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EFFICIENCY OF THE LARGE-SCALE AGRI-INDUSTRIAL ENTITIES IN UKRAINE

Abstract. The analysis of activities of large-scale agri-industrial entities (LAEs) or so called «agriholdings» in Ukraine has shown their advantages in comparison with other types of farming. Their main advantage is a real agri-industrial integration including farming, processing, trading of foods, often with own trade mark, and export activity. Also, LAEs have possibilities to attract cheap financial resources from affiliated or own banks in Ukraine and abroad. As a result, they implement modern technologies in farming and processing, produce high quality foods and have good competitive positions on agricultural and food markets in Ukraine and abroad. In the LAE exist a transfer pricing that minimize the external intermediaries, taxes and increases income. It is why the most LAE pay a higher rent for the land, salary to the workers and have higher efficiency in comparison with other form of agricultural enterprises. Real agri-industrial integration in LAE is significantly different from such integration in other agricultural entities that have small processing plants without deep reworking of agricultural row materials. LAEs provides large-scale of agricultural and processing production and have possibilities to use its advantages in form of receiving of effect of scale. The large-scale production allow them to use high productive machinery and modern technologies and thanks to this significantly increase productivity of resources, decrease costs per unit of products and, as a result, increase the efficiency of production. The narrow segment of LAEs activity is qualified personal in framework of modern agricultural and processing technologies. Existing human capital in the rural area does not meet necessary requirements because the part of active population is sharply decreasing, there are no enough qualified specialists. It should be mentioned, that problem with hiring of top managers, due to large scale and complex tasks, is one of the most actual. It is why LAE forced them self to prepare such specialists. The efficiency of eight LAEs has been evaluated. To carry out the analysis of the LAEs efficiency depending on their scale, a simulation model was developed based on the calculated correlation-regression model according to the actual data. It was determined that the dependence between the efficiency and scale of the LAEs exist at a low level. Noted that the highest level of the efficiency of functioning of the «large» LAEs is a result of the more compact layout of the production facilities and better management.

Keywords: large-scale agri-industrial entities, agriholdings, land bank, cultivated land, agri-industrial integration, technologies, efficiency.

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ЕФЕКТИВНІСТЬ ВЕЛИКОТОВАРНИХ АГРОПРОМИСЛОВИХ ФОРМУВАНЬ В УКРАЇНІ

Анотація. Аналіз діяльності великотоварних агропромислових формувань (ВАФ), або так званих «агрохолдингів», в Україні показав їхні переваги порівняно з іншими видами фермерського господарства. Основною їхньою перевагою є реальна агропромислова інтеграція, включаючи землеробство, переробку, торгівлю продуктами харчування, часто з власною торговою маркою, та експортну діяльність. Також ВАФ має можливості залучити дешеві фінансові ресурси від афілійованих або власних банків в Україні і за кордоном. У результаті вони впроваджують сучасні технології в сільському господарстві та переробці, виробляють високоякісні продукти харчування і мають хороші конкурентні позиції на сільськогосподарських і продовольчих ринках в Україні і за кордоном. У ВАФ використовуються трансфертні ціни, які мінімізують зовнішніх посередників, податки і збільшують дохід. Саме тому більшість ВАФ платять вищу оренду за землю, зарплату працівникам і мають вищу ефективність порівняно з іншими формами сільськогосподарських підприємств. Реальна агропромислова інтеграція у ВАФ суттєво відрізняється від такої інтеграції в інших сільськогосподарських структурах, які мають невеликі переробні заводи без глибокої переробки сільськогосподарських просапних матеріалів. ВАФ забезпечує широкомасштабне сільськогосподарське і переробне виробництво та має можливості використовувати його переваги за рахунок ефекту масштабу. Масштабне виробництво дозволяє їм використовувати високопродуктивну техніку та сучасні технології, завдяки чому значно збільшується продуктивність ресурсів, зменшуються витрати на одиницю продукції і, як результат, підвищується ефективність виробництва. Вузький сегмент діяльності ВАФ вимагає кваліфікованого персоналу в рамках сучасних сільськогосподарських і переробних технологій. Наявний людський капітал у сільській місцевості не відповідає потрібним вимогам, оскільки частка активного населення різко зменшується, відповідно формується дефіцит кваліфікованих спеціалістів. Слід зазначити, що проблема найму топ-менеджерів через масштабні та складні завдання є однією з найбільш актуальних. Ось чому ВАФ змушені самостійно готувати таких фахівців. Оцінено ефективність восьми публічних ВАФ. Для проведення аналізу ефективності ВАФ залежно від їхнього масштабу була розроблена імітаційна модель на основі розрахованої кореляційно-регресійної моделі за фактичними даними. Було встановлено, що залежність між ефективністю і масштабами ВАФ існує на низькому рівні. Відзначено, що найвищий рівень ефективності функціонування «великої» ВАФ є результатом більш компактного планування виробничих потужностей та кращого управління.

