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Improving Food Market Infrastructure Through the Application of Artificial General Intelligence Technologies

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Abstract: The article examines the improvement of food market infrastructure through the strategic application of Artificial General Intelligence (AGI) technologies. The study deeply analyses the operational limitations of conventional retrospective market analytics and proposes a novel, data-driven methodology for integrating advanced AGI systems into food production cycles. The scientific novelty of this research consists in developing a closed-loop AGI platform architecture specifically designed to forecast dynamic consumer preferences over a five-year horizon and to generate evidence-based production recommendations for food enterprises in the Kyrgyz Republic. Furthermore, the paper investigates how this intelligent platform optimizes supply chain logistics, reduces food waste, and mitigates market supply fluctuations under volatile economic conditions. By leveraging predictive modeling and machine learning algorithms, the proposed system enhances decision-making transparency and boosts competitiveness within the regional agro-industrial sector. Ultimately, the comprehensive findings and structured implementation frameworks provide valuable strategic guidelines for policymakers and industry stakeholders to ensure national food security and sustainable economic growth.
Keywords: artificial general intelligence; AGI; food market; digital transformation; infrastructure; consumer preferences; forecasting; food security; Kyrgyz Republic.

1. Introduction

The globalisation of food supply chains and the rapid advancement of digital technologies are establishing fundamentally new requirements for food market infrastructure. Traditional approaches to organising the production and distribution of food products, grounded in retrospective analysis of market conditions, are progressively losing their effectiveness in the context of high consumer demand volatility and the exponential growth in data volumes. This study aims to develop conceptual foundations for applying Artificial General Intelligence (AGI) technologies to modernise the food market infrastructure of the Kyrgyz Republic.

The relevance of this research is determined by a set of interrelated factors. First, the food market of Kyrgyzstan is characterised by insufficiently developed digital infrastructure, which reduces forecast accuracy and leads to significant losses throughout the supply chain. Second, the rapid diffusion of AGI technologies creates unprecedented opportunities for analysing consumer behaviour and formulating long-term production strategies. Third, the imperative to ensure the country's food security necessitates the systemic modernisation of market infrastructure on the basis of advanced analytical instruments.

2. Problem Statement

The food market is conventionally understood as a system of economic relations that shapes the supply of and demand for food products. An analysis of the evolution of this concept in both domestic and international literature demonstrates that its content has undergone substantial transformation: from a simple designation of a site of commodity exchange to a complex category encompassing the

production, distribution, exchange, and consumption of agricultural raw materials and finished food products [1].

The infrastructure of the food market comprises the totality of organisational, technical, informational, and institutional elements that ensure the uninterrupted movement of goods and information from producer to final consumer. Within the digital economy, platform-based solutions for collecting and processing consumer preference data are becoming the central element of this infrastructure.

The existing market analytics system is, as a rule, based on historical sales data and consumer surveys. This approach carries a fundamental limitation: it can describe the current state of the market, but does not provide a reliable medium-term forecast (3–5 years). This problem is particularly acute in rapidly evolving market segments — healthy nutrition, functional foods, organic produce — where consumer preferences are shaped by a complex interplay of sociocultural, demographic, and medical factors.

3. Literature Review and Methodological Foundations

The theoretical foundations of this study are grounded in the concepts of digital market transformation (Schwab, 2016), the theory of information ecosystems in agri-food chains (Trienekens et al., 2012), and works in the field of predictive analytics applied to production management [2, 3]. Questions of infrastructural provision for food markets have been elaborated in depth by domestic economists specialising in the food security challenges of Central Asian economies [4].

The concept of Artificial General Intelligence (AGI) refers to systems capable of performing any intellectual task at or above human level, in contrast to 'narrow' artificial intelligence optimised for specific tasks [5]. According to research organisations, the global AGI market reached USD 2.78 billion in 2024 and is projected to attain USD 38.55 billion by 2033, representing a compound annual growth rate of 33.9% [6]. This high growth dynamic is driven by the exponential increase in data volumes: according to IDC estimates, the global volume of data created and replicated exceeded 181 zettabytes in 2024 [7].

The agri-food sector has already seen isolated projects employing machine learning to forecast crop yields and optimise logistics. However, the use of AGI systems for comprehensive forecasting of consumer preferences and their direct integration into the production cycles of food enterprises constitutes a new and understudied direction — a fact that underscores the scientific novelty of the present work.

4. Scientific Novelty of the Study

The scientific novelty of this work consists in the development of a methodology for employing AGI systems to proactively manage the production cycles of food industry enterprises on the basis of consumer preference forecasting. The proposed approach differs fundamentally from existing analytics systems in the following respects.

