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ALTERNATIVE AGRICULTURE ADDED VALUE CHAINS APPLYING UNMANNED AERIAL VEHICLES

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ABSTRACT

Aim: All-out hostilities in Ukraine have led to systemic changes in local agri-food chains that constitute a part of the global agri-food system. Damage or destruction of land and water logistics infrastructure and the near-total unavailability of air transportation negatively impacts food security within the country and on global markets. The purpose of this article is to define the economic essence and features of shaping alternative models of agri-food chains based on the concept of added value for all stakeholders in the environment of value-oriented management at the micro level in the contemporary economic paradigm. **Methods**: The research methodology is based on the application of the chain approach as a method of scientific knowledge combined with literature review and deductive reasoning. **Results:** The results of the study indicate the importance of finding and applying alternative means of logistics, as well as ways that will reduce the agri-food chain from the farm to the consumer's table, lower transportation costs, and increase the effectiveness of communication with the end consumer, improve consumer satisfaction, and shorten food delivery time. **Conclusions**: Emerging agri-food supply chains using unmanned aerial vehicles (UAVs) will create a new public catering market segment in the agri-food retail sector and will provide companies with robust competitive advantages throughout the years to come.

Key words: added value, agri-food chain, logistics, service innovation, transformation processes, supply chains, sustainable agriculture

JEL codes: L81, M11, O310, Q110

INTRODUCTION

Amidst today's rapidly evolving technological landscape, the deployment of innovative solutions is becoming increasingly essential for providing a resilient economic model. This is specifically evident in Ukraine, where the ongoing hostilities have severely disrupted conventional logistical frameworks. There has been a drastic shift toward exploring alternative logistical strategies and methods in response to the disruptions. These new approaches serve a crucial role in maintaining the supply of agri-food products to local and global markets despite the widespread damages and constraints caused by the war. Recent

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research highlights the urgent need for transformative changes in the global agri-food system to address pressing issues such as sustainability and waste reduction [Agnusdei and Coluccia 2022]. The agri-food sector has been profoundly impacted by shortages of resources, food loss, and inefficiencies across the entire supply chain. The emphasis is growing on adopting innovative technologies and unconventional logistical solutions to tackle the challenges effectively. These advancements require the comprehensive digitalization of the agri-food business ecosystem, which involves integrating advanced technologies and optimizing logistical processes to improve efficiency and sustainability [Mann et al. 2022]. However, despite the increasing recognition of the critical role digital transformation plays in the agri-food sector, the actual technological integration within the value chain remains relatively low [Parra-Lopez et al. 2021]. The current war period has further accelerated changes in agri-food chains, prompting stakeholders and market participants to consider the prospects of these systems. It is crucial to study and develop new models that are economically viable for agri-food producers and can lay the basis for long-term sustainability strategies.

Such models should not only support the swift recovery of the economy but also drive innovation and generate additional value. This value extends beyond merely meeting consumer needs, encompassing broader benefits for stakeholders across local communities, national markets, and international partners. By prioritizing these elements, the agri-food sector can better address the current crisis, harness technological advancements, and pave the way for a more resilient and sustainable future.

The latest transformations of agri-food chains during the war, along with stakeholders and the market expectations and possible prospects of their further reshaping once the war ends, highlight the need to study and develop models that can be economically feasible for agri-food producers. These models should form the foundation for long-term sustainability strategies and innovative development. They aim to help the economy recover quickly and give impetus to the generation of added value for consumers of agri-food products and for stakeholders at all levels – local communities, national markets, and international partners.

LITERATURE REVIEW

In the context of sustainable development and value-oriented enterprise management, the concept of added value is widely recognized in management theory. In the modern globalized economy, added value is a multifaceted indicator that evolves in response to the increasing complexity of socioeconomic relations, aligning with modern interpretations of the concepts. Contemporary economic science offers various models of added value aimed at managing and enhancing enterprise value. These models include tools for managing the enterprise at the strategic level – economic value added (EVA), market value added (MVA), cash flow return on investment (CFROI), cash value added (CVA), shareholder value added (SVA), and stakeholder value added (STVA) [Stewart 1991].

It is worth noting that today's scientists have distilled no single approach to the concept of added value, which underscores the importance of this research. Practically, added value is interpreted in various ways, reflecting the value an enterprise creates for all its stakeholders. It is commonly agreed that added value has an economic nature, being generated through labor and production, recorded as the enterprise's gross income, and serving as the basis for calculating value-added tax. Furthermore, added value, created as value for consumers and through interaction with them, can also be perceived and accounted for as intellectual property.

