in promoting innovation and increasing productivity.

In the context of global value chains, research can:

Developing new crop varieties:

Creating varieties that are more resistant to pests and diseases and require fewer resources.

Improving management practices:

Providing data for more efficient agronomic management practices.

Incorporating innovative technologies: Bringing innovations in biotechnology, automation and digital solutions that increase production efficiency in line with international requirements.

They can strengthen global value chains through:

Infrastructure support: Investments in infrastructure, such as transportation and warehousing, are crucial to ensure logistical efficiency and reduce costs, increasing competitiveness.

Development of public policies:

Collaboration between the public and private sectors can result in the creation of policies that encourage sustainable agricultural practices, innovation, and access to finance for small and medium-sized producers.

Training and innovation:

Partnerships can promote training programs and joint research, ensuring that the sector is aligned with the needs of the global market and emerging trends.

9. International Agribusiness Promotion

The international promotion of Brazilian agribusiness is essential to guaranteeing access to key markets and strengthening Brazil's presence in global value chains.

Benefits include:

- **Access to new markets:** This promotion can open doors for Brazilian products to be recognized and valued in foreign markets, expanding export opportunities.
- **Strengthening the agricultural brand:** Investments in marketing and branding can help consolidate the image of Brazilian agribusiness as a supplier of high-quality, sustainable products.
- **Networking and partnerships:** International events, trade fairs and trade missions allow Brazilian companies to establish important contacts and partnerships, which are necessary for inclusion in global value chains.
- **Public-private partnerships:** These partnerships are essential for creating a favorable environment for the development of agribusiness.

Competitiveness in agribusiness is multi-dimensional and requires an integrated approach that integrates research, continuous innovation, qualified human capital, international promotion, strategic partnerships, efficient management, sustainability, and the ability to adapt to change. These are the crucial factors for positioning Brazil as a leader in the supply of quality agricultural products on the global stage.

10. Incentives and Policies:

There is a significant gap between the need to boost innovation and the reality of implementing effective policies. Although there are some programs and initiatives, the general perception is that current incentives and policies are insufficient to promote the transformation needed for a more competitive and sustainable sector.

10.1. Investment in Research and Development (R&D):

Even though it is crucial for the development of modern technologies and sustainable practices, the current investment in R&D is insufficient to meet the sector's needs, leading to an excessive dependence on imported technologies and less capacity for endogenous innovation.

The expansion of investment should include:

- **Applied research:** Increased funding for applied research that results in technologies and solutions directly usable by rural producers.
- **Financing startups:** Incentives and funding for agribusiness startups that develop innovative solutions to real demands.
- **Public-private partnerships:** Increased investment in public-private partnerships for the development of innovative technologies and solutions with technical and economic viability.
- **Training researchers:** Investment in training researchers and scientists in the agribusiness area.

10.2. Workforce training:

Training the workforce is essential for the adoption and effective use of modern technologies and sustainable practices.

The main needs are:

- **Training programs:** Implement training programs for farmers and workers in the sector that are accessible, comprehensive, and adapted to different realities and levels of knowledge.
- **Vocational education:** Improving vocational education in rural areas, to train qualified professionals for agribusiness.

- **Technology transfer:** Developing effective mechanisms for transferring technology from research institutions to rural producers.

10.3. Public-Private Partnerships:

Public-private partnerships are fundamental to the development of agribusiness, as they combine the resources and expertise of the public and private sectors.

These partnerships should be encouraged through:

- **Tax incentives:** For companies that invest in R&D and public-private partnerships.
- **Bureaucratic simplification:** The processes for forming public-private partnerships.
- **Transparency and accountability:** In the management of public resources earmarked for public-private partnerships.

10.4. Policies for Small Producers and Energy Transition:

Public policies need to take into account the reality of small rural producers, who often face difficulties in accessing technology, credit, and information.

