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Encyclopedia of AGRICULTURE AND FOOD SYSTEMS

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Agribusiness organization and management

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Abstract

This chapter provides a comprehensive overview of the agribusiness sector, examining its unique characteristics and the strategic, managerial, and operational challenges faced by firms within the complex agribusiness ecosystem. It discusses the concept and structure of agribusiness as a value chain, encompassing diverse stages from genetics and seed firms to consumer markets. The chapter emphasizes distinct factors impacting agribusiness, such as biological uncertainty, cultural and political dimensions, and regulatory frameworks. Furthermore, it addresses strategic frameworks like Porter's Five Forces, SWOT analysis, and DuPont financial analysis, highlighting their application for agribusinesses to navigate competitive pressures and achieve growth. The chapter also explores growing concerns in the food system, including sustainability through Environmental, Social, and Governance (ESG) principles and the adoption of advanced technologies, illustrating how agribusiness firms can create value, manage risks, and adapt to global and local demands. This synthesis provides readers with insights into the evolving field of agribusiness management.

Key points

- Define the concept of agribusiness and its role in the global economy.
- Understand the structure and dynamics of the agribusiness value chain.
- Explore strategic tools like SWOT analysis, Porter's Five Forces, and DuPont analysis.
- Analyze how technological advancements impact agribusiness practices.
- Examine sustainability through ESG principles and their application in the sector.
- Identify challenges like biological uncertainty, regulatory frameworks, and global trade dynamics.
- Discuss innovative business models, including value creation and risk management strategies.

Introduction

Agribusiness is a dynamic sector, essential to global food systems and economic sustainability. This chapter explores the unique complexities of agribusiness, including its value chain structure, managerial challenges, and the influence of technological, cultural, and regulatory factors. With a focus on strategic frameworks and sustainability principles, it provides a foundational understanding of how agribusiness firms navigate global and local markets.

Concept of agribusiness

The concepts of agribusiness and agro-industrial chains and systems emerged in the United States through the works of John Davis and Ray Goldberg in 1957 and 1968, respectively (Davis and Goldberg, 1957). Over the last three decades, the concept of agriculture has evolved into a complex activity that involves close integration between agricultural producers and input suppliers, as well as industry, distributors, retailers, and service providers. This integrated approach is now the dominant way of thinking and the foundation for private strategies and public policies aimed at developing these chains.

Food and agribusiness value chain and sectors

As depicted in Fig. 1, the sector can be thought of as a sequence of interrelated activities made up of:

- Genetics and seed stock firms and input suppliers
- Dealers and cooperatives
- Agricultural producers (farmers)
- First handlers, Trading Companies and Cooperatives
- Agro and biofuels industries, food industry
- Wholesalers, retailers and foodservice
- Consumers

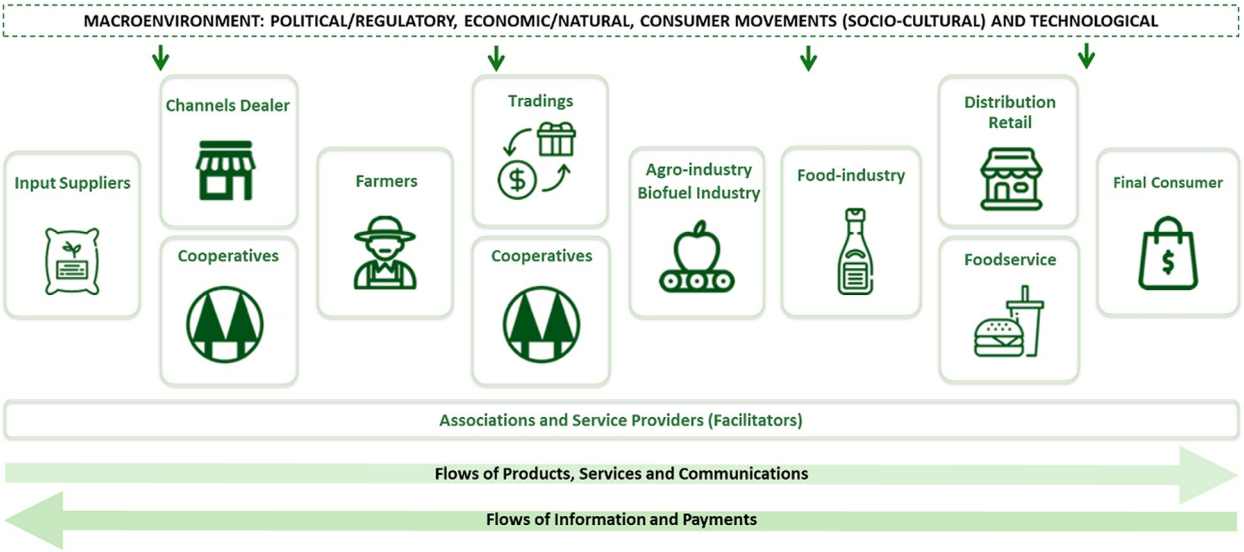

Fig. 1 Agribusiness systems and agro-industrial systems (Neves et al., 2021).

Supporting these activities are firms that provide services, financing, storage, transportation, insurance, certification, communication, consultancy, research and development to the sector. As the sector operates in an international context with substantial levels of both imports and exports of food, fibers, biofuels and other products, success requires an understanding of the needs and desires of consumers in both domestic and world markets.

Distinctive challenges faced by food and agribusiness firms

There are at least six distinctive characteristics of the sector:

1. Distinct cultural, institutional, and political aspects of food, domestically and internationally.
2. Uncertainty arising from the biological basis of crop and livestock production, as well as from demand for food, energy, and fiber.
3. Alternative forms of political intervention and regulations across subsectors and nations.
4. Institutional arrangements that place significant portions of the technology development process in the public sector.
5. Differing competitive structures within the stages of the sector.
6. Increased awareness of the linkages between nutrition (food production and consumption) and human health.

These six characteristics suggest the need for targeted managerial skills and knowledge to facilitate effective operation within the sector.

Food is essential for human life, making the assurance of adequate, safe, and nutritious food a priority for all societies and governments. Beyond sustenance, food and its consumption are integral parts of human culture. Differences in the role of specific foods across nations and cultures are critical for understanding the agribusiness sector. For example, while both wheat and rice are staple food grains, rice in Japanese culture holds a significance that extends beyond its role as a food staple, unlike wheat in many Western cultures. The key role of international trade requires that sector managers be aware of these cultural differences.

The forces of nature, such as weather and pests, can overwhelm even the sophisticated technology of modern agriculture. Production, marketing, and financial structures designed to accommodate normal aspects of uncertainty are essential for sector managers to understand. The potential for infrequent but massive deviations must also be appreciated. For example, strategies that rely on alternative uses of low-priced agricultural commodities must include contingency plans if the supply of those commodities becomes restricted. Biofuel- based alternatives, which were developed when commodity prices were low, faced significant challenges when food prices surged.

Political intervention is a reality of the agribusiness sector. The motivation for such intervention extends beyond food security and farm income support to encompass issues like food safety, environmental imperatives, resource conservation, farm worker safety, and the economic stability of rural communities. Although often aimed at differing objectives, governmental intervention can disrupt operations and markets. Internationally, this intervention is further complicated by differing attitudes and approaches across countries.

Technological advancements have significant potential to drive change in the agribusiness sector. For instance, biotechnology has not only impacted markets but also captured media headlines over recent decades. Application of information technology, through precision farming and enormous data sets (or Big Data'), has also had a similarly profound effect. Major research in this area is pursued globally in both private and public sectors. Historically, considerable developmental research has been conducted within public institutions. As a result, the management and introduction of innovations in this sector often follow different processes than if developmental research were confined solely to either the private or public sector.

The agribusiness sector encompasses a variety of competitive structures that differ across and within its subsectors. The production sector, characterized by numerous relatively small units, is widely recognized. At the same time, many agribusiness firms are large and multinational. Such organizational structures influence competition within the industry, and managers must operate within the competitive structure of their subsector while considering how alternative structures affect suppliers and customers.

These distinctive characteristics exclude several issues commonly highlighted, such as the critical role of international trade, which is vitally important in numerous economic sectors. However, within agribusiness, distinctive features of international trade include cultural attitudes toward food, the influence of political factors, and the potential for sudden supply shocks—whether domestically, among competitors, or in customer nations.

Today's priorities encompass basic food security for many consumers and nations, as well as evolving consumer demands and preferences. These products must meet the expectations of consumers who are increasingly informed by media coverage of food safety, production methods, and the long-term implications for human health and the environment.

Global agribusiness environment

The agribusiness sector operates within a global and intensively local context. While trade in agricultural products and the operations of multinational agribusiness suppliers and branded food manufacturers extend around the world, a significant amount of agricultural production still occurs locally, often following traditional practices. As urbanization increases, the need for effective transportation, processing, and distribution intensifies. National and local policies significantly shape agribusiness operations through regulations and organizational structures that vary widely across countries and subsectors. These complexities create both challenges and opportunities for agribusiness management.

Consolidation, concentration, and structural shifts along the food value chain

Shifts in the economic landscape have driven companies to focus on core competencies, outsourcing others, and reducing diversification. This has led to increasing concentration and consolidation at various stages of the food value chain, including suppliers, farmers, food industries, retailers, and food service providers (Howard, 2020).

For example, in the crop protection and seed sectors, mergers and acquisitions have led to significant consolidation, with global firms like Bayer and Corteva holding substantial market share. On the production side, the pork and poultry industries in the United States have become highly integrated, with contract growers operating under detailed guidelines set by dominant companies such as Tyson Foods and Smithfield. Similarly, in the dairy processing industry, European cooperative Arla Foods has expanded internationally to access new markets and gain efficiency and scale.

At the retail and food service level, market power has shifted toward a few dominant players. For example, supermarket chains like Walmart, Sam's Club, and Kroger have captured nearly one third of the overall U.S. grocery market share (Business Insider, 2025).

Traditional open-access markets are being replaced by hybrid supply chain models that rely on collaborative networks, often implemented by contracts. These interorganizational relationships can be formal (written agreements) or informal (oral agreements), depending on the institutional environment. In Brazil, for instance, soybean processors often work with farmers through reputation-based arrangements, while in sectors like oranges and sugar-cane, long-term contracts are more common. In some cases, reputation alone ensures compliance; in others, formal contracts are essential to secure commitments. However, in countries with weak institutional environments, even formal, written agreements may carry little weight, making enforcement difficult and undermining trust in market transactions.

Farms go beyond food and fiber: Energy, nutraceuticals, and industrial products

Modern farms increasingly serve as multiproduct and service suppliers, extending beyond traditional food production. The following 12 industries source their raw materials from farms:

1. **Food and beverages:** Farms produce grains, fruits, eggs, vegetables, milk, beef, fiber, and other items to meet growing demand for quality, environmental sustainability, and animal welfare.
2. **Animal feed:** Farms provide essential nutrition for livestock, pets and other animals.
3. **Fuel:** Biofuels derived from farm crops like corn, sugarcane, grasses, and residues contribute to renewable energy sources, biogas, biomethane and other sources of energy.
4. **Pharma-Nutrition:** Many nutraceuticals, or food products with health benefits, such as fortified juices, vitamins, and omegas, are farm-sourced.
5. **Pharma-Cosmetics:** Ingredients in skincare and beauty products, also known as "nutricosmetics," are derived from agricultural products.
6. **Electricity:** Biomass from farms is burned to generate heat that is transformed into electricity, contributing to the renewable energy grid.
7. **Plastics:** Renewable biomass sources, such as those from corn starch, sugarcane, and vegetable oils, are replacing petroleum-based plastics as a more sustainable alternative.
8. **Agritourism and educational outreach:** Farms increasingly offer tours, seasonal events, pick-your-own operations, and farm stays that provide recreation while fostering public understanding of agriculture.

