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Liliia Blagodyr[1]

Sustainable Food Systems Management in Agri-Food Companies: A Conceptual Framework and Business Models

[1]Vinnytsia National Technical University

Abstract: *The article addresses the sustainable management of agri-food companies based on the concept of food systems, which integrates digital technologies and ecosystem-based value creation. This is especially relevant for Ukrainian companies facing war-related challenges.*

Keywords: food systems, sustainable management, agri-food enterprises, business models, Ukrainian agriculture

The relevance of studying problems in the field of food systems management of agri-food companies is due to several modern challenges, such as the growing population in the world, the shortage of food resources, climate change, as well as the need to ensure the resilience and sustainability of production and distribution chains. An additional factor that made this topic relevant for Ukraine was the full-scale war with Russia and the destruction of agricultural infrastructure facilities, disruption of logistics routes and the threat to the food security of citizens.

The research addresses approaches to effectively managing a company's food system to ensure its sustainability and resilience. It covers theoretical aspects of food systems at the enterprise level, concepts of sustainable business models, and identification of areas for improving the system through introducing innovations, resource-efficient technologies, and circular economy principles.

Food systems encompass the full range of actors and their value-added activities involved in the production, storage, processing, distribution, consumption and disposal (loss or waste) of food originating from agriculture (including livestock), forestry, fisheries and the food industry, as well as the broader economic, social and natural environment in which they operate [1].

A sustainable food system (SFS) provides food security and nutrition for all while preserving the economic, social, and environmental foundations for food security and nutrition for future generations [2;3].

This food system is:

- profitable (economic sustainability) [5];
- beneficial for society (social sustainability) [3; 6];
- environmentally friendly or neutral (ecological sustainability) [3].

This definition of a food system resonates with the ESG concept [7] and the UN Sustainable Development Goals [6].

However, unlike the agri-food system, the agri-industrial concept (or agri-industrial integration) is an approach to organising agricultural production that involves close interaction and integration of various industries and spheres of activity related to the cultivation of agricultural products, their processing, and the sale of final products to consumers [9].

The essence of the agro-industrial concept [8; 9] lies in the synergy resulting from the combination of vertical integration (unification of the agricultural and processing industries into a single production complex to ensure the continuity of the technological cycle), close production ties between agrarian production, suppliers of means of production, processing enterprises and the sales system; agro-industrial specialisation (concentration on the production of certain types of farm products with the formation of specialised complexes), inter-sectoral cooperation of enterprises to save costs and rational use of resources; territorial organisation of production (rational placement of agricultural and industrial production).

Thus, the agro-industrial concept reflects the comprehensive development of all components of the agro-industrial complex - from the cultivation of raw materials to the production of final food products. The concepts of food systems and the agro-industrial complex have specific differences in the approach to food production (Table 1.1)

Table 1

Comparison of Concepts[1]

Agro-industrial Complex	Food Systems Concept
- Focused on the production chain from obtaining agricultural raw materials to food production.	- Provides a broader perspective, encompassing production, processing, distribution, marketing, consumption, and food waste disposal.
- Emphasises vertical integration of agriculture, processing industry, and sales.	- Emphasizes sustainability, safety, and accessibility of food products for the population.
- Aimed at maximising the efficiency of production processes and reducing costs through specialisation and economies of scale.	- Takes into account social, economic, and environmental consequences of food system functioning.
- Associated with industrial-intensive agriculture on an industrial scale and the food industry.	- Considers alternative food production models such as organic agriculture, urban farming, etc.

[1]*Note:* This table is based on the findings of researchers [1; 2; 6; 9; 10]

Thus, the agro-industrial concept focuses predominantly on production and process optimisation. In contrast, the food systems concept has a broader perspective, covering all stages of the food chain and their impact on society, the economy and the environment.

However, as noted [3;8], the modern food systems concept can integrate the approaches of the agro-industrial concept to ensure production efficiency if they are consistent with the principles of sustainable development.

The food systems concept is relevant to the study of agriculture and the food industry for the following reasons:

1. A holistic approach: The concept considers the entire chain from farm to fork, including economic, environmental, social, and health aspects, while the agribusiness concept focuses mainly on production.
2. Interdisciplinarity: This concept involves a wide range of disciplines (agriculture, economics, sociology, nutrition, public health, ecology) to solve complex problems, in contrast to the narrower focus of the agribusiness concept.
3. Sustainable development: The concept considers long-term environmental, social and economic consequences, while the agribusiness concept often prioritises productivity and efficiency.
4. Consumer focus: This concept incorporates consumer preferences, behaviour, and cultural aspects of food choices that the agribusiness concept may not adequately address.
5. Policy and Governance: Enables a comprehensive analysis of policies and institutional mechanisms that affect the entire food system, not just the production aspects.

