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ANALYSIS OF THE DEVELOPMENT PROSPECTS OF AGTECH STARTUPS UNDER THE CONDITIONS OF AN OPEN LAND MARKET

АНАЛІЗ ПЕРСПЕКТИВ РОЗВИТКУ АГРОТЕХСТАРТАПІВ В УМОВАХ ВІДКРИТОГО РИНКУ ЗЕМЛІ

This article aims to study the prospects for the development of agri-tech startups in Ukraine under the conditions of an open land market and identify the key factors influencing their success and integration into the modern agricultural business.. The authors draw attention to the fact that in Ukraine, where a moratorium on the sale of agricultural land had been in place since 2001, most agri-startups were established even before the official opening of the land market – that is, prior to 2021, when the first stage of the land reform began, providing for the gradual lifting of the moratorium. At the same time, under the conditions of the moratorium on the purchase and sale of agricultural land and the instability of lease relations (in particular, farmers often operated under short-term leases, which reduced interest in implementing long-term innovations), Ukrainian agri-startups functioned in a specific environment with a number of constraints. It is noted that the opening of the land market in Ukraine has significantly increased demand for the products of agri-tech startups and has contributed to accelerating the development of existing domestic players in the field of agricultural technologies.

Keywords: agricultural sector reform, startups, agri-tech sector, innovative model, full land ownership rights, precision farming technologies.

У статті проведене дослідження перспектив розвитку агротехстартапів в Україні в умовах відкритого ринку землі, а також визначено ключові фактори, що впливають на їхній успіх та інтеграцію у сучасний аграрний бізнес. Автори звертають увагу на те, що більшість агротехстартапів в Україні було створено ще до офіційного відкриття ринку землі – тобто до 2021 року, коли розпочався перший етап земельної реформи. Разом із тим, в умовах мораторію на купівлю-продаж сільськогосподарських земель та нестабільності орендних відносин (зокрема, фермери часто працювали на короткостроковій оренді, що знижувало зацікавленість у впровадженні довгострокових інновацій), українські агростартапи функціонували в специфічному середовищі з низкою обмежень. Констатовано, що відкриття ринку землі в Україні суттєво посилило попит на продукти агротехстартапів та сприяло прискоренню розвитку вже наявних вітчизняних гравців у сфері аграрних технологій. Доведено, що ключовими факторами, які зумовили активізацію діяльності агротехстартапів, є зростання попиту на цифрові рішення, розширення доступу до земельних ресурсів, можливість масштабування, активізація інвестиційної активності, розширення клієнтської бази, підвищення інтересу до агросектору з боку інвесторів, а також інституційна підтримка інновацій з боку міжнародних і національних організацій. Констатовано, що сукупна дія вказаних чинників, навіть в умовах повномасштабного військового вторгнення росії в Україну, виступає каталізатором не лише кількісного, а й якісного розширення можливостей розвитку агротехстартапів в Україні у зв'язку з активною структурною трансформацією агро-

сектору на основі інновацій. Доведено, що до перспектив розвитку агротехстартапів в умовах відкритого ринку землі належать: подальше зростання попиту на цифрові рішення та технології точного землеробства; активне залучення інвестицій для масштабування бізнесу; розширення партнерства з агропідприємствами різного масштабу; збільшення експортного потенціалу українських агротехнологій; а також інтеграція з державними ініціативами цифровізації сільського господарства.

Ключові слова: реформування аграрного сектору, стартапи, сфера агротехнологій, інноваційна модель, повноцінне право власності на землю, технології точного землеробства.

Statement of the problem. The agricultural land market in Ukraine began operating on July 1, 2021. Initially, until December 31, 2023, the right to purchase land was granted exclusively to individuals – citizens of Ukraine – with a maximum purchase area not exceeding 100 hectares per person. From the beginning of 2024, this right was extended to legal entities, and the maximum size of land plots available for purchase increased to 10,000 hectares. The actual opening of the land market in 2024 became not only an important milestone in the reform of the country's agricultural sector but also a powerful stimulus for the transformation of agribusiness. In particular, the conditions of the open land market created new opportunities for participants in the agricultural market, including opportunities for startups in agri-technologies development (so-called agri-tech startups).

The experience of many countries, such as the United States, Israel, the Netherlands, and Germany, has shown that these entities are capable of playing an important role in increasing the efficiency of agricultural production, implementing innovations, and digitizing agriculture.

