Ecosystem approach to agricultural industry: integration of participants and optimization of production

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Abstract. The integration of ecosystem business into the development of the agro-industrial complex of the digital economy represents an important stage in improving the production and economic efficiency of agriculture. The development of digital technologies in agriculture, such as agricultural drones, artificial intelligence systems and the Internet of things, opens up new opportunities for optimizing production processes, managing resources and improving product quality. An ecosystem approach to business in agriculture allows us to unite various participants in the agro-industrial complex - from farmers and equipment manufacturers to scientific institutions and financial organizations - into a single network that facilitates the exchange of information, optimization of production and the creation of innovation. This helps to increase the efficiency of resource use, reduce costs and improve the competitiveness of the entire agricultural sector. A key element of successful implementation of the ecosystem approach is the development of digital infrastructure in rural areas, including access to broadband Internet and digital educational resources. This will enable rural residents to have access to modern technology, training and information, thereby improving their productivity and quality of life.

1 Introduction

The agro-industrial services industry and financial services in general have gone through significant changes with a significant shift towards remote service providers and an increase in digital offers. This shift from the traditional provision of AIC services to its digital counterpart with the growing digital consumption of service opens new ways of development which requires a certain transformation of the usual principles in this sphere. Such imperatives stem from the constant evolution of several notable trends:

- changing consumer preferences and rising expectations. It is worth noting that consumers now demand high standards of appropriate services, a remote access, user-friendly interfaces and real-time transaction capabilities which have become certain expectations [1].

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- disintermediation reflected in the reduced role of banks in intermediation processes marks another important trend. Banks face reduced profitability and exclusion from the value chain. Hence the loss of customer base and market share as AIC services are provided avoiding technology and telecommunication companies [2].

- noticeable paradigm shift towards a more humanized approach to service. Voice and video interfaces are rapidly becoming the new norm of interaction with clients eclipsing traditional offline modes of interaction.

Experts agree that former business models no longer guarantee the necessary level of profitability and growth of incomes on the current background of the agro-industrial complex banking services sector development. Traditional income streams and working methods have become less efficient requiring a paradigmatic re-evaluation of policies and practices [3].

The researchers Gartner and McKinsey emphasize that the financial, agro-industrial and telecommunication sectors are becoming the most receptive arena for digital innovation. Innovative business models which are often called modern ecosystems and define their distinctive characteristics are emerging at the intersection of the mentioned sectors.

This evolutionary shift in the AIC sector called adaptive dynamics in the language of biologists entails the introduction of new species into an already stable ecosystem. It is important to note that this process can trigger sudden and profound changes: new entities which characteristics differ from those of the previously dominant species can cause the established players disappearance [4].

Hence, the financial and credit sector can perform as a stepping stone to the development of the AIC digital economy.

Considering the nature of the final product of banking, especially financial services, the efficiency of transformation of the bank depends on its ability to adapt to customers' needs, process data and develop value propositions based on trust. In accordance with this point of view, the review conducted by PricewaterhouseCoopers consultancy highlights consensus among the world's leading banks: the way to a successful banking business. The model requires escaping from simple meeting the demand for individual banking products to a customer-oriented approach called the «single-user market» [5]. This shift outlines a trajectory from impersonal universal products to mass customization where the user perceives financial services as based on his individual needs.

2 Research methodology

The methodical apparatus of the study uses the methods of the system-structural approach, functional, factor and comparative analysis; the construction of analytical models is supported by the combination of modern and relevant scientific approaches and methods aimed at understanding economic and social phenomena. Methodological toolkit uses the possibilities of graphical, statistical and economic-mathematical methods of information processing.

The empirical base of study in the theoretical aspect is built on the basis of well-known works of domestic and foreign economists.

3 Results and Discussions

The agricultural sector presents unique challenges for financial services due to its spatial dispersion and risk dynamics. Farmers are widely dispersed across large areas, resulting in high transport and travel costs for financial institutions. Additionally, information acquisition costs pose barriers to rural finance availability. Economic theory can shed light on these challenges by examining the roles of financial providers and farmers.

On the supply side, financial institutions face information asymmetry and the principal-agent problem. They encounter difficulties in assessing the risk of default, ensuring repayment, and enforcing payments. This leads to a mismatch of incentives between lenders and borrowers. Moreover, lenders must invest resources to evaluate the borrower's riskiness and potential moral hazard.