9. **Textiles:** Natural fibers like cotton are produced for use in textiles and clothes.
10. **Leather:** Animal hides from livestock farming are processed into traditional leather.
11. **Construction and furniture:** Farmed wood sources, such as eucalyptus, are used in construction and furniture.
12. **Paper and packaging:** Pulp from farmed wood is processed into paper and packaging materials.

Understanding the macroenvironment for agribusiness in order to face opportunities and challenges

The macroenvironment directly influences daily operations in food, agriculture, and biofuel supply chains, affecting products, service, and information flows. It encompasses four major areas: the political/regulatory; economic/natural; sociocultural; and technological environments. Each environment presents specific challenges and considerations.

Relevant issues in various environments

Socio/cultural environment: Consumer movements and attitudes

- **Sustainability and circular economy:** Rising consumer concerns focus on reducing food waste, recycling, reusing, and embracing a circular economy to maximize resource use.
- **Social inclusion:** Growing interest in smallholder support and social innovation aligns with efforts to democratize access to resources and promote diversity.
- **Local sourcing and food miles:** The "buy local" movement has increased demand for regionally sourced products, reducing carbon footprints and supporting local economies.
- **Country of origin and authenticity:** Consumers value transparency, with demand rising for products identified by their country of origin, authentic branding, and geographical denomination.
- **Dietary diversity:** An interest in multicultural ethnic foods, organic products, and homemade alternatives reflects a desire for unique and sustainable culinary experiences.
- **Lifestyle shifts:** Trends such as the slow-food movement, simpler lifestyles, and farm-to-consumer models emphasize quality, ethics, and community- driven food systems.
- **Demographic influences:** As aging populations grow, dietary preferences and tailored food products become significant.
- **Health and wellness:** Growing interest in well-being and nutrition, as well as increased curiosity and acceptance of alternative protein sources (i.e., lab-grown meats and insect protein).
- **Digital influence:** The rise in online shopping behaviors and the impact of influencers, like social media.
- **Sustainability awareness:** Greater focus on climate-related issues, animal welfare, and resource scarcity drive consumer engagement, with millennials notably active in sustainability and activism.
- **Cultural exchange:** Globalization influences food consumption, with increased appreciation for Asian cultures, local small businesses, and experiences shared with family and friends.

Agro-cities and youth attractiveness in agriculture

Brazil's agro-cities—rural towns built around agriculture—have become hubs of economic growth, reduced rural exodus, and improved living standards. As a result, many young people are no longer leaving but building their lives in these agro-cities.

In the last decade, young Brazilians have increasingly engaged in agriculture, innovating and creating startups in the sector due to its high potential. With the use of cutting-edge technology like remote sensing, big data, and localized applications, young entrepreneurs are returning to modernize their family farms and help lead the next wave of agricultural innovation. This is a promising trend for agribusiness, as it suggests a sustainable future for Brazil's rural economies.

Economic and natural environments: Global growth and resource management

- **Global economic shifts:** Asia and other emerging markets are projected to account for 70% of the global GDP in 2030, with rapid recovery from crises boosting their global influence.
- **Diet and demand changes:** Economic growth correlates with evolving dietary patterns, as increased disposable income allows for diversified diets.
- **Global economic instability:** Pandemics, exchange rates, inflation, and fluctuating interest rates impact food security and consumer spending.
- **Natural capital and bioeconomy:** Managing soil, water, biodiversity, and pollinators alongside limited natural resources; advancing bio-based innovation and circular use of by-products.
- **Productivity disparities:** Varying productivity levels across regions highlight economic inequalities, with some countries pursuing solutions to poverty and hunger.
- **New economic models:** The rise of the sharing economy and alternative work models, alongside increased remote work, shifts traditional labor needs and office demands.
- **Environmental risks:** Climate-related events threaten agricultural productivity, risking food security through water shortages, floods, and extreme weather.
- **Pandemics:** issues in animal production.
- **Plagues and diseases:** impacts on plant production.

Political/legal environment: Regulatory and policy landscape

- **Political tensions and risk management:** The instability in international relations, protectionism, and terrorism threats influences food supply chains and commodity prices.
- **Regulations and certifications:** Certification standards, stricter labeling, and traceability requirements ensure product safety and transparency.
- **Trade policies:** Trade agreements, tariffs, and agricultural subsidies influence global food distribution, while embargos and regulatory changes affect pricing and availability.
- **Public health and safety:** Public health budgets and regulations, especially post-pandemic, increase focus on food safety, with support for local production and food self-sufficiency.
- **Labor laws:** Regulations concerning worker rights, safety, and labor shortages in agriculture emphasize the sector's reliance on migrant labor and address workforce protection.
- **Environmental legislation:** Governments implement policies on pollution, plastic waste, and land preservation, with support from NGOs and pressure groups advocating for stricter environmental stewardship.

Technological environment: Advancements in food production and digitalization

- **Data-driven agriculture:** Precision agriculture and smart farming utilize GPS, data analytics, and drones to enhance productivity and resource efficiency.
- **Biotechnology and gene editing:** Advances in genomics and biotechnology support drought-resistant crops, pest management, and bio-based food alternatives.
- **Consumer interaction platforms:** Digital contracts, social media, and mobile apps offer real-time communication and relationship-building with consumers.
- **Alternative proteins and bioplastics:** Innovation in food substitutes, including lab-grown meat and insect protein, addresses sustainability, while bioplastics offer eco-friendly packaging options.
- **Artificial Intelligence (AI) and robotics:** Robotics and automation in harvesting and food processing increase efficiency, while AI offers personalized consumer experiences.
- **Startups and innovation ecosystem:** The rise of agritech startups is fueling innovation across food supply chains.
- **Increased R&D and intellectual property:** As innovation accelerates, companies are investing more in R&D to develop proprietary solutions, protect intellectual property, and maintain a competitive edge.
- **Urban and regenerative agriculture:** Tech-enabled urban farming and regenerative agriculture methods foster sustainable food production in densely populated areas.
- **Enhanced security and traceability:** Digital platforms enable transparency across supply chains, ensuring product authenticity and traceability to build consumer trust (Neves, 2023).

Producing with sustainability: The ESG concept

The economic contributions of agribusiness and food chains over the past 50 years are well known. Early efforts primarily focused on promoting economic development, but by the end of this period, sustainability had become a central priority. Initially, sustainability was viewed narrowly as an environmental issue. Still, with the arrival of the Triple Bottom Line model which encompasses people, planet, and profit, sustainability evolved to emphasize the importance of interlinking these three dimensions. It is also to be well-capitalized in respect of people, planet, and profit, and that erosion of any of these three types of capital is ultimately unsustainable. In line with this thinking, the United Nations created the 2030 Agenda in 2015, featuring 17 Sustainable Development Goals (SDGs) aimed at eradicating poverty, protecting the planet, and ensuring peace and prosperity. Agriculture is recognized as a crucial contributor to these objectives.

Environmental numbers in Brazil

Brazil has made significant strides in sustainable agribusiness despite challenges like illegal deforestation. Key achievements include:

Protected Areas: 66% of Brazil's land is covered by protected natural areas, underpinned by one of the world's strictest forest codes.

Low Carbon Emissions: In 2024 Brazil had one of the lowest net greenhouse gas emissions (in CO_2-equivalents) per capita globally, driven by high level of renewable energy use.

Renewable Energy: 47% of Brazil's energy comes from renewable sources, compared to just 10% in OECD countries.

Biofuels: Brazil leads in biofuel use, with nearly 50% of automotive fuel from biofuels and a robust decarbonization program (Renovabio).

Agricultural Innovation: Brazil's agribusiness sector employs cutting-edge technologies such as bio-inputs, regenerative agriculture, and crop-livestock-forest integration, supported by cooperatives.

Note: While assessing the full environmental impact of such actions is complex, including accounting for land-use change driven by shifts in production, Brazil has shown how responsive commercial agriculture can be to global sustainability demands.

Fig. 2 illustrates the ESG Tool for Sustainable Agribusiness, highlighting governance, environmental, and social actions critical for long-term sustainability in the sector. Meanwhile, Table 1 provides a detailed breakdown of these actions, offering a practical framework for integrating ESG principles into agribusiness strategies.

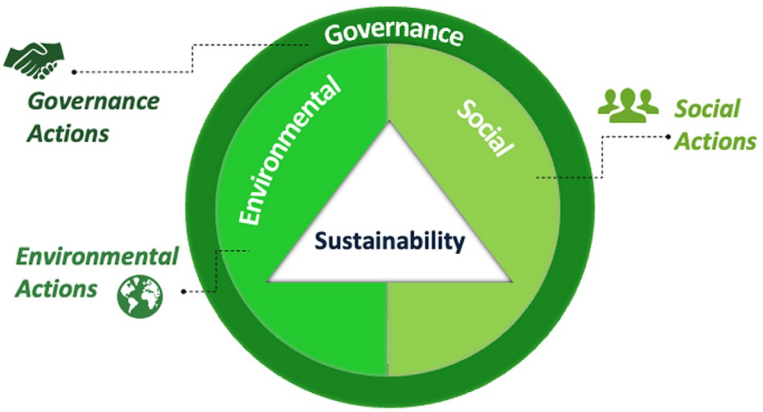

Fig. 2 ESG tool for sustainable agribusiness (Neves et al., 2021).

Table 1 ESG tool for sustainable agribusiness (Neves et al., 2021).

Governance actions	*Environmental actions*	*Social actions*
Promote economic development, opportunities, and equity.	Reduce water, carbon, and energy footprints; improve efficiency.	Ensure fair working conditions, health standards, and wages.
Ensure stakeholders respect, transparency, ethics, and integrity.	Use bioenergy, biofuels, and renewable sources.	Promote gender equity and empower women.
Build a culture of sustainability through partnerships and innovation.	Practice waste reduction and circular economy principles.	Embrace diversity of thought and opportunities for minorities and disabled persons.
Provide technology support for smallholders.	Restore native vegetation and incentivize forest recovery.	Offer educational and training programs.
Track taxes paid and GDP contribution.	Protect biodiversity, reduce deforestation, and rehabilitate degraded areas.	Invest in local communities and small businesses.
Encourage sharing economy models.	Support environmental financing and rewards.	Cultivate a sustainability-focused culture.
Pursue sustainability certifications.	Implement natural pest control and bio inputs.	Share results and benefits with stakeholders.
Develop ESG-focused investment funds.	Integrate crop-livestock-forestry systems.	Enforce a supplier code of conduct on social standards.
Enforce a sustainability code of conduct for suppliers.	Explore alternative ingredients (e.g., insects, algae).	Support nutrition security and climate-friendly diets.
Continuously re-evaluate systems and assumptions.	Promote regenerative and precision agriculture, using nanotech, GMOs, robotics, and "superplants."	

More recently, the concept of ESG criteria has expanded on the principles of the Triple Bottom Line, giving investment professionals, analysts, and corporations insight into how companies are performing on these matters. ESG is considered a refinement of the 3Ps: planet aligns with environmental considerations, people correlate with social concerns, while profit has evolved into a broader concept of governance, implying a structural approach to business practices where profit is an outcome of good governance.