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Ключові слова: великотоварні агропромислові формування, агрохолдинги, земельний банк, оброблювана площа, агропромислова інтеграція, технології, ефективність.

Формул: 3; рис.: 5; табл.: 3; бібл.: 24.

Introduction. The performance of the agri-industrial enterprises in recent years is defined by a stable positive dynamic: production increase revival of the processing industry and the position strengthening on foreign markets. Further development of this sector of the economy requires transformations of a qualitative nature to enhance its competitiveness. Modern domestic practice of agribusiness is characterized by the formation of LAEs, so-called agriholdings, that is accompanied by merger and acquisition of the previously formed agricultural enterprises of different forms of incorporation, a high level of concentration of capital, and access to financial and investment resources. Economic efficiency of LAEs functioning is often achieved by economies of scale, extensive development and sometimes by neglect of social and environmental factors. Thus, a need arises to carry out a thorough analysis of the dependence of the functioning efficiency of such entities on their scale.

Analysis of recent research and publications. The question of activity of LAEs in Ukraine was investigated by the following authors: Andrijchuk V.G. [1], Nitsenko V.S. [2—8], Demyanenko S. [9; 10], Yerankin O.O., Koczupatryj M.M. [9], Galushko V., Brummer B. [10], Horunzhy'j M.J. [11], Ushkarenko Iu., Soloviov A. [12], Ma B. [13], Piliaiev I. [14] and other.

It should be mentioned that LAE have some important advantages in comparison with other forms of enterprises in rural area. One of the most important advantage of LAEs is a real ingratiation of farming, processing and trading — raw materials from the branches follow to processing entities and subsequently in the form of the final products to the trade network. Therefore, this transfer pricing minimizes the external intermediaries, taxes and increases income. This is why most LAEs pay a higher land rent, salary to the workers and have higher efficiency in comparison with other forms of agricultural enterprises.

Real agri-industrial integration in LAEs is significantly different from such integration in other agricultural entities that have small processing plants without deep reworking of agricultural raw materials. LAEs provides large-scale of agricultural and processing production and have possibilities to use its advantages in the form of receiving of effect of scale. The large-scale production allow them to use highly productive machinery and modern technologies and thanks to this significantly increase productivity of resources, decrease costs per unit of products and, as a result, increase the efficiency of production.

The purpose of this article is to investigate the main advantages of LAEs in comparison with other form of agricultural enterprise and their efficiency depending on their scale.

Research results. An important aspect of LAE activity is their possibilities to provide the necessarily quality of agricultural raw materials and foods. Placing Ukraine on the markets of the EU, India, China and Africa require certain standards of quality. Unfortunately, it is very difficult to achieve such standards for small agricultural and processing producers and in particular, for rural households that produce from 50 to 90% of such products as milk, vegetables, potato. Thanks to modern technologies in production and processing of agricultural products, controlling of technological process, providing required quality standards, LAEs undoubtedly have competitive advantages in comparison with other form of agribusiness.