Modern processes of creating and managing added value are closely tied to the value generated by manufacturers for consumers and their direct interactions. This approach aligns with the STVA model, which emphasizes that the creation of new value should benefit not only the enterprise's owners (stakeholders) but all its stakeholders (beneficiaries). Entities involved in the economic relationships surrounding added value include various market participants and economic relations, ranging from enterprises and organizations that generate added value, to the state (through fiscal control bodies) and consumers. The connection between theoretical models, practical applications of added value, and market stakeholders is illustrated in Figure 1.

Within the framework of the chain approach as a method of scientific inquiry, various concepts and

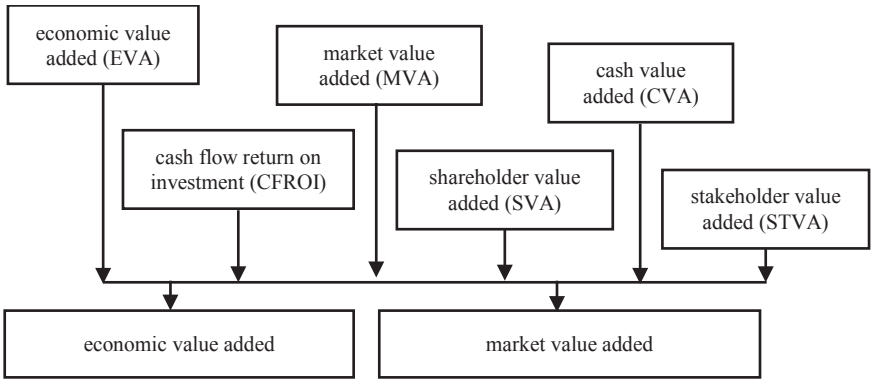

Fig. 1. Connection between contemporary concepts of added value
Source: own study based on Stewart [1991], Varchenko [2019], Maievska [2024].

approaches reflect the network of business processes and market operators involved in creating value-added products and services, their distribution, and the provision of 'feedback'. Globalization, free trade, and outsourcing have amplified the importance of the supply chain management (SCM) concept, originally developed in the 1980s. This concept continues to evolve from traditional chain management to supply chain network management, where the logistics chain is seen as a collaboration among agri-food market participants. Their goal is to efficiently transfer the flow of materials between logistics systems or deliver them directly to the end consumer [Dubovyk et al. 2018]. From a business scale perspective, the local food supply chain encompasses all processes involved in moving local food from farm to consumer. These include marketing, distribution, aggregation, processing, packaging, procurement, preparation, resource recovery, and waste disposal [Tarni et al. 2021]. This concept is defined as a short, socially driven supply chain that is geographically limited. The marketing trend promoting the consumption of local food products has spurred the recent growth of such chains, which became particularly evident during the COVID-19 pandemic. According to the FAO [2014], the agri-food chain consists of agricultural producers and organizations that, in a coordinated manner, create added value by producing specific agricultural products, processing them into food products, and selling them to the end consumer. This process ensures profitability at each marketing stage, creates benefits for society, and avoids the permanent depletion of natural resources. Market participants unite to increase productivity and ensure the fair distribution of benefits [Gereffi and Fernandez-Stark 2016].

A comprehensive approach to the formation and distribution of added cost and value helps create sustainable competitive advantages in the face of rapid changes in the external environments, ensuring long-term development. The relevance of value chain research is driven by the dynamics of uncertainty in the environment in which market participants operate. Effective management of decisions that address modern challenges requires a solid toolkit for adapting contemporary methods and approaches to managing production resources, communication, and logistics flows.

AIM AND METHODS

This article aims to outline the key principles and foundations of the emergence and development of local agri-food chains within the global agri-food system. It focuses on the concept of added value for all stakeholders, considering sustainable development in the context of war and the post-war recovery of Ukraine's economy. The objectives of this research include generalizing the development trends and transformations of local agri-food chains in a military context, assessing the potential for creating added value in Ukraine's agri-food chains, and justifying the prospects for forming innovative models of added value management in these chains.