Analysis of recent research and publications. The features of the development of the open land market have been studied by I.O. Dragan, L.V. Sergienko, Y.V. Shpak [1], O.V. Zyhrii [2], R.T. Sachok [6], and several others. These scholars particularly examined the economic and social impacts of land reform, the functioning mechanisms of the agricultural land market, and the institutional aspects of its implementation. Additionally, V. Shebanin and Y. Kormyshkin [7] drew attention to the growing prospects for agri-tech startups' development under the conditions of the open land market, although they did not conduct a detailed analysis of this specific issue.

At the same time, research into the prospects for the development of agri-tech startups under the conditions of the open land market is important, as it allows for assessing the potential of digitalizing the agricultural sector, the efficiency of land resource use, and the formation of a modern innovative model of agriculture.

This article aims to study the prospects for the development of agri-tech startups in Ukraine under the conditions of an open land market and identify the key factors influencing their success and integration into the modern agricultural business.

Summary of the main research material. In other countries, agri-tech startups first emerged under conditions of a free market, for example, in the United States in the early 2000s. At the same time, in Ukraine, where a moratorium on the sale of agricultural land had been in place since 2001 (which limited landowners to leasing rights only – they could not sell, gift, or transfer their plots except through inheritance), most agri-startups were established even before the official opening of the land market – that is, before 2021, when the first stage of the land reform began, providing for the gradual lifting of the moratorium.

So, eFarmer / FieldBee was founded as early as 2014 and has actively developed in European markets.

Drone.ua, one of the first startups focused on the use of drones for agricultural purposes, was established in 2013.

AgriEye (AgriEye company) began its operations around 2016–2017.

Agrohub launched in 2017 as a platform for agro-innovation, and Frendt started approximately in 2018–2019 [3].

This indicates that, given the traditionally agricultural nature of Ukraine's economy, there was demand for innovation in the agricultural sector even under conditions of limited land circulation. In particular, farmers actively sought technological solutions to improve farming efficiency, optimize costs, and increase productivity. At the same time, under the moratorium on the purchase and sale of agricultural land and the instability of lease agreements (in particular, farmers often operated under short-term leases, which reduced interest in implementing long-term innovations), Ukrainian agri-startups operated in a specific environment with several constraints. Only the establishment of a system under which agricultural land plots can be freely bought, sold, and exchanged between individuals and legal entities by the law, without prohibitions or moratoriums on land transactions – became a powerful stimulus for the further development of agri-tech startups, their scaling, and commercialization.

Within the scope of the study, the authors highlight that agri-tech startups are defined as innovative projects that develop and implement cutting-edge technologies in agriculture [6–7]. Consequently, after 2024, when the land market in Ukraine began to take on the characteristics of a fully functioning market (see Table 1) – with the right to private land ownership, openness to purchase and sale transactions, competitiveness, market-based pricing, transaction transparency, inclusivity, investment attractiveness, and regulation (replacing administrative bans) – demand for the products and solutions offered by agri-tech startups started to grow exponentially [2; 7].

Specifically, in 2024–2025, a number of Ukrainian startups recorded a twofold increase in their client base within Ukraine.

So, a free land market is a system where a land plot functions as a full-fledged commodity, and its circulation is carried out based on private ownership, free pricing, competition, and transparency, with appropriate state regulation. This, in turn, increased the demand for digital solutions offered by agri-tech startups – particularly precision farming technologies, GPS navigation, soil and crop condition monitoring, agroanalytics, and more.

The list of domestic agri-tech startups currently operating under the conditions of the open land market is presented in Table 2.

Table 1

Systematization and characteristics of the features of the open land market in Ukraine

Features	General manifestation of the feature defining an open land market	Advantages of an open land market
Full land ownership rights	The landowner has the right to manage the plot: sell, gift, exchange, lease, mortgage, and so on	No restrictions on forms of ownership: private, communal, or state-owned
Openness to purchase and sale transactions	Land plots can be freely bought and sold between individuals and legal entities	Absence of moratoriums or administrative prohibitions
Competitiveness	The land market operates based on supply and demand	Participants can freely set prices for land plots
Market-based pricing	Land value is determined by market mechanisms rather than administrative measures	Formation of cadastral value as a basis for transparent transactions
Transaction transparency	There is a unified land cadastre, property rights registers, and an electronic platform for verifying the status of a plot. Transactions can be conducted through a notary, electronic system, with state control	Ability to conduct transactions through a notary, electronic system, with state oversight
Inclusivity	All citizens (or legal entities within certain limits) have access to the market, not just a restricted group of participants	Access to financing and credit secured by land collateral
Regulation (instead of prohibitions)	The state sets the rules of the game but does not restrict the very fact of land circulation	For example, concentration limits – up to 100 hectares (2021–2024), up to 10,000 hectares (from 2024 onward)