The food and agribusiness sector has increasingly embraced ESG reporting standards, disclosing activities transparently, following good governance, environmental, and social responsibility. This approach helps mitigate risks and focus on achieving long-term results. Incorporating ESG principles into an already consolidated way of thinking about production chains supports sustainable development, emphasizing innovation and resilience. The "S" in ESG represents society's potential for creativity and social progress. As agribusiness and food production continue to expand, fostering inclusion, creating opportunities, and promoting social development will remain essential. In the coming 30 years, the sector's primary goal will likely center around prioritizing people.

Agribusiness firm management

An agribusiness firm's strategy defines how it acquires, builds, and exploits resources and capabilities to create either a differentiated offering of products and services or the low cost offering in the market for the customers it serves—a competitive advantage in the

market. Developing a successful strategy requires a thorough understanding of both the firm and its operating environment. SWOT (Strength, Weakness, Opportunity, Threat) analysis provides a framework for assessing the external operating environment (opportunities and threats) and the firm's internal resources and capabilities (strengths and weaknesses) (Puyt et al., 2023; Stewart et al., 1965).

Assessing the operating environment

Strategy planning in agribusiness takes place within the context of the firm's operating environment. External drivers, forces, and changes create opportunities and threats that must be addressed. This assessment involves evaluating business conditions, competitor positioning, and buyer expectations using analytical frameworks like PESTEL analysis, Porter's Five Forces model, and value chain analysis.

PESTEL analysis

PESTEL (Political, Economic, Social, Technological, Environmental, Legal) analysis (Fig. 3) identifies external drivers that shape opportunities and threats (Aguilar, 1967). Technology significantly influences the production and demand for agribusiness products or services. The impact depends on the industry's reliance on technology and the pace of technical change. Disruptive advancements can quickly outdate older technologies, reshaping production efficiency, supply chain costs, and buyer demand. Current examples of rapid technological change include genetics and genomics, autonomy and robotics, sensing and data analytics, and AI.

Political and legal drivers (e.g., policy changes, trade agreements), social trends (e.g., changing consumer food preferences, public health), and environmental issues (e.g., climate change, energy) also play pivotal roles. Competitive pressure arises from firms' varying abilities to respond and adapt. The impact depends on the change's scope and speed, and the firm's capacity to respond effectively.

Porter's Five Forces

Michael Porter's Five Forces framework assesses industry structure and competition (Fig. 3). The five forces in Porter's model are the bargaining power of buyers and suppliers, substitute products and services, new entrants, and interfirm rivalry (Porter, 1985).

Bargaining power of suppliers: Suppliers have market power if they are more concentrated than their buyers, do not receive a high percentage of their revenues from one sector, have buyers with high switching costs to change suppliers, sell a differentiated product, sell a product with few substitutes (through real differences, brand equity, or patent protection), or could forward integrate into the value chain.

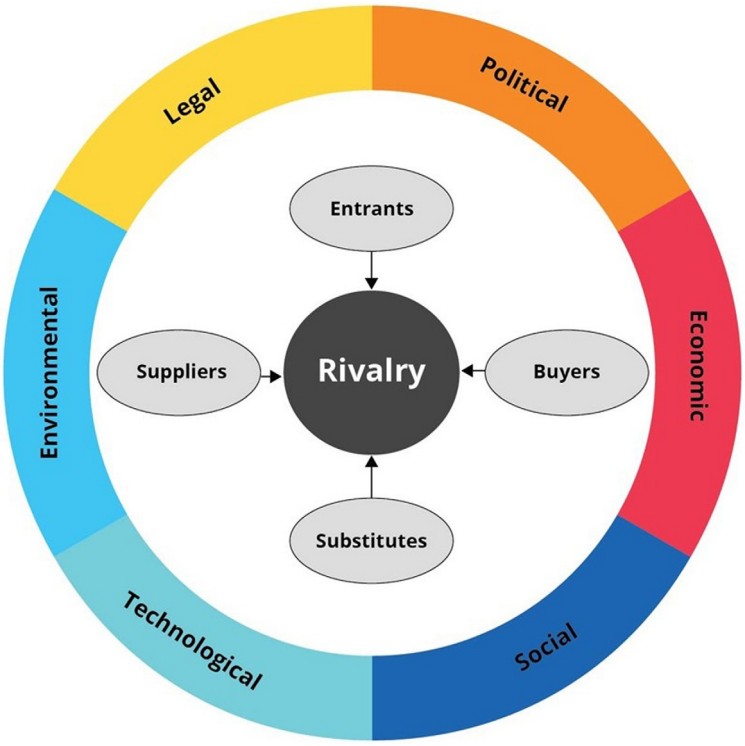

Fig. 3 PESTEL analysis and the Five Forces Model.

Bargaining power of buyers: Buyers have market power when they are concentrated, purchase undifferentiated commodities, can integrate backwards in the value chain, the input has little effect on product quality, producers cannot easily access other markets, and/or buyers have superior pricing information.

Substitute products and services: Substitutes create price pressure: the closer the substitute is to the producer's offering, the more willing buyers will be to switch to the substitute. The pork, beef, and poultry industries (substitutes) provide an example: these industries aggressively promote their products in an attempt to build loyalty to their specific protein and dampen price sensitivity.

Threat of new entrants: If the costs for new firms to enter an existing industry are sufficiently low, the threat of entry alone may limit the price firms can charge buyers. High-entry costs, such as branding or major initial investments, may deter new competitors. Agricultural machinery manufacturing requires substantial capital, limiting new entrants. Firms across agribusiness and especially food firms selling to end consumers invest in branding to create customer loyalty—a barrier to entry.

Rivalry among established firms: Rivalry within an industry is impacted by the first four forces, the number and size distribution of firms in the industry, and how firms compete for business. Agribusiness firms in many subsectors work to build strong brands, deliver differentiated products and services, and bring new technology to their buyers to dampen price pressure. In other agribusiness subsectors such as grain handling and storage, firms focus on driving down costs to compete on price.

Value chain analysis

Value chain analysis examines the stages and processes required in bringing a product or service to market, from inputs to the final consumer. Boehlje (1999) identifies six critical dimensions of a value chain: processes and activities that create the products or services, product flow, financial flow, information flow, incentive systems to reward performance and share risks; and governance and coordination systems.

Agribusiness value chains for food can be divided into two primary paths: plant-based and animal-based products (Fig. 4). These chains converge at the retail level. Value chain analysis can also be applied to non-food uses of agricultural products such as renewable fuels or building materials. These chains can be as simple as five stages: input supply, production, processing and handling, retailing, and consumption.

Value chain analysis helps to assess structural changes from increased coordination within a chain or across interdependent chains. For example, technologies like biotechnology are linking previously distinct chains. Value chain analysis clarifies rising complexity and identifies key competencies, vertical integration trends, and strategies for managing innovations that affect multiple stages of the supply chain.

Market structure and structural change

Conceptual frameworks useful for understanding structural changes in agribusiness, such as consolidation, vertical integration, and shifting vertical and horizontal firm boundaries, include:

1. **Industrial organization (structure, conduct, performance)**

   One paradigm used to understand and analyze the competitive characteristics of markets is the Structure, Conduct, Performance model (Stuckey, 2008). Structure refers to the competitive nature of the market, ranging from perfect competition (many firms, uniform information) to monopoly (one firm, unique information), with intermediate structures like oligopoly or monopolistic competition.

   As to conduct, the focus is on pricing behavior and pricing power. In perfectly competitive markets, firms have no pricing power. They are price takers with no one firm having the ability to set prices higher than competitors. In a pure monopoly, the firm has no competition and thus it has the power to set prices without any concern that competitors will take some of the market. Oligopolies and monopolistic competition feature firms with some pricing power, the level of which depends on firm numbers and size and market information.

   Performance is measured primarily by profits. In perfectly competitive markets, profits (returns above all costs) are zero or minimal while monopolies generate excess profits given their pricing power. Because of the opportunity for a monopolistic firm to charge higher prices and extract excess profits from their customers, such behavior is restricted or regulated by antitrust and other laws and regulations. Profits in oligopoly and monopolistically competitive industries depends on how competitors respond to each other's pricing or output decisions.

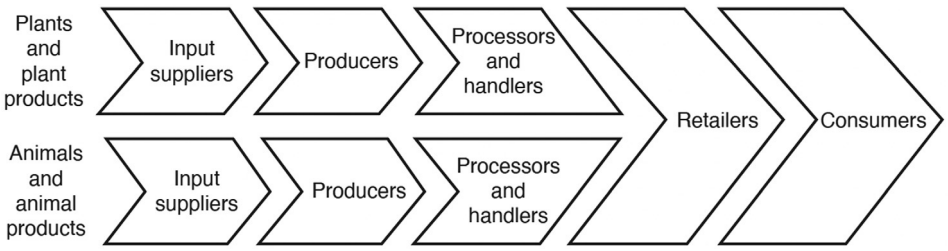

Fig. 4 Value chain for plants, animals, and their products.

2. **Transaction cost economics**
   The concepts of transaction costs and principal-agent theory as conceived by Coase (1937) and expanded by Williamson (1979) and others suggest that vertical linkages and governance in a market depend not only on economies of size and scope, but also on transactions costs, incentives, and principal-agent relationships. Under various conditions, the agent may exhibit shirking behavior (e.g., not performing expected tasks) or moral hazard behavior (e.g., the incentives are misaligned to the point that they encourage the agent to act in ways that produce outcomes inconsistent with or undervalued by the principal in the transaction).
3. **Negotiation, power, and trust**
   More hierarchical governance structures are replacing markets as the coordinating mechanism in agribusiness value chains. Negotiation, conflict resolution, trust-building, and performance monitoring are central to risk/reward sharing and system efficiency in these structures.
4. **Strategic management**
   Firms develop competitive advantages that are driven by internal considerations of costs, technology, risks, and financial and managerial resources; and external considerations such as synergies, differentiation, market power, and positioning. The dynamic capabilities approach offers a framework to mitigate changes in fast moving, unstable agribusiness operating environments and renew a firm's resources and capabilities to deliver sustained competitive advantage (Teece et al., 1997). In fact, given an increasingly turbulent business environment, there are reasons to question the basic concept of a sustainable competitive advantage and replace it with the idea of a "transitory" competitive advantage.
5. **Risk sharing**
   Apgar (2006) argues that value chain partners can mitigate risks and create opportunities but also introduce risk and uncertainty. Establishing sustainable risk and reward sharing arrangements can be difficult and it is common for one firm in the value chain to become the chain leader. The chain leader may choose to be the residual claimant on profits and assume a major share of the risk, or they may choose to share a greater fraction of the profits while shifting more of the risk to other participants in the chain. When firms fail to establish a risk- and reward-sharing arrangement that offers appropriate incentives and is perceived as fair, it often leads to one firm taking ownership of multiple stages in the value chain (vertical integration). Gray and Boehlje (2005) suggest that most tightly aligned supply chains that seek to share risk and rewards among participants will be increasingly dominated by larger firms at both the buyer and supplier level—leading to more consolidation, particularly at the production end of those industries.

Firm strategy

Agribusiness firms craft strategies to align their strengths with market opportunities and challenges. Successful firm strategy focuses on using the firm's resources, competencies, and capabilities to achieve a sustainable competitive advantage, creating value for the buyers it serves in ways that differ from its competition, deliver superior financial performance, and mitigate risk from changing market conditions. At the most general level, firms create competitive advantage through differentiation (superior product/service at a premium price) or cost leadership (comparable product/service at a lower price) (Porter, 1996). Most food and agribusiness firms pursue a differentiation advantage. In contrast, much of production agriculture (farmers) operates in commodity markets and as a result pursues a cost leadership strategy. However, increasingly farm firms also focus on differentiation through production of superior quality products and products with unique characteristics (identity-preserved), serving local markets, and branding their production, among other approaches (Mihailovic et al., 2020).