On the demand side, farmers lack access to credit due to information asymmetry and transaction costs. Many farmers lack a credit history, making it challenging to obtain loans. Social capital, such as trust and networks, is often overlooked in lending decisions despite its potential to improve risk-sharing and reduce default rates. Collateral is commonly used as a risk-sharing device but entails significant transaction costs for both lenders and borrowers.

Transaction costs are influenced by factors such as seasonality, spatial distribution, consumer preferences, technological changes, financial regulations, and the efficiency of financial institutions. Traditional financial products may not align with the timing of agricultural operations, necessitating credit to bridge the gaps. Overall, addressing these challenges requires understanding the complex interplay of economic factors in agricultural finance.

In the circumstances of emerging and developing economy such as Russian, the financial sector has largely followed a banking valuation model in which banks have a significant influence on the financial landscape having a decisive impact on the digital trajectory as a result. However, according to general global trends financial markets are also subject to regulatory pressures especially for restrictions on transactions of international payment systems (such as VISA, MasterCard) and payment applications. Consequently, maintaining the standards of service accessibility and quality has become a main challenge requiring constant adaptation and innovation in a changing regulatory framework.

Efforts to strengthen the digital infrastructure aimed at providing users with innovative and convenient payment methods as well as at focusing on the complex contours of Russian geopolitical landscape continue unabated at the same time. Various market initiatives have emerged including alternative payment mechanisms that operate outside the traditional framework of bank cards as well as the emergence of «no-card transactions» and such systems as Pay are the examples.

Experts agree that the form factor itself has a minimal influence on users' choice of financial service access [6]. The driving force is rather in the triple combination of simplicity, security and convenience that characterizes user experience increasing the value of the offer and the user-friendliness. Users can interact seamlessly through strategic technological cooperation with a wide range of services, both financial and non-financial. Thus, the dominance of platform business models is becoming known in various sectors from trade to health. Consequently, the financial and credit sector can lead to the development of the agro-industrial complex digital economy.

Considering this trend, the business model of the ecosystem exemplifies this paradigm shift by organizing interconnected networks of services and facilities to provide integrated and coherent user experience.

Developing this concept, the ecosystem is a set of interrelated and complementary services that are easily integrated into a single technological structure. Ecosystems characterized as innovative business models support the fundamental economic nature of the services they provide including financial services while innovatively changing the delivery mechanisms and the interaction between providers and users.

The concept of an ecosystem is the integration of services some of which may not be directly correlated with the core business of the organization owning the platform is central.

However, the merger adds value to the end-user noting the critical ecosystem advantage of achieving a new level of value that is not achievable through the individual efforts of each service provider. The value that once consisted solely of the production of goods and services now revolves around a symbiotic relationship between service providers and their clientele. Even services within an ecosystem that cannot yield immediate benefits contribute to improving overall user experience where positive affecting the profitability of the ecosystem in general is a result.

However, it is important to emphasize that legal recognition of ecosystems remains scarce in most jurisdictions. Consequently, the interpretations and distinctions proposed by experts and scholars are often informative without formal legal distinctions. Such definitions clarify the operational nuances of these business models; they do not codify the strict regulatory framework underlying their operation. Table 1 provides the examples of ecosystem components in different countries.

Table 1. Ecosystem elements definition examples in selected countries

Country	Elements (components) of the ecosystem
China	Platforms, platform operators, participating entities and users
USA	Infrastructure, regulatory framework, digital solutions and technologies, users
EU	Platforms, service providers, users
Singapore	Digital infrastructure and platforms, regulators, participating entities (users, service providers, operators)

The ecosystem pillar shows itself as a platform that acts as a bridge which brings a variety of stakeholders together as shown in Table 1: [7]

1) Users including natural persons, individual entrepreneurs and non-natural persons;

2) Companies which are integral to the functioning of the ecosystem including both financial and non-financial service providers;

3) A set of digital technologies and tools that facilitate the formation of customer pathways including artificial intelligence, service aggregators and biometrics.

Entry into these ecosystems can take many forms, from mobile applications and websites to the new concept of super applications. The Super Application, a multifaceted mobile application, is an excellent ecosystem interface that combines a wide range of services and products in a single domain.