Source: compiled based on [2; 4; 5–6] and agri-tech startups data

Table 2

List of domestic agri-tech startups operating under the conditions of the open land market

Agri-startup, year of establishment	Field of activity	General development features	Development features in the context of the open land market
AgriEye, 2016–2017	Satellite monitoring, soil analytics	Remote field condition monitoring system, land treatment recommendations	Growing demand for analytics for effective land resource management
eFarmer / FieldBee, 2014	GPS navigation, precision farming	Ukrainian-Dutch startup developing GPS autopilot systems for agricultural machinery. FieldBee is widely used across Europe	Increasing farmer interest in precision agriculture
Agrohub, 2017	Analytics, research, collaboration platform	A platform that brings together farmers, businesses, and tech companies to jointly develop innovations in the agricultural sector	Intensified interaction between market participants and investors
Drone.ua, 2013	Drones and field treatment	One of Ukraine's leading startups in the field of agricultural drones. The company provides mapping, spraying, and crop monitoring services	Expansion of services driven by demand for precise operations on large land areas
Frendt, 2018–2019	IoT, cultivation condition monitoring	Develops systems for monitoring soil moisture, temperature, and other parameters using sensors and cloud platforms	Integration with farm management systems focused on profitable land use

Source: compiled based on [3–5; 7] and agri-tech startups data

The startup Agrieye, prior to the opening of the land market, focused on remote satellite monitoring of fields and providing recommendations for land treatment. After the market opened, the demand for their analytical services increased significantly, as landowners began actively seeking ways to manage their land resources more efficiently. This stimulated the expansion of the platform's functionality, improvement in data accuracy, and the development of tools for yield forecasting. In particular, AgriEye:

1. Began using data from new high-resolution satellites, which allowed for more detailed and timely field imagery for more accurate monitoring.

2. Developed a user-friendly interface for quick access to real-time analytics via smartphones, making it easier to make decisions directly in the field.

3. Started identifying zones affected by pests or diseases, enabling faster response and the application of protective measures.

4. Added tools for detailed analysis of soil moisture, acidity, and other parameters, helping to more accurately select fertilizers and optimize agrotechnical practices.

5. Enhanced its machine learning algorithms, which helped landowners better plan harvests and optimize resource use.

As for the startup eFarmer / FieldBee, before 2021, the majority of its customers were located abroad (mainly in EU countries). However, after the opening of the land market in Ukraine, there was a noticeable increase in interest from Ukrainian agricultural producers, particularly those owning large or consolidated land plots. This

spurred the adaptation of the product to the specifics of the Ukrainian market.

In particular, the company strengthened its presence in Ukraine by expanding its Ukrainian-language support service, launching local educational programs and webinars for farmers on the implementation of precision farming.

Additionally, the company participated in field days (e.g., during AgroExpo or AGRO exhibitions), where it showcased the following in action: GPS navigation systems for tractors; autopilot functions; equipment connectivity to the mobile application; the ease of installation and use of the systems, even for small farms.

Agrohub operated as a platform for connecting farmers, businesses, and technology companies. After the opening of the land market in Ukraine, the startup intensified its efforts to establish stronger links among farmers, agribusinesses, investors, and tech developers. In particular, the business entity:

1. Introduced "innovation sessions", where farmers voiced their needs and startups proposed technological solutions.

2. Organized workshops, webinars, and networking events to facilitate introductions between investors and promising agri-tech projects.

In addition, Agrohub became a platform for: pilot projects with agri-tech startups based on large agricultural companies; corporate acceleration programs – for example, in collaboration with Kernel, MHP, or SmartFarming; the creation of interaction platforms between the agricultural and IT sectors, such as AgTech Ukraine. This enabled Agrohub to expand its range of services, attract more investment, conduct more research, and launch joint projects that contribute to the innovative development of the agricultural sector.

After the land market was opened, Drone.ua not only recorded a significant increase in demand from Ukrainian agricultural producers, but also strategically adapted its operations to the new conditions – specifically, to serve domestic owners of large land plots, who, following the market liberalization, began to invest more actively in effective land management tools.

Here are the specific areas in which the startup's operations have evolved [3]:

1. Upgrading and expanding its drone fleet with models featuring high payload capacity and increased autonomy, capable of servicing large land areas (500 hectares and more).

2. Transitioning to the use of drones with multispectral imaging capabilities to enable more precise assessment of crop and soil conditions.