As a result, LAEs, as rule, engage in three types of activities: farming, processing and food trading. For the mentioned types of activities there are specific financial flows, which can be concentrated and redirected to the spheres of activities that require accelerated development in short or long run. This translates into a real possibility for LAEs to optimize financial flows in the mentioned types of activities which are impossible to do under conditions of separated farming, processing and trading. It is much easier for LAEs to accumulate the financial resources and invest them in agricultural production in comparison to individual farmers. Compared to other industries, farming is characterized by its seasonal nature and consequently, significant turnover fluctuations. This is why, one of the main problems for agricultural enterprise and farmers is that of financial resources. They do not have enough own financial resources, bank loans are expensive and banks

are not interested in crediting them because it is high risk business. In contrast, LAEs possess their own financial resources use the resources of their founders, that in many cases have own banks, attract foreign investments, and cheap loans from foreign banks [2; 5; 15].

It can be argued therefore, that LAEs face no problems with financial resources and they can implement modern technologies at all stages of the production process — from farming to retail and it is their indisputable competitive advantage compared to other types of agribusiness. LAEs, however, are affected by a shortage of qualified personnel. Modern farming is characterized by implementation of modern, knowledge-intensive technologies, in particular, biotechnology, improvement and increase of production and quality of crops and animals, guarantee of food quality and safety, ensuring ecological balance between agricultural development and its influence on the environment. Consequently, the development of farming and all agribusiness will be determined not just by traditional resources like land and capital, but real possibilities of implementation of scientific and technological progress. Farming has become a science-intensive industry which utilizes highly productive and expensive machinery and equipment. Concentration and integration in agribusiness and creation of LAEs require implementation of modern management for all levels of administration — from bottom to top. It is the only way to explore the possibilities and to realize advantages of large-scale agri-industrial production and receive the effect of scale. And this, in turn, requires a completely revised structure of human capital. The existing human capital in the rural areas does not meet such requirements because the part of active population is sharply decreasing and there are not enough qualified specialists. It should be mentioned, that the problem with hiring of top managers, due to large scale and complex tasks, is one of the most pressing. This is why LAEs strive to train such specialists themselves. *Table 1* presents the scales of the biggest LAEs in Ukraine at the beginning of 2020.

Table 1

Land bank of some LAE in Ukraine at the beginning of 2020, in thousands of hectares

№	Name of LAE	Land bank, thnd. ha	№	Name of LAE	Land bank, thnd. ha
1.	Kernel	600	14.	LNZ Group	80
2.	UkrLandFarming	470	15.	Agro-Vista	75
3.	NCH (Agroprosperis)	410	16.	Agrotrade	72
4.	Myronivskyi Hliboproduct	370	17.	Panda	62
5.	Astarta	210	18.	Vitagro	60
6.	HarvEast	147	19.	Svarog	60
7.	Epitsentr Agro	127.5	20.	Rostok-Holding	57
8.	IMK	123,9	21.	Agromino + Resilient	53
9.	Mriya	119	22.	AgroGeneration	48
10.	Ukrprominvest-Agro	116.5	23.	AST	47
11.	Agrofirm Svitanok	90	24.	Agroton	40
12.	Nibulon	83	25.	Grain Alians	38
13.	TACSAgro	83	26.	KSG Agro	21

Note: based on Agricultural Consulting: http://www. farming.org.ua.

The information about eight public agricultural companies of Ukraine was taken as the basis for the analysis of the relation between LAE functioning efficiency and their scale. It should be mentioned that many more LAEs are functioning in Ukraine, but not all of them are officially reporting their financial results. Mostly LAE include several legal entities with «formal» relationship among them. There are two main types of LAEs in Ukraine [5; 7; 9; 16]:

- Public, that have official administrative and legal connections among the entities of holding, publish their consolidated reports, including financial, participate in different agricultural association;

- Non-public — no consolidated reports, including financial, have non formal connections among their entities.