The research methodology used in this research is based on the chain approach, which has become a key framework in the scientific analysis of business processes. This approach, as outlined by various scholars, involves examining and integrating interconnected processes within a system, providing a comprehensive understanding of how individual components contribute to the system's overall functionality and efficiency [Porter 1995]. In the context of agri-food enterprises, the chain approach has been crucial for identifying and analyzing both traditional and innovative supply chain models. Additionally, a literature review and deductive analysis have been applied. The primary focus of this analysis is to model and evaluate local traditional and alternative agri-food chains by integrating innovative technologies and unconventional logistics solutions. The deductive analysis follows the framework outlined by Lambert and Cooper [2000]. The first step in the deductive analysis is establishing a framework for analyzing agri-food chains based on the chain approach. This involves identifying key components of traditional supply chains and evaluating how innovative technologies and non-standard logistics solutions can be integrated. Using this framework, models of local traditional and alternative agri-food chains are developed to assess how these changes impact overall efficiency, sustainability, and value creation within the supply chain. The analysis then focuses on evaluating the formation of added value as perceived by all participants and stakeholders. This includes examining how the incorporation of innovative technologies and non-standard logistics solutions contributes to increased efficiency, reduced waste, and enhanced stakeholder satisfaction. The scientific novelty of this research lies in its approach to modeling agri-food chains by integrating innovative technologies and unconventional logistics solutions. By focusing on value creation for all participants, the study provides a comprehensive understanding of how these elements enhance the effectiveness and sustainability of agri-food systems.

RESULTS AND DISCUSSION

Rapid technological progress in the agri-food sector has led to the widespread deployment of innovative solutions, enabling the creation of new products and services and their integration into supply chains or the establishment of new market niches. Amid the ongoing hostilities in Ukraine, which have caused significant infrastructure damage and skyrocketed logistics costs, finding alternative solutions is crucial for ensuring the sustainable development of the agri-food industry. One such solution is the use of unmanned aerial vehicles (drones), which are increasingly employed in the sector for tasks such as plant protection, crop assessment, and problem area identification. The use of drones in the agri-food retail segment represents an innovative solution that could significantly impact the structure of local agri-food.

The area of food delivery to the consumer's door gained extreme popularity during the COVID-19 pandemic [Dallas et al. 2021]. Currently, individual safety measures for delivering are an important factor affecting the choice of food delivery. That made some service delivery services introduce a contactless delivery mode for the safety of buyers and couriers. In this mode, couriers leave orders at the door, if practical.

The manufacture and sale of food products by drone-delivery services are a good alternative to delivery by traditional means of transport, not only from the point of view of fuel costs but also the costs of human labor and safety measures.

Among the segments of the target audience that use food delivery, the following segments of consumers of drone delivery services can be distinguished, including:

- fresh vegetables, fruit, berries, and green goods producers (Chain 1 in Fig. 2),
- craft food producers (Chain 1 in Fig. 2),
- producers' associations such as cooperatives and clusters (Chain 2 in Fig. 2),
- conventional stores, online shops, and marketplaces (Chain 3 in Fig. 2),
- direct sale food processing producers (Chain 4 in Fig. 2),
- cafés, restaurants, and fast-food restaurants that offer ready-to-eat food delivery services (Chain 5 in Fig. 2).

Conventional approaches to forming local agri-food chains and alternative agri-food supply chains are shown in Figure 2.

In the conventional approach to managing the agri-food chain, economic value added is created in short chains, with VAT serving as a new indicator of this