Moreover, Drone.ua implemented platforms for processing data collected by drones, which enabled the creation of vegetation indices, fertilizer application maps, and recommendations for variable-rate spraying. Integration services with ERP systems of agricultural enterprises were introduced to facilitate real-time management based on aerial analytics. Overall, the startup transformed from a provider of individual drone services into a comprehensive partner in the digital transformation of agricultural production, with the opening of the land market serving as a significant catalyst for this development.

After the opening of the land market, the number of consolidated plots owned or leased increased, which in turn led to a growing demand for scalable solutions [5]. Thus, Frendt, specializing in IoT solutions for monitoring growing conditions, has taken several important steps that have strengthened its role in the structure of modern agribusiness, including:

1. Beginning to integrate its IoT solutions with platforms such as Soft.Farm, Cropio, and AgriChain (which allows automatic connection of sensor data to the overall farm management system).

2. Increasing the variety of sensors capable of monitoring not only moisture and temperature but also other parameters – soil electrical conductivity (salt content), precipitation levels, solar radiation intensity, and pest activity (which enabled more accurate yield forecasting and optimization of irrigation, fertilization, and crop protection).

In fact, under the conditions of the open land market, Frendt has transformed from a supplier of individual sensors into an integrator of comprehensive IoT solutions for agribusiness.

Thus, the opening of the land market did not so much cause the emergence of new agri-tech startups as it intensified the demand for their products and accelerated the development pace of already existing domestic players. This occurred due to the influence of the following factors (see Table 3): demand for digital solutions, expanded access to land resources, the ability to scale, attract investments, broaden the customer base, increased investor interest in the agricultural sector, institutional support, and promotion of innovation.

The combined effect of the factors outlined above acts as a catalyst for the transformation of the agri-tech environment by domestic agri-tech startups, rather than being merely a consequence of changes in the legal framework. Meanwhile, foreign agri-tech startups and large technology companies have operated and continue to operate in Ukraine, but their presence remains limited in scale and is mostly concentrated in the segment of large agricultural enterprises.

Thus, among the prospects for the development of agritech startups in the context of an open land market, the following key directions can be identified: continued growth in demand for digital solutions; active attraction of investments to finance agri-tech solutions, scale startups, and launch new products; and expansion of collaboration between agri-tech startups and agricultural enterprises. Moreover, in the future, domestic agri-tech startups have the opportunity to expand their presence in foreign markets, particularly in Eastern Europe, Asia, and Africa, where the demand for effective agricultural technologies is also increasing.

Conclusions. The scope study established that the opening of the land market in Ukraine has significantly increased the demand for agri-tech startup products and contributed to the accelerated development of existing domestic players in the field of agricultural technologies.

It has been proven that the key factors driving the activation of agri-tech startups are: increasing demand for digital solutions, expanded access to land resources, scalability opportunities, intensified investment activity, expansion of the customer base, growing investor interest in the agricultural sector, as well as institutional support for innovation from international and national organizations. It has been established that the combined effect of these factors, even amid the full-scale Russian

Table 3

List and description of factors that increased the demand for agri-tech startup products in Ukraine

Factors leading to significant development of agri-tech startups	Features of the factors contributing to the development of agri-tech startups
Demand for digital solutions that enable informed agronomic and economic decision-making, along with an increased need for precise management	In particular, under the new conditions, landowners are interested in detailed soil analysis, yield forecasting, minimizing costs for fertilizers and plant protection products, as well as real-time monitoring of field conditions – precisely the services provided by agritech startups
Expanded access to land resources, enabling scalability, attracting investments, and growing the customer base	The opening of the land market creates new opportunities for agricultural enterprises and innovative startups to expand their cultivated areas and scale up their operations. As farmers' land banks grow, there is an increasing need for more efficient management technologies and production optimization, which drives demand for innovative solutions
Growing interest of investors in the agricultural sector	Clearer rules of the land market, the expected growth of its capitalization, as well as Ukraine's attractiveness as an agricultural country have increased investors' interest, particularly in agri-tech startups as tools for enhancing agribusiness profitability
Institutional support and promotion of innovation	During the reform and post-reform periods, the activities of international organizations – such as FAO (Food and Agriculture Organization of the United Nations), the EBRD (European Bank for Reconstruction and Development), incubators, and industry associations – intensified, contributing to the promotion of innovations in agriculture. In particular, the USAID "AGRO" Program (2020–2025) and EU4Business initiative were launched, among others

Source: compiled based on [1; 4–6]

military invasion of Ukraine, acts as a catalyst not only for quantitative but also qualitative expansion of agri-tech startup development opportunities in Ukraine, due to the active structural transformation of the agricultural sector based on innovation.