Food systems exist at different levels, including household, company, community, region, state, and world.

At the global level, the food system encompasses worldwide food flows, production across countries, international trade, and supply and demand trends in global markets. This is the highest level for analysing general trends and patterns in food systems. At the national or regional level, food systems are examined within individual countries or regions. Factors such as domestic production, imports/exports, available natural resources, policies, legislation, and cultural food traditions are considered. At the local level, food systems are analysed within specific communities, cities, or regions within a country. Local resources, infrastructure, supply and distribution channels, local customs, and food consumption culture play a key role. At its most fundamental level, the food system involves food production, procurement, preparation, and consumption within individual households.

The food system is a complex and multifaceted phenomenon that, when analysed across different scales, provides a deeper understanding of its diversity and the interactions among the various components and factors influencing food security.

In the context of the firm's stakeholder theory, an enterprise's food system acts as a mechanism for balancing the interests of various stakeholders (shareholders, employees, consumers, suppliers, local

communities, the state, and the environment) through the formation of shared values and ensuring mutually beneficial cooperation. From a value creation perspective, an enterprise's food system creates economic, social, and environmental value at all stages of the food chain. This includes developing financial value for owners and investors, ensuring fair income distribution for employees and partners, creating consumer value through quality and affordable food products, and minimising negative externalities.

In the sustainable development paradigm, the enterprise`s food system is a model of organising the production and consumption of food products. This system aims to meet the current needs of business and society while ensuring that future generations also have opportunities. It balances economic, social, and environmental aspects by using resource-efficient technologies, applying the principles of a circular economy, and enhancing resilience to external challenges.

Thus, an enterprise's food system can be defined as an integrated set of interconnected processes, structures, and connections that ensure the entire cycle of food production, from raw material production to final consumption, considering the interests of all stakeholders.

Within this research context, Ukrainian agricultural and food processing organisations highlight stakeholder interactions, sustainability imperatives, and ecosystem-based value-creation processes through the theoretical construct of integrated enterprise food systems. The proposed integrated framework for transforming agri-food companies combines three key concepts into a single system. The enterprise's food system is the central element, covering the entire cycle from producing raw materials to consuming products. Digital technologies, in general, and artificial intelligence are transformative technological tools for optimising food system processes. The ecosystem model of value creation is an approach to organising interaction between stakeholders and creating shared value [12; 13].

Modern food systems are evolving towards sustainability through various innovative business models [14], each with its characteristics and role. Each business model type aligns with the accordant part of the agri-food system.

A circular business model focuses on reducing or recycling food waste and agricultural by-products. It creates value based on the principles of the circular economy and bioeconomy. It covers sustainability's economic and environmental dimensions and is highly dependent on the political and legal environment and stakeholder engagement.

Through direct sales, alternative, local, and social food networks connect small-scale producers with consumers. They promote and create value based on local agri-food resources and traditional knowledge. They aim for farmer inclusion and regional sustainable development, covering the economic and social dimensions. These networks function as local food systems with geographical and social proximity between the different actors.

Disruptive business models are fundamentally new or different approaches to existing ones, changing how things work towards sustainability. They can cover various dimensions of sustainability and aim for institutional changes in the system.

New coordination or online food distribution business models include concepts for urban food retail, online food delivery services, and online farmers' markets. These models support food security (social dimension) and function as local food systems with geographical proximity between different actors.

Regional food consortia, labs, and hubs are based on collaboration between private and public actors, creating synergies and joint strategies to increase the food system's sustainability. They cover various dimensions of sustainability and function as regional clusters and networks that drive and support the food system towards sustainability.

Sufficient business models promote sustainable consumption and cover healthy eating (social aspect) and environmental dimensions. They aim to influence consumers and support the transition to a sustainable food system.

Inclusive business models aim to create economic opportunities for low-income communities by integrating them into the company's value chain. These models simultaneously have a social and economic dimension of sustainable development, as they improve the material situation of vulnerable groups and contribute to their social integration. A key feature of such models is applying an approach to the local agri-food system based on territorial collective action when different actors join forces to achieve a common goal.

Values and emotional ties play a unique role in family business models, which traditionally influence business decision-making. These same factors can become powerful drivers of the transformation of such enterprises towards sustainable production. Family businesses embrace the environmental and social dimensions of sustainable development, proving a high level of responsibility for the impact of their activities

on the environment and society. A characteristic feature of such business models is the formation of strong relationships between the business and its stakeholders, especially with suppliers and the local community, which creates a solid foundation for long-term sustainable activities.