First, conventional business intelligence systems operate in a post-hoc analysis mode, whereas the proposed AGI platform provides forecasting over a five-year horizon, accounting for a complex set of factors: demographic shifts, health sector trends, changes in cultural and dietary patterns, ecological constraints, and macroeconomic conditions.

Second, the novelty lies in proposing a model of mandatory AGI consultation at each production cycle launch. Under this model, prior to adopting an investment decision regarding the expansion or modification of a product range, the producer submits a query to the AGI system, which, on the basis of multimodal data analysis (sales data, social media, medical statistics, geodemographic data, global trends), generates a demand forecast for the product over a period of up to five years.

Third, scientific novelty is present in the authors' concept of a 'closed loop', whereby data on actual consumer behaviour collected at the point of sale are fed back into the AGI system for continuous refinement of the predictive models. This approach ensures that the system is self-learning and that forecast accuracy improves with each successive production cycle.

5. Model for Integrating AGI into Food Market Infrastructure

The model proposed by the authors envisages the creation of a multi-tier AGI platform embedded in the food market infrastructure. The platform architecture comprises four functional modules.

Module 1 — Data collection and aggregation. At this level, continuous collection of information from heterogeneous sources is carried out: transaction data from retail chains, consumer reviews in social media, results of marketing research, disease burden statistics and changes in dietary guidelines, customs statistics on food import and export, and international analytical reviews of food trends. Big Data technology ensures the processing of incoming information streams in real time [8].

Module 2 — Predictive analytics based on AGI. The core of the system is an AGI module trained on multi-year time series of consumer behaviour, incorporating regional specificities. The Kyrgyz Republic, as an agrarian country with a developing economy, is characterised by pronounced seasonal consumption patterns, a high share of traditional products in the population's diet, and a growing demand for products in the 'healthy nutrition' category among the urban population. The AGI system processes all of the above factors simultaneously, generating a multi-scenario consumer preference forecast with a probability assessment for each scenario.

Module 3 — Generation of production recommendations. The output of the AGI platform consists of structured recommendations for producers, including: the optimal product portfolio for the forecast period, recommended production volumes by product line, preferred packaging formats and consumer portion sizes, price ranges corresponding to the effective demand of target segments, and recommendations regarding distribution channels.

Module 4 — Monitoring and feedback. A closed management loop is achieved by integrating the AGI platform with the ERP systems of food enterprises and the point-of-sale systems of retail chains. Actual sales data are transmitted back to the predictive model in real time, adjusting its parameters and improving the accuracy of subsequent forecasts.

6. Practical Application and Expected Effects

Piloting the proposed model within the food market of the Kyrgyz Republic gives grounds to anticipate the following practical outcomes. First, a reduction in commodity losses throughout the supply chain as a result of more precise alignment between production volumes and actual demand — based on global experience with analytical systems in the food industry, this effect ranges from 15 to 30% [9]. Second, an improvement in production profitability arising from the optimisation of the product matrix and a reduction in storage costs for unsold goods. Third, a strengthening of the country's food security through the alignment of domestic production with the long-term needs of the population.

The model holds particular practical significance for small and medium-sized food enterprises in Kyrgyzstan, which, owing to resource constraints, do not possess their own analytical services. A cloud-based implementation of the AGI platform makes it possible to provide these enterprises with access to analytical tools on a subscription basis, fundamentally lowering the barrier to entry for the digital transformation of the sector.

The institutional mechanism for implementing the proposed model could be the establishment, under the Ministry of Economy and Commerce of the Kyrgyz Republic, of a national AGI analytics centre for the food market. Such a centre would aggregate data across the entire value chain and provide forecast services to market participants on a regulatory basis.

7. Conclusions

The research conducted yields the following conclusions. The food market infrastructure of the Kyrgyz Republic is in need of systemic modernisation on the basis of digital technologies. The application of AGI systems opens fundamentally new possibilities for the proactive management of production decisions, grounded in reliable forecasting of consumer preferences.

The methodology of mandatory AGI consultation at each production cycle, proposed by the authors, represents a scientific novelty possessing both theoretical significance — in terms of advancing the concept of digital transformation of food markets — and practical applicability within the conditions of the Kyrgyz economy. The implementation of this methodology will contribute to

enhancing the competitiveness of domestic food enterprises, reducing food losses, and strengthening the food security of the country.

Further research in this direction should be devoted to developing the technical specifications of the AGI platform, taking into account the particularities of Kyrgyzstan's information infrastructure, as well as to assessing the economic efficiency of its implementation at specific food industry enterprises.

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