The value plate

Assessing internal resources and capabilities (SWOT analysis) requires an objective and thorough examination of the firm and its operations. The internal value chain (or value plate) is a useful tool in this process (Porter, 1985). In Fig. 5, the firm's primary

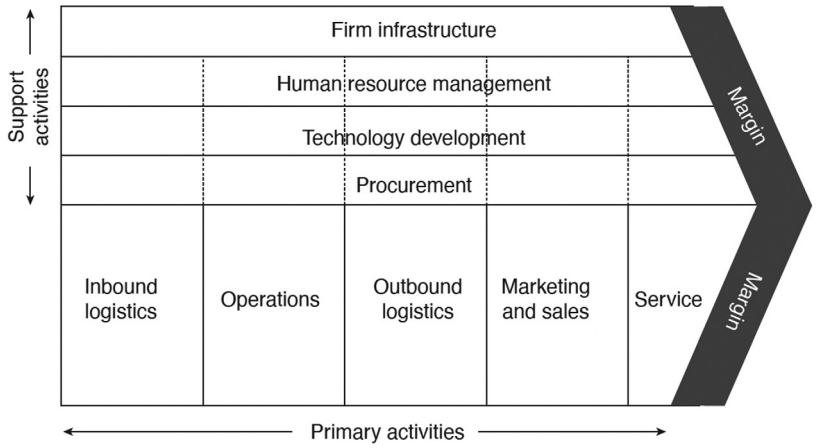

Fig. 5 The value plate.

activities are indicated by the vertical sections in the lower segment. Supporting activities within the firm are represented by the upper rows. The section labeled "margin" captures the goal of profitable operations—revenues that exceed the total cost of production. The interconnectedness of a firm's value plate with those of its suppliers and customers forms a subsector's value chain.

The importance of value plate components can differ significantly across sectors. Service is critically important in the farm machinery and equipment sector whereas inbound logistics is a major success determinant for food processors. Although vastly different in orientation, technology development is fundamentally important for biotechnology-based input manufacturers and for branded food companies.

Effective use of firm resources and capabilities, relative to competitors, determines the size of the margin component of the value plate. Efforts to increase margin have traditionally emphasized enhancing efficiency (shrinking the cost components) or increasing revenues (growing the size of the plate). Recent trends include outsourcing support activities to reduce costs and aggressively implementing information technologies in both the support segment and the operational components of the primary activities.

Value creation and capture

Value creation—providing goods and services that earn revenues exceeding costs—is central to a firm's existence. As detailed by Schumpeter (1942), competitive economies rely on market entry and the creative destruction of innovation to shift value to consumers. Value capture emphasizes value retention over time, for shareholders. The VRIO (Value, Rarity, Inimitability, Organization) framework (Barney, 1991) provides an important model for assessing an agribusiness firm's ability to capture value through differentiation or cost leadership. Key questions include:

- **Is the advantage desired?** (Value: Does the firm deliver products and services that buyers find valuable?)
- **Is the advantage unique?** (Rarity: Does the firm perform activities differently or perform different activities than competitors?)
- **Is the advantage difficult to imitate?** (Inimitability: Is the advantage hard to copy?)
- **Can the firm deliver the advantage?** (Organization: Does the firm have the organizational structure needed to bring the advantage to market?)

While value is measured in financial terms, a long list of intangible assets have advanced in importance including technology, innovation, intellectual property, strategic alliances, management capabilities, employee relations, customer relations, community relations, sustainability, and brand value. As a result, value capture often involves sharing across multiple firms in the value chain. Information and communication technologies (ICT) have accelerated change and altered the sustaining value of resources and capabilities.

Agribusiness firms adeptly integrate ICT and science-based innovations to address the "virtual-physical" operational context. Although mobile phone use has advanced rapidly in developing nations, agricultural production—such as fruits, vegetables, grain, and livestock—must still be transported from rural to urban areas. Unfortunately, this process is often hampered by inadequate physical infrastructure. Intangible drivers of value creation and capture will continue to shape change within the global agribusiness sector. However, the most substantial gains will come from successfully implementing these intangible drivers alongside supportive physical infrastructure.

Growth

For long-term success growth is a necessary goal for most agribusiness and farm managers. Capital markets (for publicly traded firms) and investors expect growth. Growth injects vitality into an organization and helps counteract the constant challenges posed by competitors. For production agriculture, growth is often necessary to remain cost competitive through exploitation of scale economies. Therefore, growth in some dimension is often necessary to maintain a firm's market position. Although profitable growth is a key managerial focus, achieving sustained profitable growth has proven difficult—one study reported 90% of companies worldwide fail to sustain profitable growth (Zook, 2010). Growth strategies are typically categorized into the following dimensions:

- Growth in existing product markets
- Product development
- Market development
- Diversification (either in related or unrelated markets)

Bain and Company (Zook, 2010) extend this framework within the concept of "profit from the core," where successful growth strategies are found to:

- Reach full potential in the core business
- Expand into logical adjacent businesses surrounding the core
- Preemptively redefine the core business in response to market turbulence

Case study: Orbia's three-pillar strategy for growth

A recent case study from the Center for Food and Agricultural Business at Purdue University highlights successful firm growth within the sector (Castro et al., 2021). Orbia was founded in 2019 as a joint venture between Bayer, a German crop protection manufacturer and seed producer present in Brazil for over 125 years, and Bravium, a Brazilian logistics operator. The two companies created Orbia as a spin-off of a successful Bayer unit where Bravium was a key service provider. Orbia's vision is centered around three fundamental pillars: a loyalty program, an online ag input marketplace, and an online commodity marketing platform (Fig. 6).

Fig. 6 Orbia's three-pillar business model.

The loyalty program, the first pillar launched, is comprised of products and services farmers can acquire/redeem once they have accumulated points from their purchases with Orbia's sponsoring companies. This was originally a loyalty program offered exclusively by Bayer named Rede AgroServices in which farmers accumulated points when they purchased Bayer's crop protection products or seeds.

Bayer had pursued two initiatives that were critical in launching Orbia successfully. First, Bayer made a massive push to enroll its customer base in the Rede AgroServices loyalty program. The enrollment process required farmers to provide and regularly update extensive information about their operations. As of 2021, 183,000 farmers had joined Orbia's platform, representing 70% of the arable land in Brazil. In the second initiative, Bayer made a wide array of reward products and services available to farmers. Farmers could select from a menu of items that included agricultural products and services, home appliances and electronics, and motorcycles, among other products and services.

After spinning off from Bayer, Orbia approached other input manufacturers about joining the loyalty program as sponsors. Hundreds of agriculture-related suppliers such as firms selling weather stations, agronomic software, agronomic consulting services, and more joined the platform to increase their access to farmers and as a result, their sales. About 1000 suppliers had joined the platform by 2021 to offer their products and services to farmers, and these firms view Orbia as an important element of their marketing strategy.

Through the input marketplace, the second pillar, Orbia has been able to bring many retailers to its platform to offer their product portfolios online. In 2020, R$ 200 million (about US $40 million) in inputs were sold—a significant increase from only R$ 6 million (about US $1.2 million) at launch in November 2019. By 2021, 180 agricultural retailers across Brazil used Orbia as their online marketing channel. Orbia initially grew with ag retailers that were more closely aligned with Bayer in Brazil. However, as an independent entity, Orbia wants to be the "digital arm" of other input manufacturers and bring more retailers to the marketplace platform.

Orbia's third pillar is grain trading. Through Orbia's trading platform, farmers can place grain offers to potential buyers that are typically trading companies. This opens up the potential to convert farmers' payments into agricultural inputs offered on the marketplace, characterizing a barter operation. Over the years, barter operations have become an important payment and credit mechanism in Brazil as they reduce the risk of credit to retailers and manufacturers, secure grain for trading companies and, very importantly, are a practical way for farmers to manage price risk and minimize working capital needs. When Orbia opened the grain trading platform, it created a digital-bartering solution. In September 2020, Orbia partnered with Bunge to procure grain online and has engaged retailers that already participated in the agricultural input marketplace to do the same. In the first 3 months of operation with Orbia, Bunge was able to source about 75,000 tons of grain. While this is a very small percentage of the total grain Bunge buys, the company predicts this number can reach up to 20% of its total grain purchased.

The uniqueness of Orbia's value proposition is that it simultaneously works with all three pillars, engaging farmers across the business cycle. Orbia provides farmers with superior value when they buy inputs, contract services, and sell their production. At the same time, Orbia seeks to ensure it adds significant value to firms surrounding farmers, including firms engaged in the loyalty program to foster brand loyalty; product and service suppliers that use Orbia as a marketing channel to reach different farmer segments; and grain handling and merchandisers who want an alternative channel to procure grain.

Marketing

Marketing is one of the most important functions for food and agribusiness firms. It involves the development of relationships, or the "contract building" process with potential customers. Successful firms are demand-driven, meaning they deeply understand and build strong, stable relationships with their buyers. Marketing can be defined as a social and managerial process by which

individuals and groups obtain what they need and want through the creation, offering, and trading of products and values with others (Kotler et al., 2021). Thus, marketing aims to satisfy customer needs through trade.

Marketing activities can be divided into two blocks: understanding agribusiness buyers and performing to meet their needs and wants (the marketing mix). Understanding agribusiness buyers requires firms to assess the needs of both the final consumers and intermediaries through marketing research. Agribusiness firms analyze the purchasing behavior of consumers (B2C) and business buyers (B2B) to understand their needs and wants. Firms also analyze the operating environment (PESTEL, 5-Forces, value chain) to anticipate market changes. They must also anticipate and react to competitors' strategic moves. The goal is to identify opportunities to create additional value for customers and/or threats to the value being delivered. Firms will choose among these opportunities based on which market segments the company targets and will take action to address relevant threats.

Performing involves taking action based on the understanding of buyers. Firms differentiate products and services from competitors and use market insights to adapt products, brands, and packaging to satisfy buyer needs. Firms set prices to capture a portion of the value created, implement distribution strategies to ensure product availability, and use communication strategies (e.g., traditional media promotion, social media, influencers, digital promotions, field demonstrations, and personal selling) to convey the value added.

Performing via products, services, packaging, and brands

A product represents the group of attributes, functions, and benefits that buyers purchase, including goods, services, information, packaging, brands, and ideas (Kotler et al., 2021). According to Garvin (1987), for an offer to be perceived as high quality by the buyer, the following factors must be considered:

- **Performance:** the product's capacity for delivering against expectations.
- **Characteristics:** the number and complexity of characteristics that differentiate the product.
- **Reliability:** the possibility of a product failing within a certain time frame.
- **Conformity:** the degree to which the design and operational characteristics of the product comply with pre-established standards.
- **Durability:** the time frame it takes for the product to be replaced.
- **Rendered services:** development, speed, and effectiveness of the services offered before, during, and after the purchase.
- **Aesthetics:** the design, the color, the product's taste, and other more subjective aspects of the product.
- **Quality perception:** reputation or perceived brand image.

Many products are branded. According to the American Marketing Association (AMA) a brand is any distinctive feature like a name, term, design, or symbol that identifies goods or services. Customers use brands as sources of information, simplifying choices, and reducing acquisition risks. Brands capture beliefs about the attributes and general image and reputation of the product among buyers. Selling new products under well-established brand names increases acceptability through brand loyalty. Buyers also build loyalty by associating functionalities, images, and experiences with brands. In competitive markets, products and services tend to become more uniform, so brands evolve to create differentiated value. The success of a brand depends on these customer associations.