The creation of any LAE starts from an initiation of investors and their vision of the future company. The critical point, in this case, is the personal approach of the owners which, after a discussion with LAE top managers, can be classified into the following three main approaches [1; 4; 8; 10; 17]:

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1. Single or simplified which is based on a single economic indicator. Owners negotiate with managers one quantitative indicator, as a rule it is EBITDA (earning before investment, taxes, depreciation and amortization) or net profit. For the achievement of the planned indicators managers receive bonuses or, if there is no achievement, some managers are replaced. This approach is characterized by low control from the side of the owner because the farm is not their primary business and they have different companies in other industries.

2. Ordinary or short. It is characterized by several financial and economic indicators, system of motivation for managers, participation of owners in their development and controlling of achievement.

3. Complex or detailed. It includes development and control of detailed technological and financial indicators on the level of fields, animals, production units. The owners directly participate in strategic and operation planning and controlling activities.

Proposed classification is based on subjective vision of owners and managers their relationships and business development but it helps to understand the principles of creation and functioning of LAE in Ukraine.

There are three main stages in LAE development in Ukraine [3; 9; 11; 18]:

1. 2000—2010 — rapid development of LAE, accumulation of land and capital.

2. 2011—2015 — transitional stage between aggressive accumulation of resources and increasing of productivity and efficiency of production. This stage is characterized by deceleration of accumulation land and capital and intensification of resources use.

3. 2016 — present time — increasing competition among LAE for land lease, developing of processing, dipping of agri-industrial integration, logistics development, trademarks and their promotion on international markets.

One of the first LAEs in the history of Ukrainian agribusiness was the Ukrainian-British joint venture LTD «NIBULON» (83 thnd. ha), created in 1991. It specialized in the production and trade of hybrid corn and sunflower seeds. Now «NIBULON» is one of the biggest domestic producers and exporters of agricultural products (wheat, barley, rye, corn, sunflower seeds and others). However, it is not a public LAE and does not publish its consolidated financial reports (based on Latifundist: http://latifundist.com; Nibulon: https://www.nibulon.com/).

Another example is public LAE KSG Agro (21 thnd. ha). It is an agri-industrial company with a wide range of produce: wheat, barley, corn, sunflower, rapeseed, vegetables (carrot, onion, cabbage, beetroot), potato, as well as gardening, milk, cattle meat, pork, sheep breeding, biofuels, flour, cereals, sunflower oil. It is also involved in export, for instance, selling flour to China. The production strategy of this company is based on precision farming (based on Latifundist: http://latifundist.com; KSG Agro: http://www.ksgagro.com).

Very interesting is also another deep integrated public LAE is Agroliga Group (10 thnd. ha). Compared with other LAEs this company is small. It produces mostly grain, sunflower seeds and rapeseed oil (with own trade mark). Recently the owner has decided to build a bio thermal power plant for utilization of straw and seed husk.

Other examples of LAE are such public companies as: Agromino (53 thnd. ha — grain, sunflower, rapeseed with low level of agri-industrial integration); Kernel (600 thnd. ha with deep level of integration; Industrial dairy company (124 thnd. ha — grain, technical crops, developed animal husbandry); AgroGeneration (48 thnd. ha — grain, technical crops with low level of agri-industrial integration); Mironivsky Hliboproduct (370 thnd. ha, — grain production, poultry breeding with high level of integration), Astarta (210 thnd. ha, — grain, sugar beets, sugar with high level of integration. The key information on the surveyed enterprises was the EBITDA and the Income, that was divided by the area of land that the company cultivated in 2019 (*Table 2, Fig. 1*).

To analyze the information presented, we have calculated the correlation-regression model of the dependence of the efficiency on LAE scale, the results of which showed the closeness of linear relationship at 34.8%, indicating a low level of the dependence of the analyzed indicators.

To analyze the information presented, we have calculated the correlation-regression model of the dependence of the efficiency on LAE scale, the results of which showed the closeness of linear relationship at 30.48%, indicating a low level of the dependence of the analyzed indicators.