It has been proven that the prospects for the development of agri-tech startups under the conditions of an open land market include: further growth in demand for digital solutions and precision agriculture technologies; active attraction of investments for business scaling; expansion of partnerships with agricultural enterprises of various sizes; increased export potential of Ukrainian agritechnologies; integration with government initiatives for digitalization of agriculture.

Considering the obtained results, it is advisable to direct the prospects of further scientific research towards an in-depth analysis of the interaction mechanisms between agritech startups and land market participants, particularly in the context of the impact of different land use models on the demand for technological solutions.

References:

1. Drahan I. O., Serhiyenko L. V., Shpak Yu. V. (2023) Spetsyfika rozvytku rynku zemli sil′s′kohospodars′koho pryznachennya: dosvid Yevropy ta krayin Tsentral′noyi Aziyi. [Specifics of the development of the agricultural land market: experience of Europe and Central Asian countries]. *Ekonomika, upravlinnya ta administruvannya – Economics, Management and Administration,* vol. 2 (104). pp. 129–136.

2. Zyhriy O. V. (2016) Vplyv moratoriyu na prodazh zemel′ sil′s′kohospodars′koho pryznachennya [The impact of the moratorium on the sale of agricultural land]. *Aktual'ni problemy pravoznavstva – Current problems of jurisprudence*, vol. 3 (7), pp. 64–68.

3. Mudra (2020) 5 ukrayins′kykh startapiv u sferi ahrarnykh innovatsiy [5 Ukrainian startups in the field of agricultural innovation]. Available at: https://mudra.ua/ua/articles/5-ukranskih-startapv-u-sfer-agrarnih-nnovacj/

4. Koryuhin A., Lobunets′ T. (2022) Rynok zemli yak instrument aktyvizatsiyi diyal′nosti v ahrarniy sferi [The land market as a tool for activating acti*vities in the agricultural sector]. Ekonomika ta suspil'stvo – Economy and Society,* vol. 39. Available at: http://www.economyandsociety. in.ua/index.php/journal/article/view/1377

5. Kormyshkin Yu. A., Bovkun O. A. (2018) Biznes-infrastruktura ahrarnoho pidpryyemnytstva [Business infrastructure of agricultural entrepreneurship]. *Vcheni zapysky universytetu "KROK". Seriya: Ekonomika -Academic notes of the university "KROK". Series: Economics*, vol. 4, pp. 117–122.

6. Sachok R. T. (2024) Perspektyvy rozvytku rynku sil′s′kohospodars′kykh zemel′ v Ukrayini [Prospects for the development of the agricultural land market in Ukraine]. *Irpins'kyy yurydychnyy chasopys – Irpin Legal Journal*, vol. 2(15), pp 119–126.

7. Shebanyn V., Kormyshkyn Yu. (2019) Formy innovatsiynoyi aktyvizatsiyi ahrarnoho pidpryyemnytstva v umovakh tsyfrovoyi transformatsiyi ekonomiky [Forms of innovative activation of agricultural entrepreneurship in the context of digital transformation of the economy]. *Ekonomika APK – Economics of the Agricultural Industry*, no. 26, vol. 10, pp. 18–25.

Список використаних джерел:

1. Драган І. О., Сергієнко Л. В., Шпак Ю. В. Специфіка розвитку ринку землі сільськогосподарського призначення: досвід Європи та країн Центральної Азії. *Економіка, управління та адміністрування.* 2023. № 2 (104). С. 129–136.

2. Зигрій О.В. Вплив мораторію на продаж земель сільськогосподарського призначення. *Актуальні проблеми правознавства*. 2016. Вип. 3 (7). С. 64–68

3. 5 українських стартапів у сфері аграрних інновацій. Mudra, 2020. URL : https://mudra.ua/ua/articles/5-ukranskih-startapv-u-sfer-agrarnih-nnovacj/

4. Корюгін А., Лобунець Т. Ринок землі як інструмент активізації діяльності в аграрній сфері. Економіка та суспільство. 2022. No 39. URL: http://www.economyandsociety.in.ua/index.php/journal/article/view/1377

5. Кормишкін Ю.А., Бовкун О. А. Бізнес-інфраструктура аграрного підприємництва. *Вчені записки університету «КРОК». Серія: Економіка.* 2018. Вип. 4. С. 117–122.

6. Сачок Р.Т. Перспективи розвитку ринку сільськогосподарських земель в Україні. *Ірпінський юридичний часопис*, 2024. № 2(15). С. 119–126.

7. Шебанін В., Кормишкін Ю. Форми інноваційної активізації аграрного підприємництва *в* умовах цифрової трансформації економіки. *Економіка АПК*. 2019. Т. 26, № 10. С. 18–25.