Packaging also plays an important role, with technological improvements in packaging extending shelf life and facilitating on-the-go consumption of food products. Environmentally friendly packaging, such as plastics made from sugar cane and corn, is gaining attention.

Performing via price

Price can be defined as the amount of money necessary to acquire a given quantity of goods or services. Although other variables of the marketing mix have become more important, price remains one of the fundamental elements in determining market share and profitability. Price is also flexible, easily altered compared to product changes or distribution channel commitments.

Despite its importance, many firms struggle with pricing. According to Kotler et al. (2021), the most common pricing errors are: prices overly oriented to costs; prices not revised frequently enough to capture market changes; prices not aligned with the rest of the marketing mix; and prices that don't reflect variation across different product items, market segments, and purchase occasions. With dramatic growth in online purchasing and easy access to information, pricing strategies have become more important and sophisticated.

Food prices are sensitive societal issues, especially given their variation due to supply and demand conditions. Lower income populations spend a much larger percentage of their disposable income on food. Thus, price increases attract substantial consumer, media, and government attention.

Performing via distribution channels (wholesalers, retailers, and supply chain management)

According to Coughlan et al. (2006), a distribution channel consists of interdependent organizations (wholesalers, retailers, and logistics providers) that make products or services available for use by buyers. When planning distribution channels, it is important to:

- Define opportunities and threats of the current distribution system.
- Analyze channels for the company's products and seek new channels as appropriate, defining distribution objectives such as: market presence, type and number of points of sale, services offered, market information, product promotion, and incentives.
- Identify approaches for entering new markets, including franchises, joint ventures or other contractual forms; vertical integration; or national or international contracts with distribution partners.
- Determine the annual distribution budget and implement the distribution plan.

Efficient and effective distribution channels are vital for food due to perishability and the weight/value ratio of food products.

Performing via integrated communications

Marketing communication transmits information to buyers, influencing their attitudes and behaviors. More specifically, marketing communication informs target customers that the right product is available at the right price and place. All organizations, private firms, and nonprofit entities use some form of marketing communication to promote their offerings. This communication assists firms in achieving financial and non-financial objectives. In setting up a marketing communication strategy, the following activities are performed:

- Identify the target audience that will receive the communication and develop the desired objectives (brand knowledge, brand memory, and persuasion, among others).
- Define the communication mix that will be used: the traditional media plan, the digital media and social media influencer plan, the field demonstration plan, the public relations and publicity plan, the sales promotion plan, as well as direct marketing actions, among others.
- Develop the budget and goals and measure the return on investment and impact of the activities.

Food marketing communications face increased regulatory scrutiny, especially regarding human health issues and adult and childhood obesity, which leads to strict regulations on what can and cannot be said about a food product in many countries.

Performing via sales force and people

The agribusiness sales force is comprised of individuals responsible for making sales happen. Selling is increasingly a team activity requiring a portfolio of technical, relationship, and commercial skills. Sales force decisions include deployment of the sales force in the market, recruiting and retaining a well prepared and motivated sales team, management of the sales force, and, finally, monitoring the effectiveness of the sales force. The agribusiness sales force for crop and livestock input suppliers is a fundamental source of knowledge and information for farmers (Keshavarz, 2021).

In marketing, these five elements of performance—products, prices, channels, communications, and people—form the marketing mix. Combined, this marketing mix is intended to deliver superior value to buyers at a premium price or comparable value at a lower cost. Monitoring and adjusting the marketing mix is necessary to sustain a competitive advantage amidst evolving customer needs and competitor actions.

Finance

Finance is crucial for assessing the profitability of agribusiness firms, guiding investment and operational decisions. Finance is centered on cash sources, cash usage, and asset returns (Brigham and Ehrhardt, 2020). Typically, riskier investments are expected to yield higher returns. For agribusinesses, the cost of financial capital serves as a benchmark, guiding investment decisions to ensure they yield returns sufficient to cover this cost. Once investments are made, financial statements (income statements, balance sheets, cash flow statements, and statement of owners' equity) help managers measure, monitor, and correct operations.

Financial statements and key performance metrics

The four key financial statements—the balance sheet, income statement, cash flow statement, and statement of owners' equity—offer insights into a firm's financial status and performance. These documents are typically prepared annually, with quarterly updates for earnings, and adhere to Generally Accepted Accounting Principles (GAAP) or International Financial Reporting Standards (IFRS), verified by independent audits. The income statement, cash flow statement, and statement of owners' equity document financial performance over a set period, while the balance sheet presents a snapshot of assets, debts, and equity at a particular date.

Analysis of these financial statements focuses on profitability, asset management, liquidity, and solvency. Key financial metrics are return on equity (ROE) and return on assets (ROA). ROE is a benchmark for investors to assess management's performance relative to alternative investments, factoring in asset returns and financial leverage (see "Capital structure and financial leverage" section). ROA, measuring operating income of the firm, is further analyzed through the DuPont model (Fig. 7), which breaks ROA into profit margin and asset turnover. Profit margin measures the percentage of revenue left to compensate financial capital. Asset turnover reflects how effectively management generates revenue from assets. Some firms use a low-margin, high-turnover strategy, common in retail, while others adopt a high-margin, low-turnover strategy, typically in manufacturing. Ideally, firms aim for high margins and high turnover. Thus, the DuPont model aids in understanding how operating margin, asset turnover, and capital structure drive financial performance (Roucan-Kane et al., 2013; Melvin et al., 2004).

Capital structure and financial leverage

A firm's capital structure, or the mix of debt and equity, is designed to minimize the weighted average cost of capital (WACC) to maximize firm value. Financial leverage, or debt use, boosts ROE but also increases financial risk, because higher debt-to-asset ratios demand greater cash flow to cover obligations. Two broad financial concepts underlie financial leverage: liquidity, or the ability to service short-term debts, and solvency, or the capacity to meet long-term obligations. Common liquidity metrics include working capital turnover and the quick ratio, while solvency is often assessed by the debt-to-asset ratio. Financial leverage affects return on assets, impacting liquidity, solvency, and earnings leverage—the sharing of operating profits between lenders and equity holders. Agribusinesses raise debt from banks, bond markets, or suppliers and equity from private investors, public markets, or retained earnings.

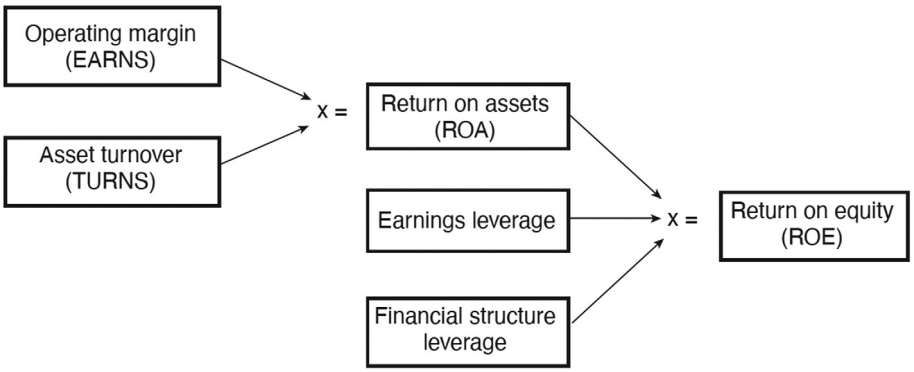

Fig. 7 DuPont identity of return on equity.

Investment analysis and capital budgeting

Agribusinesses regularly seek opportunities to acquire assets to grow the business and create additional customer value. Investment analysis often happens through a tool using net present value analysis (NPV) or discounted cash flow (DCF) approaches. These methods project cash inflows and outflows, estimate the appropriate discount rate, and assess sensitivity to varying assumptions. The lengths of projections vary but typically span five to 10 (or more) years of cash flows.

The discount rate should reflect the time value of money and the return needed to offset project risk. Many firms use their WACC as the discount rate, requiring a project to generate sufficient returns to meet expected returns on capital. A positive NPV suggests project acceptance, while a negative NPV suggests rejection.

Sensitivity analysis, aided by advanced spreadsheet programs, tests the impact of key cash flow assumptions on outcomes. Firms may also choose to compute and report an internal rate of return (IRR)—the discount rate at which NPV is zero—providing a rate of return for comparison with other investments. However, some projects have multiple IRRs, complicating the analysis.

Risk and uncertainty

Agribusiness faces various types of risk, traditionally categorized as production, marketing, financial, legal, and human risks. But these categories do not adequately capture all the risks and uncertainties agribusiness firms face as identified by Teece et al. (1997) (Table 2).

An alternative classification is dividing risks into **tactical/operational** and **strategic**.

Tactical/operational risk

This includes business and financial risks inherent in routine operations. Business risk covers uncertainties in prices, costs, and production, while financial risk arises from debt obligations, magnified by leverage and interest rate fluctuations. Tools like insurance, hedging, and diversification help manage these risks. Typical recent research in this area is provided in Table 3.

Table 2 Domain of risk and uncertainty.

Categories of risk	*Illustrative sources of risk*
Business Partners and Partnerships	Interdependency, confidentiality, cultural conflict, information sharing
Competitors and Competition	Market share, price wars, antitrust, industrial espionage
Customers and Customer Relationships	Product liability, credit risk, poor market timing, inadequate customer support
Distribution Systems and Channels	Cost, transportation, services availability, dependence on distributors, supply chain disruptions
People and Human Resources	Health, contract terms, turnover, recruiting, training, retention, organizational culture
Regulatory and Legislative	Reporting and compliance, environmental, food safety, traceability, government trade negotiations, government farm subsidies
Political	War, terrorism, civil unrest, law, governing agencies, enforcement of intellectual property rights, change in leadership, revised economic policies, budget shortfalls
Reputation and Image	Corporate image, brand image, reputation of key employees, community relationships
Technological	Complexity, obsolescence, workforce skill sets, adoption rate, diffusion rate
Financial Markets	Cash, interest rates, foreign exchange, portfolio misalignment
Operations and Business Practices	Natural hazards, facilities, disease outbreaks, contractual risk, internal processes and controls, management transitions
Financing and Financial Structure	Debt servicing capacity, leverage, debt structure, nonequity financing, liquidity, solvency, profitability
Market Prices and Terms of Trade	Product price volatility, input price volatility, cost structure, contract terms, market outlets and access

Adapted from Teece DJ, Pisano G, and Shuen A (1997) Dynamic capabilities and strategic management. *Strategic Management Journal* 18: 509–533.

Table 3 Recent research on managing tactical and operational risks in agribusinesses.