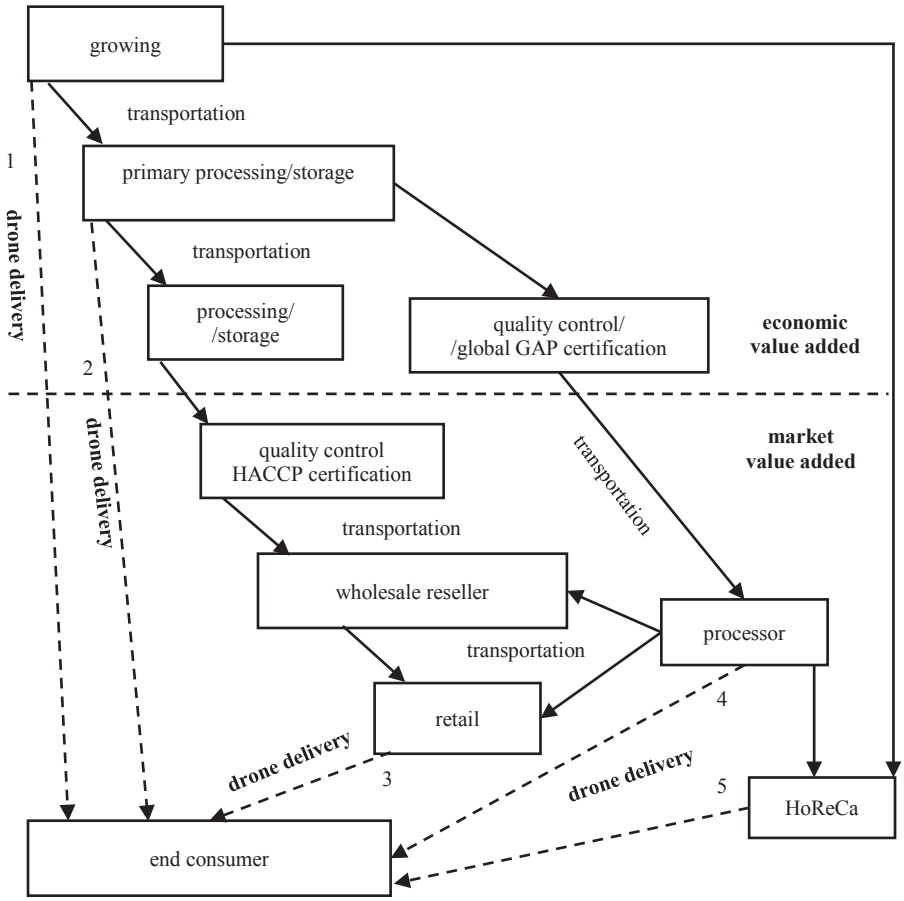

Fig. 2. Alternative agri-food supply chains involving UAVs
Source: own study based on publicly available data.

value. Market value added, on the other hand, is generated in longer, more complex chains. Unlike economic value added, which is reflected in accounting and financial reports, market value added is more difficult to measure. Added value can also be perceived and accounted for in the form of intellectual property, such as trademarks, patents, and franchises. Additionally, it can be expressed in terms of service quality [Galchynska et al. 2023]. Market value added is also formed from selling products in premium market segments that can become the market for UAV-based services.

Service companies can act as entities providing UAV delivery services, while agri-food companies are responsible for delivering products to consumers and are interested in evolving their delivery models and technologies. Compared to traditional wheeled delivery, UAV product delivery offers several advantages, including speed, accuracy, and safety. However, alongside the creation of a new market niche, drone delivery also presents certain disadvantages. The prospects of developing local agri-food chains using UAV technology are analyzed in a SWOT matrix, as shown in Figure 3.

Despite certain technical difficulties, UAV delivery has a few undeniable advantages over the traditional delivery approach. Drone delivery creates added value for both internal and external stakeholders of the agri-food chain, as depicted in Figure 4.

Modern trends indicate that added value is formed through the interaction between agricultural producers and internal and external stakeholders. For external stakeholders, this value may include additional services, loyalty programs, and new transportation methods (e.g., UAV delivery). For internal stakeholders, value can come from employee involvement in improving

	Strengths	Weaknesses
Internal	• cost-effectiveness of UAV maintenance • primary delivery costs reduced • speed, accuracy and high delivery time expectancy • surprisingly impressed consumers	• time and money-consuming pilot preparation • huge UAV fleet investments • special software required for logistics management
	Opportunities	**Threats**
External	• delivery-to-consumer cost reduced • independence from petroleum prices • air pollution reduced • significant increase in delivery quality	• law unlatching the market requirements while applying UAVs for commercial services • the necessity to procure parts abroad, giving rise to foreign exchange fluctuations exposure • time spent by consumers to get used to innovative tech

Fig. 3. SWOT analysis of agri-food supply chains involving UAV technology
Source: own study based on Gürel and Tat [1965].