It is essential to highlight the features that distinguish complex ecosystem architecture from traditional business structures. These characteristics are multifaceted and include the following:

- a conglomeration of interconnected consumer segments, each representing a distinct aspect of the market and offering a wide variety of products or services.
- a phenomenon of an inter-market network effect where the attractiveness and usefulness of a product or service to a user is enhanced by a large number of suppliers representing that particular offer.
- an inter-market subsidy strategy that plays a crucial role in shaping transaction volumes and stimulating user involvement, especially in the ecosystem life cycle stages.
- a firm IT framework that leverages digital advances and the global reach of the Internet to ensure smooth and seamless interaction among all ecosystem actors.
- a concept of mutual integration of services which is realized through the technological unification of loyalty schemes or subscription models as well as the integration of content emphasizing the benefits of interaction with multiple services.
- a central importance of collecting user data and understanding behaviors that play an important role in managing ecosystem dynamics.

As for determining access parameters, the components of the ecosystem are divided into open, closed and hybrid models. Closed ecosystems are characterized by strict access protocols and limited internal competition which emphasizes the provision of a range of services or goods rather than an extensive network of service providers. Conversely, open ecosystems are characterized by an inclusive approach welcoming participants on the basis of transparent and equitable criteria. The hybrid ecosystem, a model widely adopted in the international arena, is a harmonious combination of open and closed aspects comprising a dynamic balance of contrasting operational methodologies. Table 3 provides illustrative examples of the application of open and closed ecosystem components in different scenarios.

The e-commerce sector tends to follow an open model while financial services are usually provided in a closed system as shown in Table 3. It is important to note that both open and closed models are equally common in the service and content sectors. Both global and Russian ecosystems gravitate towards the hybrid model emphasizing the convergence of different operational paradigms.

Such observations indicate that there are no geographical limitations to the inclusion of participants in ecosystems. Indeed, the operational paradigms adopted in different countries demonstrate striking consistency, highlighting the convergence of approaches in global terms.

It is important to note that an ecosystem in any service sector consists of three main components critical to its smooth functioning: e-commerce, logistics and financial services as shown in Figure 1. These elements interact with supporting operational efficiency and holistic ecosystem service delivery.

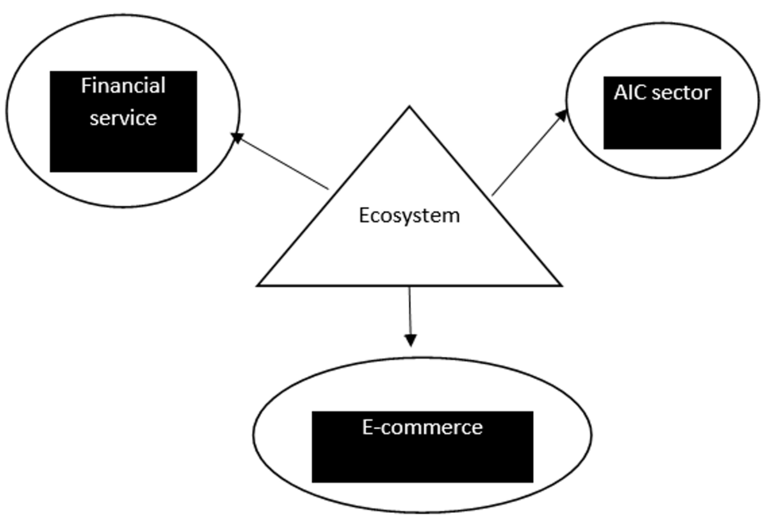

Fig. 1. Main ecosystem components

It is extremely important to admit that the top of this operational «triangle» may have deviations depending on the sector where the platform's owner operates. However, the core of the services convergence paradigm is invariably payment service independently of the industry nuances. It assumes paramount importance in the operational structure of the ecosystem serving as a point of reference for the aggregation of customer data, a resource which is critical to the development of both financial and non-financial services.

Systematic analysis of these aggregated data facilitates the development of individual proposals tailored to customers' preferences, thus contributing to new aspects of customer service quality. Such strategic maneuvers therefore reinforce market dominance in the ecosystems in which operations take place, while nurturing and perpetuating user loyalty. This reality highlights the active involvement of non-financial organizations in the payment industry through joint ventures with banks (e.g., Google) or independent efforts to develop payment services (e.g., Yandex, Mail.ruGroup, Wildberries, Ozon).