Category	*References*
Crop Insurance	Connor, L., Rejesus, R.M. and Yasar, M., 2022. Crop insurance participation and cover crop use: Evidence from Indiana county-level data. *Applied Economic Perspectives and Policy*, *44*(4), pp. 2181–2208.
	Diffenbaugh, N.S., Davenport, F.V. and Burke, M., 2021. Historical warming has increased US crop insurance losses. *Environmental Research Letters*, *16*(8), p. 084025.
	Yu, J. and Sumner, D.A., 2018. Effects of subsidized crop insurance on crop choices. *Agricultural Economics*, *49*(4), pp. 533–545.
	Wu, S., Goodwin, B.K. and Coble, K., 2020. Moral hazard and subsidized crop insurance. *Agricultural Economics*, *51*(1), pp. 131–142.
	Aglasan, S., Rejesus, R.M., Hagen, S. and Salas, W., 2024. Cover crops, crop insurance losses, and resilience to extreme weather events. *American Journal of Agricultural Economics*, *106*(4), pp. 1410–1434.
Financial Stress	Davis, E.C. and Katchova, A.L., 2020. The impact of bank deregulations on farm financial stress and stability. *Sustainability*, *12*(4), p. 1684.
	Dinterman, R., Katchova, A.L. and Harris, J.M., 2018. Financial stress and farm bankruptcies in US agriculture. *Agricultural Finance Review*, *78*(4), pp. 441–456.
	Patrick, K., Kuethe, T. and Ifft, J., 2018. Implement dealer financing and farm financial stress. *farmdoc daily*, *8*(96).
Hedging/Options/ Contracts	Maples, W.E., Giri, A.K., Coble, K.H. and Subedi, D., 2022. Impact of government programs on producer demand for hedging. *Applied Economic Perspectives and Policy*, *44*(3), pp. 1126–1138.
	Wever, H., Michels, M. and Musshoff, O., 2024. Unearthing the behavioural factors influencing commodity futures contracts adoption in agriculture—A systematic literature review. *Australian Journal of Agricultural and Resource Economics*, *68*(4), pp. 931–947.
Diversification/Supply Chain	Reckling, M., Watson, C.A., Whitbread, A. and Helming, K., 2023. Diversification for sustainable and resilient agricultural landscape systems. *Agronomy for Sustainable Development*, *43*(4), p. 44.
	Imbiri, S., Rameezdeen, R., Chileshe, N. and Statsenko, L., 2024. Risk propagation and resilience in the agribusiness supply chain: A systematic literature review. *Journal of Agribusiness in Developing and Emerging Economies*, *14*(4), pp. 712–732.
	Zhong, J., Cheng, H. and Jia, F., 2024. Supply chain resilience capability factors in agri-food supply chains. *Operations Management Research*, pp. 1–19.
	Sekaran, U., Lai, L., Ussiri, D.A., Kumar, S. and Clay, S., 2021. Role of integrated crop-livestock systems in improving agriculture production and addressing food security–A review. *Journal of Agriculture and Food Research*, *5*, p. 100190.

Strategic risk

Strategic risk affects the company's direction and value, influenced by political, economic, and technological uncertainties, as well as industry-specific dynamics. Unlike tactical risks, tools/techniques such as insurance, futures/options, contracts and other market instruments are not available to manage strategic risks. These risks require flexible management strategies, such as adaptability, diversification, and creative real options to mitigate potential impacts.

Real options in strategic risk management

Real options theory, widely used in financial and commodity markets, has been extended to investment and strategic decisions in uncertain environments (Dixit and Pindyck, 1994; Amram and Kulatilaka, 1999).

The basic premise of real options theory is that many investments—and most strategic decisions—are subject to risk and uncertainty in terms of future payoffs and costs. Decisions are often best divided into stages, allowing for new information after the first stage to be obtained that can influence the probability and size of future payoffs. Initial investments resemble a futures market call option, providing the opportunity (but not the obligation) to commit more resources as new information is revealed.

Options thinking emphasizes the benefits of delaying financial commitments in uncertain environments. The benefits of delay are twofold:

1. The uncommitted funds can earn returns elsewhere while the firm waits.
2. Additional time allows for gathering more information, leading to better-informed decisions that reflect the true value of the investment.

This delay can be advantageous irrespective of future outcomes. Delaying a decision to obtain more information about either good or bad events in the future has value for two reasons: (1) to capture the benefits of completing the investment or commitment if it is higher than expected, and (2) maintaining the flexibility to avoid a mistake if the benefits are not as high as expected. Thus, the opportunity to obtain more accurate information is valuable, even if the outlook is negative.

Real options concepts are particularly useful in analyzing strategic risks where the decision-maker has the ability to make resource or financial commitments over time and thus change the value of the payoff of the strategy. For example, decisions concerning the timing and sequencing of the commitment of resources to new business ventures and selling to new markets to take advantage of new information revealed during the time delays are critical to strategic management.

Real options theory also applies to evaluating risks and rewards in joint ventures and strategic alliances. These arrangements, particularly prevalent in industries like biotechnology and food manufacturing, offer flexibility compared to acquisitions, acting as "options" that enable companies to hold off on full commitments until new information is available. For example, Folta and Miller (2002) applied real options to strategic alliances in biotechnology, and similar methods apply to strategic decisions involving asset acquisitions, R&D investments, start-ups, and technology adoption.

Loftus Ranches case study: Real options analysis

Real options thinking and analysis have become an integral part of strategy development and implementation, as seen in case studies like Loftus Ranches, where the company evaluated the potential expansion of its hops production division into producing and marketing craft beer using real options analysis (Widmar et al., 2015). This approach allows agribusinesses to better manage uncertainty, balance flexibility, and optimize decision-making in rapidly changing environments.

Supply chain management

The global intricacies of agri-food production make supply chain management a core focus for agribusiness. Efficient supply chains ensure that time-sensitive agricultural goods reach consumers in safe, optimal conditions while minimizing waste. Firms must balance supply and demand while navigating volatile factors such as weather, global trade dynamics, and regulatory requirements.

A significant challenge in agribusiness supply chains is the bullwhip effect, where small fluctuations in consumer demand create larger fluctuations upstream in the supply chain, from retailers to manufacturers to farms. For example, during the COVID-19 pandemic, unexpected shifts in egg demand caused liquid egg prices to fall below bottled water prices, while shell egg prices increased dramatically (Malone et al., 2021). This effect leads to inefficiencies such as excessive inventory, higher operational costs, and lost sales. The bullwhip effect also amplifies price volatility upstream in agricultural markets (Fig. 8). Regulatory constraints further complicate adjustments to demand fluctuations, as even the largest market-based economies have experienced large increases in regulatory burdens for agri-food supply chains. For example, U.S. protein supply chains face tens of thousands of state and federal regulations, with aquaculture being the most heavily regulated and poultry and egg the least (Staples et al., 2021). Firms mitigate the bullwhip effect by improving communication, employing strategies like Sales & Operations Planning (S&OP), and investing in real-time data technologies.

Agribusiness supply chains are uniquely impacted by three factors: biological lags, seasonality, and perishability. These factors introduce additional uncertainty in scheduling, inventory, and distribution. For example, the 2022 avian influenza outbreak drove up consumer prices for months as it took time to replace lost flocks (Mitchell et al., 2024). Perishable goods like fresh produce and dairy require efficient logistics to reduce waste (shrinkage) and maintain quality. Seasonal production driven by weather conditions causes supply fluctuations, requiring managers to align variable supply with demand forecasts. The biological nature of production adds uncertainty to quality control efforts, making statistical process control critical. Technologies like GPS-enabled equipment and automated data collection help monitor soil health, pest activity, and yields to improve production quality.

Geopolitical and cybersecurity risks

Global agribusiness supply chains are vulnerable to geopolitical risks, such as trade conflicts and regulatory shifts, which disrupt access to critical inputs and exports. The 2018–2019 U.S.-China trade conflict disrupted global soybean markets, forcing agribusinesses to seek alternative markets and suppliers (Grant et al., 2021). Similarly, the war in Ukraine caused grain and oilseed

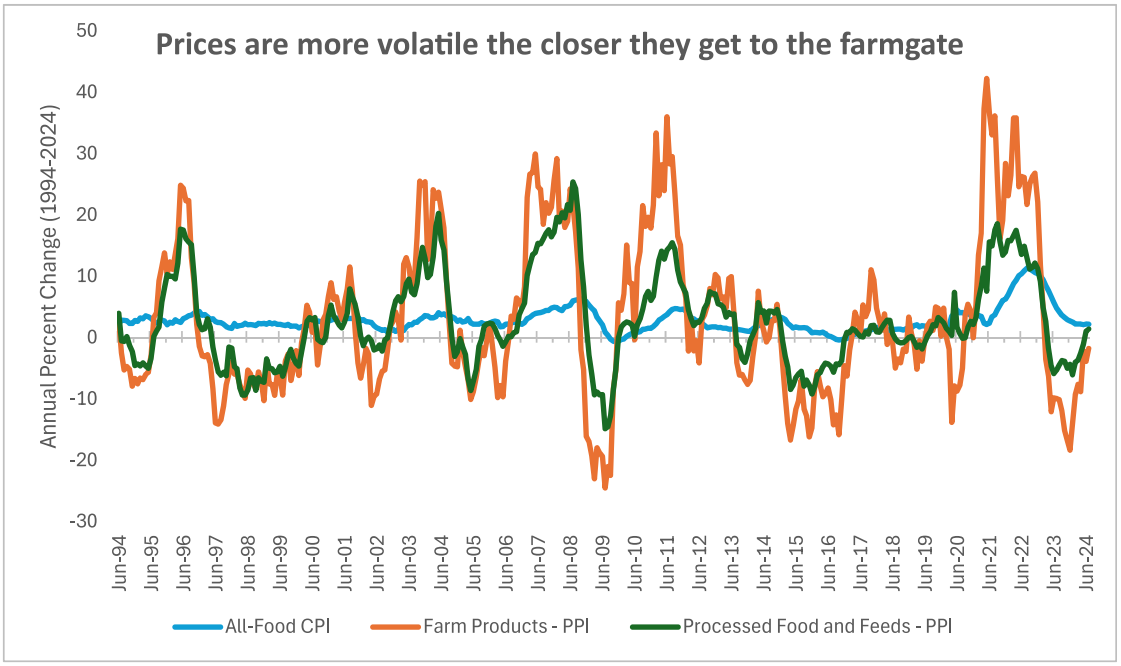

Fig. 8 U.S. agri-food price changes at three steps of the value chain (1994–2024).

shortages, raising export costs and impacting global food security (Countryman et al., 2024). To mitigate such risks, firms diversify suppliers across politically stable regions and adopt "friend-shoring," sourcing inputs from geopolitical allies.

Cybersecurity is a growing concern as digital tools become integral to supply chain management. Cyberattacks can disrupt operations, compromise sensitive data, and threaten traceability systems. Agricultural production has become more interconnected, thus increasing its vulnerability to cyberattacks (Geil et al., 2018). To safeguard supply chains, agribusinesses address these threats by adopting cyber-biosecurity strategies to protect biological data and infrastructure, ensuring the integrity of critical processes, and providing targeted training programs to mitigate risks from cyber threats, such as intellectual property theft (Duncan et al., 2019).

Economies of scope and scale

Economies of scale lower costs by spreading fixed costs over larger production volumes, while economies of scope reduce costs by sharing resources across multiple products. Firms often benefit from being large in terms of their assets and revenues, as fixed costs can be spread over greater units sold, reducing overall average costs. Because many agribusiness sectors have large, fixed costs, agribusiness markets often have natural monopoly characteristics (Howard, 2020).

This has led to rapid consolidation in certain agricultural sectors, where a few firms dominate the market. Larger agribusiness firms gain significant cost advantages due to their ability to leverage economies of scale while smaller producers in localized supply chains face greater challenges. For example, large Pacific Northwest hop farms dominate the market by leveraging economies of scale, spreading fixed costs across greater land area to achieve lower marginal costs compared to smaller producers in regions like Michigan (Staples et al., 2021).

Logistics

Multi-country distribution networks add complexity to logistics, where delays can extend lead times along the supply chain (Carter et al., 2023). The perishability of fresh produce, dairy, and similar goods requires quick transportation to prevent spoilage. In agribusiness, logistics are complicated further by the biological production cycles, meaning delays can cause significant losses. Modern supply chains increasingly rely on traceability technologies, such as sensors and GPS, to track shipments, monitor perishable goods, and reduce waste (Mitchell et al., 2021).