Focal companies occupy a special place in the value chain, as they provide leadership and coordination of the activities of other participants. Due to their central position, they can play a decisive role in influencing various market participants and contributing to implementing sustainable supply chain management principles. These business models cover sustainable development's social and environmental dimensions, providing a systemic approach to solving environmental and social problems. Public-private research partnerships with a clearly defined strategy are essential for the success of such models, which, thanks to the leadership role of focus companies, become the driving force for the transition of individual enterprises and entire industries to the principles of sustainable development.

Ukrainian companies are building their agri-food systems by combining the above-mentioned business models (Table 2), considering the dimensions of sustainable development and the challenges and opportunities associated with these models in the Ukrainian context.

Table 2

Sustainable Business Models in the Ukrainian Agrifood Sector[1]

Business Model Type	Ukrainian Companies/Examples	Key Characteristics	Sustainability Dimensions	Challenges & Opportunities
Circular Business Model	Astarta (biogas production from sugar beet pulp); MHP se (biogas from poultry waste); Kernel Holding s.a. (using sunflower hulls for energy).	Converting agricultural waste into energy; implementing zero-waste technologies; reducing the environmental footprint.	Economic, Environmental	Challenges: high initial investment, regulatory barriers; Opportunities: cost reduction, new revenue streams, improved environmental compliance
Alternative, Local & Social Food Networks	Dobra Ferma (community-supported agriculture); Organic Original LLC (direct farm-to-consumer sales); farmers' markets in major cities	Direct sales to consumers; emphasis on organic/local production; community engagement.	Economic, Social	Challenges: limited scale, seasonal fluctuations. Opportunities: premium pricing, stronger consumer loyalty, rural development.
Disruptive Business Models	Drone.UA (precision agriculture services); Agroportex Agroportex (blockchain for agricultural commodities).	Technology-driven innovations; new approaches to traditional challenges; fundamental shifts in operations.	Various (depending on focus)	Challenges: scaling difficulties, resistance to change. Opportunities: competitive advantage, attracting investment, system-level impacts.
New Logistics or Online Food Distribution	Zakaz.ua (online grocery with local foods); Biofresh (organic food delivery)	Digital platforms for food distribution; shortened supply chains; urban-focused solutions.	Food Security (Social)	Challenges: logistics coordination, maintaining food freshness. Opportunities: market access expansion, reduced food miles,

				enhanced urban food security.
Regional Food Consortia & Hubs	Ukrainian Agri CouncilUkrainian Agri Council; Lviv Eco-Food Cluster; Ukrainian Organic Cluster	Multi-stakeholder collaboration, knowledge sharing, joint resource utilisation.	Various (economic, social, environmental)	Challenges: coordination issues, competing interests. Opportunities: collective problem-solving, stronger market position, policy influence.
Sufficiency Business Models	Good Wine (sustainable consumption education); EthnoProduct (traditional, low-impact foods); Ecosnack (packaging-free retail)	Promoting sustainable consumption, educational components, and alternative consumption patterns.	Social (health), environmental	Challenges: limited consumer awareness and price sensitivity. Opportunities: growing conscious consumer segment, health trends alignment.
Inclusive Business Models	Molokiya (supporting small dairy farmers), Selyska Cheese (cooperative model)	Integration of vulnerable groups, rural development focus, capacity building	Social, economic	Challenges: knowledge gaps, quality consistency. Opportunities: Social impact, diverse supplier base, community resilience
Family Business Models	Galicia (multigenerational family business); Liluck (family berry farm); Staryi Porytsk (family cheese making)	Long-term orientation; strong values and traditions; close community ties	Environmental, social	Challenges: succession planning, modernisation. Opportunities: strong stakeholder relationships, authentic branding, and commitment to local communities.
Focal Company Business Models	MHP se (vertical integration leadership; shift from resource company to culinary company); Nibulon (infrastructure development); Ukrlandfarming (supply chain orchestration), Kernel Holding s.a. (business-ecosystem leadership and change from a resource company to service-oriented infrastructure company)	Supply chain leadership, setting industry standards, strategic partnerships	Social, environmental	Challenges: balancing power dynamics and resistance from smaller partners. Opportunities: system-wide improvements, scalable solutions, strong public-private partnerships

[1]*Note:* This table is based on research findings [14], adapted by the author to reflect examples of Ukrainian agri-food companies applying sustainable business models.

The comparative analysis of the agro-industrial concept and the food systems approach reveals significant differences in their scope and priorities. The latter offers a more comprehensive framework for addressing modern food production and distribution challenges.

Our findings suggest that various innovative business models, including circular, inclusive, and focal company models, contribute differently to sustainable development goals while addressing the specific needs

of stakeholders throughout the food system. Ukrainian agri-food companies can enhance their resilience and sustainability by implementing these models based on their particular context and capabilities.

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Blagodyr Liliya M*. — PhD in Economics, Associate Professor, Department of Management, Marketing and Economics, Vinnytsia National Technical University, email: blagodyr@vntu.edu.ua*