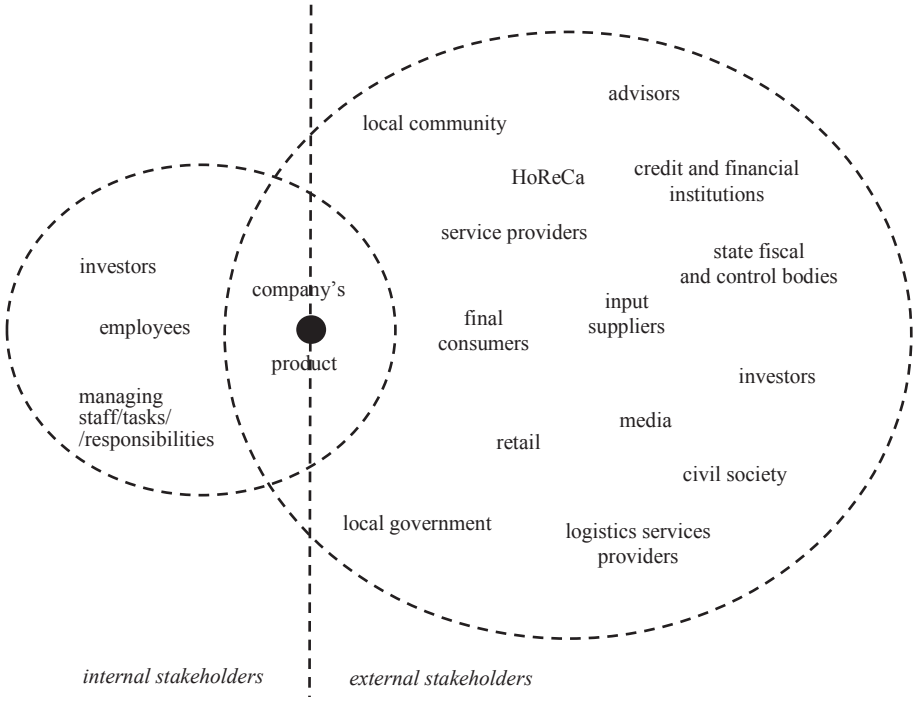

Fig. 4. Stakeholder-oriented approach to creating added value in the agri-food chain involving UAV technology
Source: own study based on Kvasha and Vakulenko [2023], Riquelme-Medina et al. [2023], Svitovyi et al. [2023].

business processes, decision-making, and delegation, as well as corporate social responsibility programs. For investors, added value can stem from the prestige of the enterprises, as innovations in logistics help reduce the environmental impact. The dynamics of added value creation and the evolving relationships between enterprises and their stakeholders in the agricultural market highlight the need for further research, especially considering the radical transformations driven by security factors at both the micro (person-to-person) and macro (regional, state) levels.

Transformation processes and features of added value management in local agri-food chains in an environment of complete uncertainty and threats require further study and streamlining. This includes the development of effective economic models allowing agri-food producers to develop sustainable strategies in the face of warfare, as well as the post-war economy.

CONCLUSIONS

The use of UAVs as a tool for food delivery to consumers will create a new market segment of consumer goods delivery services and introduce a new service standard. For companies that will provide this service or other companies that will use their services, UAVs will create sustainable competitive advantages. Like any innovative solution, this hypothesis requires further research and practical verification. The above-mentioned scientific approaches to added value management for all stakeholders of an agricultural enterprise are the basis for differentiating the directions of promising scientific research and further increasing knowledge in this area. In this context, it is important to form a research network and formulate new approaches to studying the problem of managing added value for stakeholders at all stages of the agri-food chain. The processes of agri-food chain digitization and agri-food service transformation require further study and knowledge systematization.

The next step to be performed in the verification of the models should involve validating the models and refining them based on feedback from empirical data and stakeholder input. This iterative process ensures that the models are practically applicable and aligned with the theoretical insights gained from the literature review.

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ALTERNATYWNE ŁAŃCUCHY WARTOŚCI DODANEJ W ROLNICTWIE Z WYKORZYSTANIEM BEZZAŁOGOWYCH STATKÓW POWIETRZNYCH

STRESZCZENIE

Cel: Działania wojenne na Ukrainie pociągnęły za sobą systemowe zmiany w lokalnych łańcuchach rolno-spożywczych, które stanowią część globalnego systemu rolno-spożywczego. Uszkodzenie lub zniszczenie infrastruktury logistycznej lądowej i wodnej oraz praktycznie niedostępny transport lotniczy negatywnie wpływają na bezpieczeństwo żywnościowe w kraju i na rynkach globalnych. Celem artykułu jest zdefiniowanie istoty ekonomicznej i cech kształtowania alternatywnych modeli łańcuchów rolno-spożywczych opartych na koncepcji wartości dodanej w rozumieniu wartości dla wszystkich interesariuszy w środowisku zarządzania zorientowanego na wartość na poziomie mikro we współczesnym paradygmacie ekonomicznym. **Metody:** Metodologia badań oparta jest na zastosowaniu podejścia łańcuchowego jako metody poznania naukowego połączonego z przeglądem literatury oraz rozumowaniem dedukcyjnym. **Wyniki:** Wyniki badania wskazują na znaczenie znalezienia i zastosowania alternatywnych środków logistycznych, a także sposobów, które skrócą łańcuch rolno-spożywczy od gospodarstwa do stołu konsumenta, obniżą koszty transportu i zwiększą skuteczność komunikacji z konsumentem końcowym, poprawią zadowolenie konsumenta i skrócą czas dostawy żywności. **Wnioski:** Powstające łańcuchy dostaw produktów rolno-spożywczych, wykorzystujące bezzałogowe statki powietrzne (BSP), stworzą nowy segment rynku gastronomicznego – sektor handlu detalicznego produktami rolno-spożywczymi – i zapewnią firmom solidną przewagę konkurencyjną w nadchodzących latach.

Słowa kluczowe: wartość dodana, łańcuch rolno-spożywczy, logistyka, innowacyjność usług, procesy transformacyjne, łańcuchy dostaw, rolnictwo zrównoważone