Sourcing procurement

Sourcing and procurement are critical components of agribusiness supply chains and involve identifying and acquiring raw materials like seeds, fertilizers, feed, and machinery. Effective sourcing ensures quality and availability, while procurement ensures that these materials are acquired at the right time and price. Technologies like blockchain and enterprise resource planning (ERP) systems improve visibility and traceability, helping firms mitigate supply risks.

Efficient sourcing and procurement strategies also reduce lead times, allowing firms to respond quickly to changes in demand. Just-in-time (JIT) strategies minimize inventory costs, while statistical quality control methods, including Hazard Analysis and Critical Control Points (HACCP), ensure food safety and reduce risks from foodborne pathogens. Food processors also use International Organization for Standardization (ISO) certifications and Clean in Place (CIP) processes to ensure food safety. Process mapping also helps to ensure food safety by identifying critical points where quality can be monitored and controlled. Many agribusiness firms also use structured management methodologies and regulatory frameworks to ensure product quality and minimize waste. For example, HACCP is a preventative system designed to identify, evaluate, and control food safety hazards throughout production. ISO certifications set globally recognized quality and safety standards. Clean-in-Place (CIP) refers to automated cleaning systems for processing equipment without disassembly. Process mapping is a visual tool used to analyze workflows and identify points for quality control. Statistical process control, including Total Quality Management (TQM) and Six Sigma, are data-driven approaches that use statistical methods to monitor and improve manufacturing quality, reduce variation, and minimize waste.

Changes in consumer preferences and stricter environmental regulations have led agribusinesses to adopt sustainability reporting. This shift toward sustainability reporting is particularly critical in regions with stringent environmental regulations, like the European Union (Deconinck et al., 2023). Advanced supply chain management (SCM) software enables firms to track key metrics, such as Scope 3 emissions, for regulatory compliance and corporate social responsibility. Technologies such as blockchain technology, artificial intelligence (AI), and Radio Frequency Identification (RFID) enhance transparency, optimize product flow, and help firms meet environmental and safety standards (Loy et al., 2024).

Data analytics, AI, and precision production and distribution

Digital technology and data analytics have advanced significantly over the past few decades. During the 1990s, it became clear that more accurate and timely data could be used to make better decisions. However, the information technology systems needed to collect and analyze this data were often too expensive and difficult to implement for many organizations. In the early 2000s, advances in communication made it easier for farms and agribusinesses to analyze and share data. Despite this progress, the cost and implementation challenges of information and communication technologies (ICT), along with limited connectivity in rural areas, persisted. Today, technologies such as cloud computing, AI, Big Data, and the Internet of Things (IoT) are breaking through barriers, making digital solutions more accessible and effective. For this reason, experts believe that the food production and distribution sector is in the early stages of a digital transformation.

Current status and availability of precision agriculture technology

A multi-year survey of agricultural retailers in the U.S. (Erickson and Lowenberg-DeBoer, 2023) provides insight into the adoption of precision farming technologies. Table 4 shows the percentage of acres of local market area that retailers estimate is farmed with precision technologies. In 2023, more than 70% of acres were farmed with guidance/autosteer and yield monitors, which are now standard on most new equipment. More than half of farm acres utilized sprayer section controllers, planter row or section shutoffs, and grid or zone soil sampling. The variable rate of lime and fertilizer applications stabilized at about 50%. The survey also highlighted significant growth since 2017 in the use of cloud storage, electronic records/mapping, and data analysis services, indicating that producers are increasingly leveraging their data for decision-making and sharing it with supply chain partners.

A 2019 survey of 800 commercial farmers (Thompson et al., 2019) found that a large proportion of farmers operating 2000 or more acres commonly collect yield, soil, and imagery data, with around 70–90% adoption rates. This data influences key decisions like fertilizer, seeding rates, and drainage, with a majority of survey respondents reporting positive results: 72% report a positive yield impact from data-driven seeding rate decisions; 81% from fertilizer decisions, and 85% from drainage decisions. Collecting data from all three sources results in even more satisfaction than if only one data stream is collected. The survey indicates that 47% of farms use data software platforms, with 63% of farmers with 5000 acres or more using such platforms. In terms of data sharing, over 70% share their farm data with at least one service provider. Farmers who subscribe to software platforms or share data with service providers tend to be more influenced by data in their seeding and fertility decision-making than those who collect data but do not utilize a platform or share their data.

Lowenberg-DeBoer and Erickson (2019) reviewed global research on precision agriculture adoption, noting rapid adoption of guidance systems, sprayer boom control, and planter row or section shutoffs, with variable rate technologies seeing slower uptake. However, the authors anticipate wider adoption as robotics and AI advance.

Studies on profitability indicate modest operating profit increases from adopting precision agriculture technologies. Schimmelpfennig (2016, 2018) found small profit increases (1.1–2.8%) from GPS soil and yield mapping, guidance systems, or variable rate technologies. A more recent exploratory study by Pope and Sonka (2020) used a detailed survey of a small farmer sample (10) who are recognized as early precision farming technology adopters to obtain cost estimates and highlight benefits of approximately 25 individual precision farming tools or practices. Categories of tools and practices included: "Legacy Control Systems" (e.g., yield monitors and auto steer), "Mapping," "Agronomic/Fertility Systems" (e.g., grid/zone soil mapping, variable rate technology, sensors), "Monitoring Systems" (e.g., drones or aerial imagery), and "Decision Support Technologies" (e.g., analytics, management systems).

This study suggested significantly higher payoffs, with an average net benefit of $90 per acre, and a benefit cost ratio of 9.7 to 1. These earlier adopters are using a much larger proportion of the tools/practices that are available, and the higher payoff, compared to previous studies, reflects the compounded benefits of integrating precision farming technologies. These system-wide benefits indicate a "new way of farming" where the interaction among practices amplifies the overall impact.

Payoffs of precision production and distribution

For the producer

Cost reduction/efficiency improvement—Precision farming's improved measurement of soil characteristics and weather patterns directly reduces costs and increases efficiency by optimizing input use and tracking their impact on yield and profitability. Additionally, creative machinery scheduling and 24/7 operations can boost equipment utilization and lower per-acre costs.

Table 4 Farmer use of precision technologies, local market area estimated by retailers (Erickson and Lowenberg-DeBoer, 2023).

Service	*2017*	*2020*	*2022*	*2023*
Guidance/Autosteer	60%	66%	69%	77%
Yield Monitor	–	65%	68%	72%
Sprayer Section Controllers	–	62%	63%	64%
Planter Row or Section Shutoffs	–	46%	51%	54%
Grid or Zone Soil Sampling	45%	52%	57%	51%
Variable Rate Technology (VRT) Lime Application	40%	44%	52%	43%
VRT Fertilizer Application	38%	44%	49%	43%
Cloud Storage of Farm Data	14%	29%	42%	40%
Variable Down Pressure on Planter	14%	31%	41%	38%
Electronic Records/Mapping for Quality Traceability	–	21%	34%	31%
Any Data Analysis Service	13%	25%	38%	30%
VRT Seeding	13%	19%	22%	22%
Satellite or Aerial Imagery	19%	31%	31%	21%
Soil Electrical Conductivity (EC) Mapping	9%	14%	19%	15%
VRT Irrigation	–	5%	6%	15%
Variable Hybrid Placement Within Fields	7%	17%	14%	12%
UAV or Drone Imagery	6%	12%	17%	10%

For the value chain

Food safety—For a branded-product food company, a food safety scare can be disastrous. Improved monitoring of soil preparation, plant growth, harvesting, and processing enables traceability throughout the supply chain, ensuring food safety.

Sustainability—A growing number of food processors and retailers are responding to the "sustainability" concerns of their customers. Precision farming helps suppliers meet and document sustainability criteria, becoming a "qualified supplier" in response to a more demanding supply chain.

Traceability—If there is a food safety or contamination issue, consumers, food companies, and government officials are eager to reveal the source and take mitigating action. Precision farming enhances the ability to trace contamination sources at the farm level and provides documentation to verify sustainability practices and ensure compliance with supplier standards.

For the environment

Reduced fertilizer and chemical leaching and runoff—Precision application of fertilizers and pesticides, optimized for location, timing, and amount, reduces leaching and runoff into ground and surface water and the resulting deterioration of water quality.

Conserving irrigation water—The availability of water for irrigation purposes is declining in many locations because utilization and drawdowns exceed recharge rates. Precision farming technologies enhance irrigation efficiency by applying water precisely when and where it's needed, conserving scarce water resources.

Comprehensive nutrient management—Concerns about soil and water (or even air) degradation in rural areas has resulted in regulatory pressures, restricting the application of inorganic and organic (manure and animal waste) fertilizer. Precision farming helps develop nutrient management plans that reduce environmental degradation and lower costs by applying fertilizers, including animal waste, more efficiently.

Automation and robotics

Robots are increasingly used in planting, weeding, and harvesting, especially in fruit and vegetable crop production. In grain production, autonomous grain carts and tractors have garnered considerable press, with these systems using GPS and wireless technologies to operate without drivers.

The Hands Free Hectare project at Harper Adams University in the UK uses automated machines to grow crops remotely, with autonomous equipment used to plant, weed, and harvest the crop. Cost analysis on robotics by Lowenberg-DeBoer et al. (2019) based on data from this project suggests that automation can reduce costs more significantly for smaller farms, though economies of scale in larger farms remain.

Erickson and Lowenberg-DeBoer (2023) indicate that the retailer adoption rate of drones was 57% in 2023. This percentage is expected to increase to 75% by 2026. Drones are now used for crop monitoring, and will increasingly be used for application of seed, fertilizer, and pesticide inputs.

In the livestock sector, robotic milkers have been adopted to reduce labor costs, improve milk production, and create valuable data for managing herd health and optimal cow replacement. Robotic milkers adapt milking frequency to individual cows and by lactation stage. These systems also use sensors and cameras to monitor animal behavior, health, and feed consumption. Just as precision agriculture in crop production results in more timely data and improved decision-making, a robotic milking system creates a wealth of data that can be used to make decisions.

Human capital management

Firms succeed or fail based on the capabilities of their people, making human capital investments critical for increasing profitability (Scafarto et al., 2016). Mergers and acquisitions have transformed many agribusinesses into large, global organizations, requiring complex coordination to execute operational, financial, marketing, research, and development strategies (Trejo-Pech et al., 2021). Both large and small firms often rely on multinational labor pools, creating challenges like language barriers that impede employees' understanding of job expectations and safety protocols. In response, organizational managers need leadership skills to motivate and retain valuable employees.

Agricultural firms depend heavily on labor efficiency, employee motivation, and workforce retention. Unique challenges include seasonal labor needs, physically demanding work, and workforce diversity. Effective human resource (HR) strategies are critical for addressing these issues and ensuring operational efficiency (Bitsch and Olynk, 2008).

Retention and promotion strategies

Retaining and managing human capital is a critical challenge for agribusinesses, especially as they compete for employees in a tight labor market (Moore et al., 2020). Job satisfaction is highest when employees believe their efforts will lead to meaningful rewards, such as promotions or pay increases. Clear job roles, fair performance evaluations, and transparent reward systems are key to maintaining a motivated workforce. Aligning personal goals with job rewards further enhances job satisfaction.

Relative to previous generations, younger employees are more inclined to "job-hop" primarily due to the lack of clear career advancement opportunities (Tetteh et al., 2021). To reduce turnover, agribusinesses must provide defined promotion pathways, professional development, and upskilling opportunities. Work-life balance and strong management relationships also play crucial roles in retention. Firms that invest in employee well-being and manager-employee communication can create a more engaged workforce, improving long-term retention rates.