Banks assume multifaceted roles within the ecosystem depending on the nature of production and distribution of services as shown in Figure 5. These roles range from suppliers and coordinators to aggregators with unique responsibilities and are critically important for ecosystem resilience and operational cohesion.

Consequently, banks assume a key role as facilitators, independently leading the development of ecosystems through their portfolio of financial products. The spread of a variety of services offered by different organizations not only enhances personalization but also increases the potential to attract customers. However, this role which is attractive for banks for its many advantages requires significant investment making it viable only for large financial institutions.

Alternatively, the bank will assume the dual role of central integrator of the ecosystem and owner of its platform if it is in the role of aggregator. In contrast to the role of coordinator, this function requires relatively less investment but provides greater organizational flexibility. The effectiveness of value creation for customers depends on the seamless exchange of data between service providers which underlines the paramount importance of data compatibility.

In contrast, the provider’s role is to provide financial services on a third-party platform without a banking license. Success depends on a combination of economic efficiency, customer service quality and transaction execution speed and scale. Interest in Agriculture Value Chain Financing (AVCF) has increased recently, but many of its components have been in use for some time. For instance, financing within the value chain, provided by processors or traders to farmers, is common in cases where traditional financing institutions do not offer adequate products for farmers. However, these arrangements differ from AVCF as they do not consistently leverage contractual relationships to enhance farmer creditworthiness for future financial transactions.

AVCF encompasses various financial instruments categorized based on the financial needs they address, such as product financing, receivables financing, physical asset collateralization, risk mitigation products, and financial enhancements. Different AVCF schemes are classified based on the driving actor, with buyer-driven and producer-driven models being among the most common. In buyer-driven models, finance is utilized by buyers to secure commitments from producers under specific conditions.

One example of buyer-driven AVCF is demonstrated through Company A, an Indian agribusiness offering customized financial solutions to value chain actors. Unlike traditional banks and microfinance institutions (MFIs) that provide finance on an individual borrower basis, Company A offers financial services to the entire ecosystem within which borrowers operate. For instance, Company A designed specific financial products for actors in the dairy value chain, tailored to the value of milk-producing animals for farmers and larger credits for aggregators operating with more farmers and collection centers.

Contract farming is another example of a buyer-driven model within AVCF. While it has been praised for potentially increasing incomes for both farmers and sponsors, its impact on smallholder farmers varies. Some studies suggest that contract farming can reduce transaction costs, increase efficiency, and enhance farm profitability and welfare. However, there are concerns about its effects on wealth inequality, dependency, and the division of risk, as buyers may preferentially contract with farmers most likely to maximize profits, potentially excluding smallholders and exacerbating inequality among rural populations.

4 Conclusions

Value chains in agriculture are highly diverse, influenced by factors such as crop type, geographical conditions, and socio-economic contexts. Within these chains, credit is just one element of the various flows connecting stakeholders. The Ecosystem Approach, grounded in Grounded Theory, aims to develop concepts and processes based on observations from different regions and expertise areas. It's not a one-size-fits-all solution but a starting point to understand how agricultural value chain financing is evolving to meet stakeholders' needs. Six propositions serve as a roadmap for further qualitative and quantitative research, ensuring transferability through principles of external validity.

Some propositions from the Ecosystem Approach are already being implemented by pioneering agribusinesses and financial institutions, evolving AVCF instruments to offer tailored financial products and better risk mitigation. However, other components, like financial platforms for transaction records and a value-web approach, are still nascent. For financial institutions and development organizations, this framework provides insights into factors driving financial sustainability and systemic health. Integrating financial platforms and a value-web approach may enhance social capital and reduce reliance on collateral, promising advances in agricultural finance.The development of the ecosystem considered as a prerequisite of maintaining optimal business profitability in a digitalized environment is also a catalyst for business expansion across sectors. As the Bank of Russia stresses the emergence of a platform business model gives significant advantages to small and medium-sized enterprises which face limited resources that prevent the affiliate network expansion. Thus, the development of the ecosystem is increasing economic growth, productivity and innovation dynamism within enterprises thereby positively influencing labor market dynamics, inflation trends and various macroeconomic indicators.

Enterprise involvement in ecosystems has two benefits: reduced transaction costs and increased productivity which helps economic growth trajectories. Notably, empirical evidence from Western European countries shows that each increase in the share of e-commerce in total trade by 10 percentage points corresponds to a slight increase in the average annual GDP growth rate of 0.01 percentage points.