Table 2

Efficiency of public agricultural holdings in Ukraine, 2019

Name of large-scale agro-industrial entity	Year of incorp.	Income, mil USD	Income, $.USA/ha	EBITDA, mil $.USA	EBITDA, $.USA/ha	Land cultivated, th. ha
Agroliga Group	1992	50	5040	11	1120	10
Agromino	2007	37	704	11	210	52
Kernel	2008	3992	7532	346	653	530
Industrial dairy company (IDC)	2007	170	1368	39	317	124
AgroGeneration	2007	34	588	-1	-22	58
Mironivsky Hliboproduct	1998	2056	5556	379	1024	370
KSG Agro	2001	24	1138	10	457	21
Astarta	1993	500	2126	87	370	235

Source: formed on the basis of (Agricultural Consulting: http://www. farming.org.ua; Isakova D. (2015): The ranking of 20 most efficient agricultural companies of Ukraine. Forbes Ukraine, № 8. http://forbes.net.ua/magazine/forbes/1399408-rejting-20-samyh-effektivnyh-agrokompanij-ukrainy; Released to the public: rating of effective public agricultural holdings: https://delo.ua/business/vyshli-na-publiku-rejting-samyh-effektivnyh-publ-369612/; Top 100 latifundists of Ukraine: https://latifundist.com/rating/top100) and our calculations.

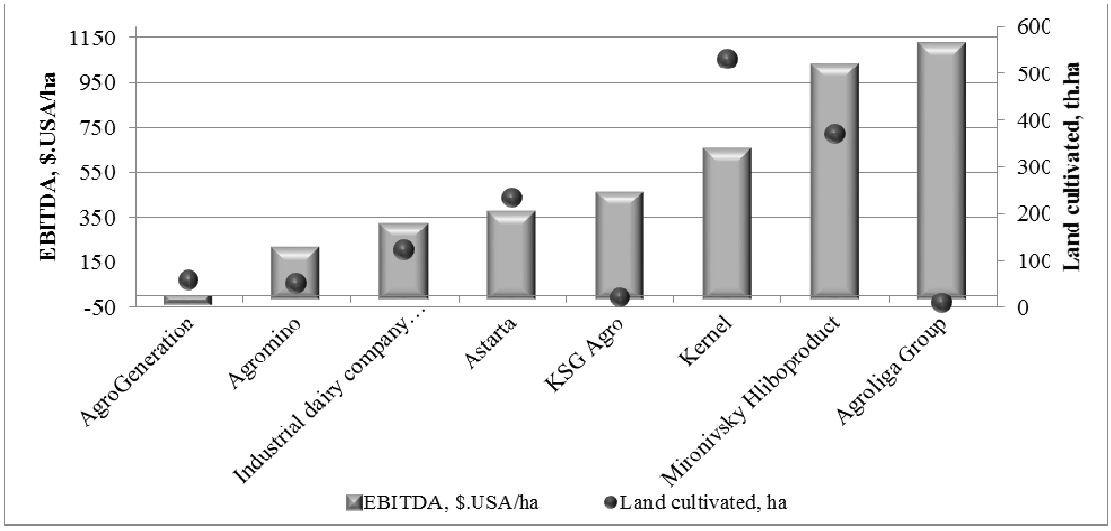

Fig. 1. **Efficiency of public agricultural holdings in Ukraine, 2019**

Source: formed on the basis of (Agricultural Consulting: http://www. farming.org.ua; Isakova D. (2015): The ranking of 20 most efficient agricultural companies of Ukraine. Forbes Ukraine, № 8. http://forbes.net.ua/magazine/forbes/1399408-rejting-20-samyh-effektivnyh-agrokompanij-ukrainy; Released to the public: rating of effective public agricultural holdings: https://delo.ua/business/vyshli-na-publiku-rejting-samyh-effektivnyh-publ-369612/; Top 100 latifundists of Ukraine: https://latifundist.com/rating/top100) and our calculations.