To improve retention, successful agribusiness firms establish clear pathways for promotion, provide regular performance feedback, and ensure that promotions are tied to measurable performance metrics. Offering professional development opportunities, such as skills training and leadership programs, can help employees feel more invested in their careers and motivated to stay with the company long-term.

Human capital development

Employee education is a common retention and promotion strategy. Large firms have learning and development departments that create and execute such programs, as on-the-job training can often convey information that more formalized education might overlook. Some agribusinesses may turn to executive education programs offered by universities and consulting firms. For example, the Center for Food and Agricultural Business at Purdue University partners with agribusiness firms to design, develop, and deliver such programs.

Some firms incentivize through education reimbursement. Dual-degree programs like the MS-MBA in Agricultural Economics and Agribusiness Management at Indiana University and Purdue provide advanced agribusiness and managerial training for working professionals. Beyond traditional degrees, the rise of micro-credentials allows agribusiness professionals to gain specialized skills in a shorter time frame. These stackable, skills-based credentials, such as food processing or supply chain analytics, allow individuals to tailor their learning and enhance their careers without committing to full-time degree programs. These credentials can also be integrated into larger degrees later, making them flexible options for lifelong learning.

Health and safety

Ensuring safe working conditions is a fundamental aspect of HR management, particularly in high-risk sectors like meatpacking, cattle feeding, and dairy farming, where the risk of injury, illness, and infection is high. The COVID-19 pandemic underscored vulnerabilities in food supply chain labor, where close working quarters, limited ventilation, and demanding physical labor contributed to high virus transmission rates (Saitone et al., 2021). Agribusinesses must implement safety measures such as improved ventilation, access to personal protective equipment (PPE), proper sanitation, and social distancing. Regular health screenings and clear communication about hygiene practices are essential for reducing disease transmission. In addition, employers now consider long-term strategies such as restructuring workspaces and upgrading infrastructure to make workplaces more adaptable to future health crises.

Failing to prioritize safety and health risks can lead to high turnover, lost productivity, and increased costs. A proactive safety culture, regular training, and open communication enhance retention and public perception. When employees feel their health and well-being are protected, they are more likely to remain in their roles, which enhances overall job satisfaction and retention.

Organizational structure

As firms grow, their organizational structures often shift to corporate hierarchies. A typical structure includes a President or Chief Executive Officer (CEO) at the top, which is hired by a board of directors, then followed by senior managers (often with the title of vice president) overseeing functional areas. These vice presidents have titles like chief marketing officer, chief financial officer, and chief operating officer, among others. Additional senior leadership team members would be added as specific to the firm, such as a vice president for human resources, vice president for research and development, or a chief information officer. Large firms might also segment leadership roles by regions or market focus. One potential drawback to this type of structure is when functional areas become silos that do not collaborate well with each other.

For the largest organizations, each vice-president might have additional mid-level managers, often potential senior leadership candidates, responsible for specific divisions within functional roles. Additional layers of management may be added between senior management and front-line employees (i.e., factory line workers, sales and service representatives, etc.). The number of layers between the president and frontline employees indicates whether the firm has a vertical or flat reporting structure. Vertical structures are very hierarchical and offer clear authority but limit lower-level decision-making, while flat structures empower lower-level employees but risk poor decision outcomes.

Entrepreneurship, innovation, and research and development

Innovation drives the long-term success of firms, the health of industries, and the broader economy. It spans various forms, including products, services, processes, business models, or management systems that address specific challenges and create value. The food and agribusiness sector has undergone several innovation waves over the last century, including advancements in machinery, precision agriculture, chemistry, seed technology, information management, food services, and restaurant concepts.

As global populations rise and consumption patterns evolve, disruptive innovation is increasingly essential to improving efficiency along the food chain. Innovation is needed across all sectors, from input suppliers and agricultural producers to food distributors and retailers. Agricultural inputs can enhance crop yields and ensure safer, more wholesome, and affordable food for consumers. Agribusinesses often work in tandem with plant and animal producers to address challenges such as improving land productivity, shortening production cycles, and adopting low-impact, environmentally friendly technologies. These efforts include renewable energy, advancing localized solutions, and optimizing soil conservation practices.

Consumer demand for products with "credence attributes"—those perceived as environmentally friendly, animal-welfare--conscious, or healthier—has driven agribusinesses to invest in innovations that maintain low prices (Lusk, 2018). Grocery retail

innovations, such as e-commerce, mobile shopping, and experiential grocery store designs, now focus heavier on multi-channel distribution and enhanced customer experiences (Wang et al., 2020).

Entrepreneurship

Entrepreneurship refers to the process of recognizing business opportunities and profitably bringing them to the market. Entrepreneurs, known for their risk tolerance, excel in managing and mitigating risks to ensure successful ventures. Entrepreneurs in the food system focus on addressing market gaps and unsolved problems with profitable business models (Bylund and Malone, 2024). Trends such as changes in consumer behavior, technological advancements, and global challenges like sustainability and food security drive entrepreneurial opportunities. Agribusiness entrepreneurs often collaborate with industry stakeholders, including research institutions and government agencies, to develop and refine solutions.

McGrath and MacMillan (2000) outline five essential entrepreneurial traits:

1. Passionately seek new opportunities.
2. Pursue opportunities with focused discipline.
3. Pursue only the very best options—prioritization is critical to success.
4. Focus on execution—the entrepreneur doesn't just stop with invention or discovery.
5. Engage broad participation in their venture—while an inventor may work alone with few collaborators, a successful entrepreneur is skilled at engaging a large set of participants to bring the new idea to market.

McGrath and Macmillan (Fig. 9) provide more specificity concerning the skills and capabilities critical to successful entrepreneurship.

Research and development (R&D)

R&D is central to driving innovation, fostering economic growth, and addressing societal challenges like climate change, resource scarcity, and shifting consumer expectations. The development of "innovation ecosystems" fosters collaboration among startups, established firms, academic institutions, and government agencies to address these grand challenges. The agribusiness value chain's length and complexity is key for R&D and innovation. Successfully transitioning upstream innovations—such as those in engineering, biotechnology—to consumer markets requires navigating knowledge transfer, adoption barriers, and regulatory compliance. Innovations in biofuels, industrial products, and pharmaceuticals are reshaping traditional value chains, offering growth opportunities while challenging incumbents to adapt to biological-based raw materials.

Radical innovations disrupt markets by utilizing alternative resources, reducing costs, or offering superior products that offset switching costs for consumers. Such innovations can challenge established firms by attracting new customers or displacing incumbents. For example, the rise of renewable biological-based raw materials impacts traditional firms serving food and fiber industries while opening avenues for pharmaceutical and industrial products.

Managing research and development

Selecting and prioritizing R&D projects becomes a critical challenge for agribusinesses. Companies often prioritize projects with low technical or regulatory risks, minimal market risk, and short time-to-market. Projects leveraging in-house capabilities and those with significant costs already incurred are also highly favored (Roucan-Kane et al., 2013). After identifying innovative ideas, companies must decide which projects to pursue, often using a portfolio approach. Fig. 10 illustrates Deere and Company's portfolio of innovations, showcasing a strategic balance between incremental and transformative innovations. This approach highlights how

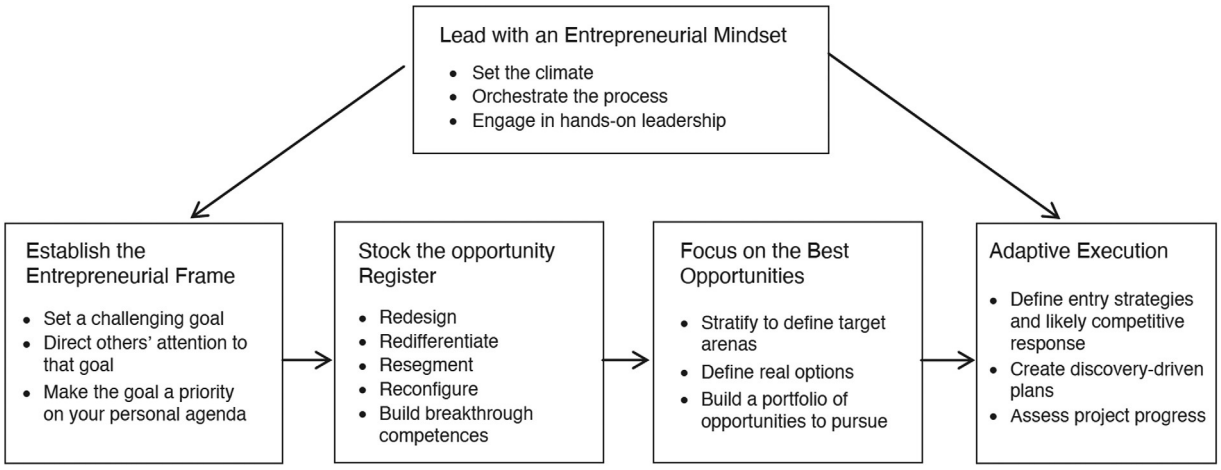

Fig. 9 Essentials of entrepreneurial strategy.

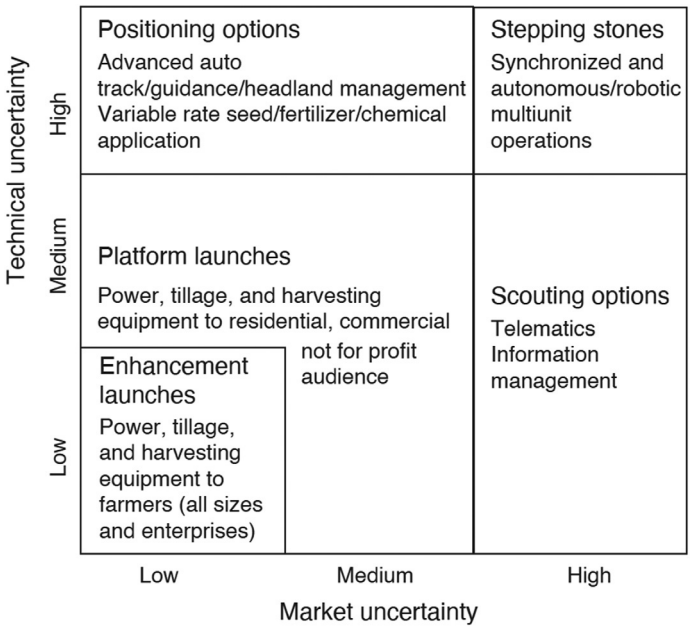

Fig. 10 Deere portfolio of innovations. Adapted from Boehlje M, Roucan-Kane M, and Bröring S (2011) Future agribusiness challenges: Strategic uncertainty, innovation and structural change. *International Food and Agribusiness Management Review* 14(5): 53–82.

cross-functional teams and multiple selection methods—such as economic models, structured assessments, and informal methods—are used to manage product innovation projects (Roucan-Kane et al., 2011). The R&D process evolves over time as uncertainties resolve and new ideas emerge. Deere and Company's portfolio approach, as illustrated by Boehlje et al. (2011), highlights the importance of balancing incremental and transformative innovations within an R&D strategy.

Conclusion/summary/outlook

The agribusiness sector exemplifies the intersection of tradition and innovation, balancing global complexities with local realities. As firms adopt strategic tools and embrace sustainability, they are better equipped to navigate uncertainties and capitalize on emerging opportunities. The future of agribusiness lies in integrating technological advancements and resilient strategies to address the evolving needs of consumers and the planet.

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