Additionally, productivity gains for firms can be achieved by eliminating information asymmetries and the costs of interaction among ecosystem components combined with increased competition among the most efficient enterprises. In particular, in jurisdictions with advanced platform development increased use of platforms leads to a marked 2.5% increase in company productivity. However, the impact of ecosystems needs to be carefully considered as the risk of monopolization or disruption of the value chain may require regulatory intervention.

Moreover, reducing inflation could be achieved by reducing information asymmetries. For example, in the United States e-commerce inflation recorded a drop of one percentage point from the 2014-2017 consumer price indexes for similar products while the spread of e-commerce in Spain correlated with declining commodity prices, subsidies.

Finally, ecosystem functioning enables enterprises to reduce costs by outsourcing non-core services (e.g., cleaning or logistics) while increasing labor supply and demand flexibility by overcoming geographical constraints in the labor market. Such inclusiveness enhances employment prospects for various demographic groups including persons with disabilities, people with mobility disabilities and part-time workers.

According to McKinsey&Company research, banking ecosystems provide a powerful antidote to two typical business problems:

- fundamental indicators needed to improve key business indicators and stimulate growth trajectories (e.g., customer engagement and relationship management, product and service delivery).

- administrative functions that support core activities indirectly related to profitability (e.g., accounting and reporting, management of accounts payable and accounts receivable).

An ecosystem that offers a wide range of services adapted to the needs of SMEs and optimizes their administrative operations serves as a catalyst for enterprise development. Such ecosystems create an enabling environment for business development, similar to the business incubator by reducing the costs associated with expanding the sales network and providing start-ups with tools for market research and marketing activities.

It is clear that the platform business model not only enhances the well-being of society through the spread of new service standard but also catalyses economic innovation and contributes to the qualitative reorganization of business.

Nevertheless, while the Russian banking sector was leading efforts to digitize the economy, the creation of its own ecosystems entailed exorbitant financial, technical and organizational investments, making it accessible to only a select few. Therefore, unwavering confidence in this approach may not be prudent. In the light of these limitations, exploring alternatives that adapt the existing business model becomes a viable proposition. It is noteworthy that the study of the potential of the business model «Bank as a Service» («BaaS») looks promising.

References

1. I. Podkolzina, A. Tenishchev, Z. Gornostaeva, H. Tekeeva, O. Tandelova, Assessment of Threats to Environmental Security and Climate Change. BIO Web of Conferences, **63**, 04002 (2023)
2. I. Podkolzina, A. Tenishchev, Z. Gornostaeva, H. Tekeeva, O. Tandelova, Ecological and Food Security in the Conditions of the Geopolitical Situation in the Worldglobal Digital Transformation Trends in Real Sectors of the Economy. SHS Web of Conferences, **172**, 02041 (2023)
3. L. Agarkova, T. Gurnovich, S. Shmatko, I. Podkolzina, V. Filonich, Priority directions of development of the cluster of innovative education in the regional agro-industrial complex. International Journal of Monetary Economics and Finance, **6(2)**, 718 (2016)
4. A.S. Salamova, O. Dzhioeva, Green transformation of the global economy in the context of sustainable development, 152-159 (2023)
5. A.S. Salamova, Global networked economy as a factor for sustainable development, 03053 (2020)
6. V. Sebestyén, E. Domokos, J. Abonyi, Focal Points for Sustainable Development Strategies: Text Mining-Based Comparative Analysis of Voluntary National Reviews. Journal of Environmental Management, **263** (2020)
7. S.G. Shmatko, L.V. Agarkova, T.G. Gurnovich, I.M. Podkolzina, Problems of increasing the quality of raw material for wine in the stavropol region, **7(2)**, 725-730 (2016)
8. Z.K. Tavbulatova, Sustainability of the banking system of the national economy: definitional certainty and conceptual approaches, **4(58)**, 92-99 (2017)
9. R.M. Stulz, FinTech, BigTech and the future of banks, **34(1)**, 106-117 (2022)
10. M.S-A. Shemileva, Use of modern innovative technologies (2023)
11. M.R. Tashtamov, Financial Innovations and Digital Technologies in the Banking System: Institutional Perspective (2023)
12. M.M.M. Magomadova, Transforming the insurance market with the help of innovation (2023)