- **Specific support programs:** Access to credit, training, and technical assistance for small producers.
- **Incentives for sustainable agriculture:** Incentives to adopt practices that preserve natural resources and reduce environmental impact.
- **Energy transition:** Incentives to adopt a more sustainable energy model, with renewable energy sources, such as the promotion of biofuels.

In addition to investments in research, training, infrastructure, and partnerships, we need clearer, more consistent, and effective public policies, based on constant and transparent dialog with all stakeholders. This is crucial to ensure the sustainable and democratic development of the sector, benefiting small and medium-sized producers.

11. Trends:

11.1. 4.0 technologies:

The implementation of 4.0 technologies, such as big data, the internet of things (IoT) and artificial intelligence, will continue apace in agribusiness. Analyzing these technologies requires a comprehensive view, taking into account their specific applications and the challenges inherent in implementing them in the sector.

Main technologies and their impacts:

Artificial intelligence (AI), with 80.5% of respondents:



• **Applications:** More accurate crop forecasts, early detection of diseases and pests, optimization of resources such as water, fertilizers and energy, automation of processes such as harvesting and planting, and image analysis for monitoring crops and livestock. Development of autonomous robots for agricultural tasks, as well as decision support systems for farmers.



• **Challenges:** Availability of high quality and quantity data for training models, computational cost, need for expertise in AI and ML, ability to explain AI models when interpreting decisions and the need to adapt models to different environmental and production contexts.

Autonomous equipment, with 66.2% of respondents:



• **Applications:** Autonomous robots for spraying, harvesting, planting and other repetitive agricultural tasks. Automated irrigation and crop monitoring systems. Robotics applied to livestock management, including automated milking and health monitoring.



• **Challenges:** Cost of implementation, maintenance and repair of equipment, adaptation to different environmental and terrain conditions, as well as operational safety.

Management applications and software, with 58.4% of respondents:



• **Applications:** Analysis of large data sets to identify patterns, trends, and insights relevant to decision-making. Crop forecasts, logistics optimization, climate risk management, market analysis and new product development are just a few examples. Integration with satellite images and drones to monitor crops and identify risk areas.



• **Challenges:** Storage, processing, and analysis of large volumes of data, need for expertise in data science, data security and privacy, interpretation of complex information and integration with other management systems.

Blockchain, with 32.5% of respondents:



• **Applications:** Traceability of agricultural products, ensuring transparency and security in the supply chain, facilitating access to finance for farmers through asset registration and smart contracts.



• **Challenges:** Cost and complexity of implementation, need for common standards and protocols for interoperability and scalability of systems to handle large volumes of data.

11.2. Precision Agriculture (PA), with 76.6% of respondents:

This concept of agriculture represents a paradigmatic shift in the way agricultural resources are managed, using technologies to optimize the use of inputs and maximize productivity. Its growing adoption reflects the need to increase efficiency, reduce costs and minimize environmental impact. However, the successful implementation of PA presents specific challenges.

Precision agriculture techniques: PA is based on various integrated technologies and techniques to monitor and manage the variability present in an agricultural area. They are:

Remote sensing: The use of satellite images, drones, and aircraft to collect information on crop conditions, such as plant health, nutrient levels, soil moisture, among others. Spectral analysis and high-resolution images make it possible to identify spatial variations.

Geographic information systems (GIS): GIS are essential tools for integrating and analyzing the data collected, creating maps that show the spatial variability of crop conditions. It allows the area to be zoned, with different management recommendations for each area.

Soil and plant sensors: Sensors placed in the soil or on plants measure parameters such as humidity, temperature, nutrient levels, and other variables in real time, enabling an immediate and precise response to the plant's needs.

Precision application systems: Equipment for applying inputs such as fertilizers, pesticides, and seeds, with GPS technology, allows for variable application, adapting the dose according to the specific needs of each area of the crop.

Automation: The automation of machinery and equipment, using technologies such as GPS, sensors and automatic control, allows agricultural tasks to be conducted with greater efficiency and precision, reducing labor costs.

Benefits of precision agriculture:

- **Optimizing the use of inputs:** AP makes it possible to apply the exact number of inputs, such as water, fertilizers, and pesticides, to each area of the crop, reducing waste and minimizing environmental impacts.
- **Increased productivity:** The use of accurate information and optimized resource management leads to increased productivity and crop yields.
- **Cost reduction:** Decreasing the use of input, increasing efficiency, and reducing losses resulting in a reduction in production costs.
- **Improved quality:** Accurate management of crop or livestock conditions, with detailed information on plant or animal health, makes it possible to obtain higher quality products.
- **Sustainability:** Reducing the use of inputs and optimizing the use of resources contributes to the environmental sustainability of agricultural systems.

Challenges of implementing precision agriculture:

- **Custo:** A aquisição e a manutenção de equipamentos e softwares de AP podem ser caras, especialmente para pequenos e médios produtores.

A internet e à conectividade em áreas rurais muitas vezes são limitadas, dificultando a utilização de tecnologias de AP baseadas em dados em tempo real.

- **Cost:** The acquisition and maintenance of PA equipment and software can be expensive, especially for small and medium-sized producers.
- **Connectivity:** Access to the internet and connectivity in rural areas is often limited, making it difficult to use PA technologies based on real-time data.
- **Training:** Farmers need training to operate and interpret the data generated by PA systems.

- **Data integration:** Integrating different sources and systems can be complex, requiring appropriate software and hardware solutions.

- **Variability of conditions:** PA must take into account the variability of climatic and soil conditions, which requires specific models and techniques.



11.3. Regenerative agriculture, with 68.8% of respondents:

Regenerative agriculture is an integrated approach that seeks to improve soil health, increase biodiversity, sequester carbon, and improve the resilience of agricultural systems to climate change. Its adoption is increasing in response to growing environmental concern and the need for more sustainable agricultural systems. However, implementation presents specific challenges that must be considered.

Principles of regenerative agriculture: Restoring agricultural ecosystems and increasing biodiversity. **They are:**

- **Soil cover:** Keeping the soil covered all year round, using cover crops, crop residues and other practices, reduces erosion, improves water infiltration, regulates soil temperature, and increases biological activity.

- **Crop diversity:** Implementing diversified cultivation systems, including crop rotation, consortia, and agroforestry, increases biodiversity and reduces the incidence of pests and diseases, as well as improving soil health.

- **Minimal or no ploughing:** Avoiding or minimizing ploughing preserves soil structure, increases biological activity and water retention capacity.

- **Integrating animals:** Integrating cattle and other animals into agricultural systems, with rotational grazing or crop-livestock integration, improves soil fertility, reduces the need for chemical fertilizers, and promotes biodiversity.

- **Holistic management:** Adopting an integrated approach to farm management, considering all aspects of the agricultural system, such as soil, water, plants, animals, and climate, as well as the interaction between them.

The potential of regenerative agriculture:

- **Carbon sequestration:** Regenerative agriculture practices, such as soil cover and increased organic matter, can sequester atmospheric carbon, contributing to climate change mitigation.

- **Improving soil quality:** Regenerative agriculture improves soil structure, fertility, and water retention capacity, increasing resilience to extreme weather events and productive capacity.

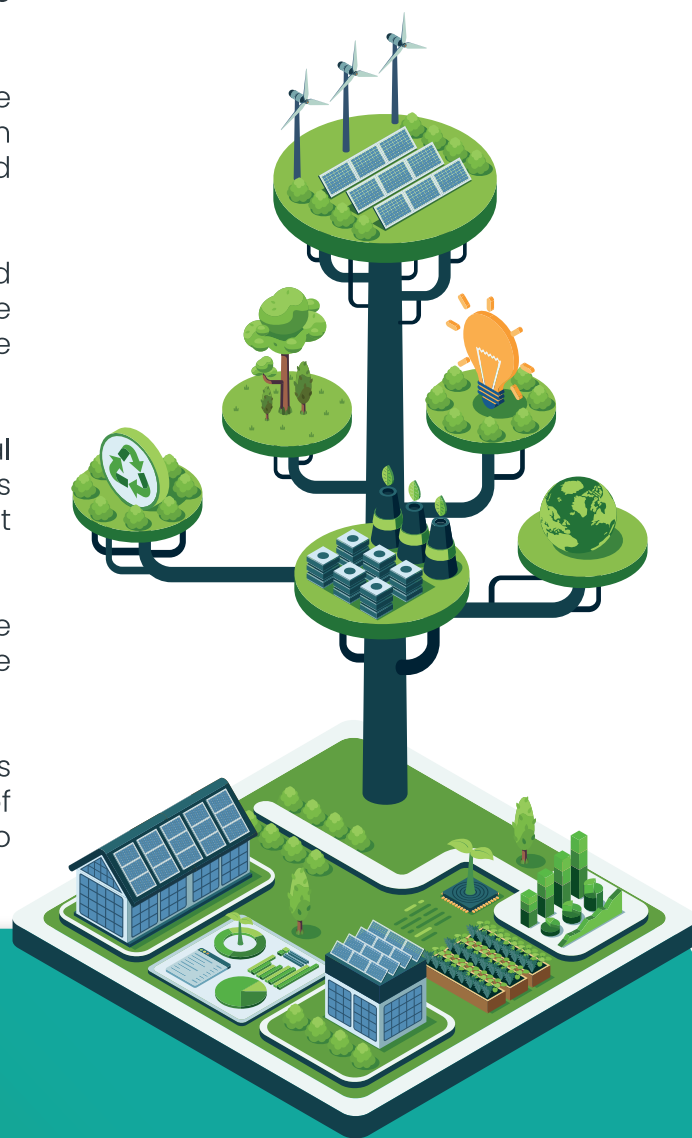
- **Increased biodiversity:** Crop diversification and the integration of animals increase the biodiversity of agricultural systems, promoting the resilience and health of ecosystems.

- **Reduced use of inputs:** Regenerative agriculture can reduce the need for fertilizers, pesticides, and other inputs, reducing production costs and environmental impact.

- **Resilience to climate change:** Healthy soils and diversified agricultural systems are more resilient to climate change, including extreme events and climate variability.

Challenges in implementing regenerative agriculture:

- **Transition:** The transition to regenerative agriculture can require significant changes in farming practices, requiring time, investment, and adaptation on the part of farmers.
- **Knowledge and training:** Knowledge and training of farmers is necessary for the effective implementation of regenerative agriculture practices.
- **Market and prices:** Demand for agricultural products produced using regenerative methods is still limited and prices may not fully reflect environmental costs and benefits.
- **Funding:** Access to adequate funding for the implementation of regenerative agriculture practices can be a challenge.
- **Monitoring and evaluation:** Effective methods for monitoring and evaluating the impacts of regenerative agriculture need to be developed to ensure their effectiveness.



12. Papel da ABAG:

ABAG plays a key role in promoting innovation and competitiveness in Brazilian agribusiness. This includes:

- **Advocacy and representation:** Representing the sector before governments and international bodies, defending the interests of agribusiness, and promoting favorable public policies.
- **Fostering innovation:** Boosting initiatives and partnerships that stimulate innovation, such as innovation hubs and training programs.
- **Dissemination of knowledge:** Disseminating good practices, technologies and knowledge among producers, especially small ones, and other stakeholders.

- **Network building:** Facilitating the creation and strengthening of cooperation networks between the different players in the agribusiness ecosystem.

In conclusion, Brazilian agribusiness faces challenges, but it also has enormous potential for growth. Innovation, combined with effective public policies and the joint work of all strategic stakeholders, is fundamental to building a more sustainable, competitive, and inclusive sector.

ABAG has an influence on this crucial process, and its action will be decisive in the coming years.



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