Accordingly, the next step in the research was the selection of Agroliga Group and Mironivsky Hliboproduct as those that differ the most from the statistical series in the analytic part of the study. The calculated results of the second model showed the correlation at the level of 70.24%. The increase of the dependence factors by 37.69 percent compared to the first model reflects the actual presence of such dependence, albeit at the low level. Simultaneously, it proved the testimony of a number of high-ranking executives on the more efficient functioning of medium-scale agricultural holdings compared to the giants that we have identified.

To carry out a more in-depth analysis of the dependence of the functioning efficiency of large-scale agri-industrial entities on their scale, we decided to expand the sample by simulation modeling [6; 9; 15; 19; 20], as the statistical data of *Table 1* were insufficient. To implement the simulation model of the dependence, we used the previously calculated regression model with the correlation of 39.76%, the analytical form of which is represented by the formula:

$$Y = 0.6366x + 404.62. \quad (1)$$

We used the second option to calculate the regression formula that has higher level of closeness coherence because it reflects empirical character of this coherence. The analysis of LAE activity reflected their heterogeneity because they have a different level of agri-industrial integration.

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Due to this LAEs have different results of their activities. It reflects a factor of normal distribution of «tails», that shows some LAEs that strongly stand out from totality (Top 100 latifundists of Ukraine: https://latifundist.com/rating/top100). This is why such companies as Agroliga Group and Mironivsky Hliboproduct were removed from the calculation because they are narrowly specialized. In particular, in the development of the dependence simulation model it was considered that:

• the cultivated area is normally distributed;

• EBITDA (USD/ha) is calculated as the sum of the expected profit (calculated under the given model and dependent of the land cultivated — 1) and the unexpected (stochastic) profit normally distributed.

The density of the normal distribution has the form [8; 21; 22]:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-a)^2}{2\sigma^2}}, \quad x \in (-\infty; \infty), \tag{2}$$

where $x = \sigma\mu + a$ – the variable, value of which is simulated;

$a = M(x)$ – the expected value of the variable x;

σ — the standard deviation of the variable x;

$\mu = \sqrt{-2\ln(\xi_1)}\cos(2\pi\xi_2)$ — normally distributed random variable with parameters $a = 0$, $\sigma = 1$ (Box-Muller method);

ξ_1, ξ_2 – uniformly distributed values on the interval $[0, 1]$ that can be obtained by using the random number generator (in Excel spreadsheets — function Rnd).

In this research, the simulation of the cultivated area was carried out with parameters $a = 50$ thousand ha, $\sigma = 152{,}6$ thousand ha.

The results of the simulation model of the dependence EBITDA (USD/ha) on the area cultivated by LAEs are presented in (*Table 3, Fig. 2*) and allowed us to build the following linear regression model:

$$Y = 0.6977x + 228.08. \tag{3}$$

Table 3

Clustering the results of the simulation model of the dependence EBITDA (USD/ha) on the area cultivated by LAEs

№	Clusters of entities by EBITDA, USD/ha	Coef.	The average value of EBITDA for the cluster, USD/ha	The LAE average area for the cluster, thousand ha
1	Up to — -415	0.0017	-448	31
2	-415 — -321	0.0061	-361	40
3	-321 — -226	0.0137	-265	48
4	-226 — -131	0.0280	-171	53
5	-131 — -36	0.0479	-80	61
6	-36 — 58	0.0897	11	67
7	58 — 153	0.1189	107	76
8	153 — 248	0.1401	201	87
9	248 — 342	0.1537	294	101
10	342 — 437	0.1334	387	112
11	437 —532	0.1041	481	139
12	532 — 626	0.0787	575	165
13	626 — 721	0.0443	671	189
14	721 — 816	0.0207	762	232
15	816 — 911	0.0113	858	276
16	911 — 1005	0.0046	948	305
17	1005 — 1100	0.0024	1042	370
18	1100 — 1195	0.0005	1166	356
19	1195 — 1289	0.0001	1196	233
20	1289 and higher	0.0001	1384	297

Source: authors' development

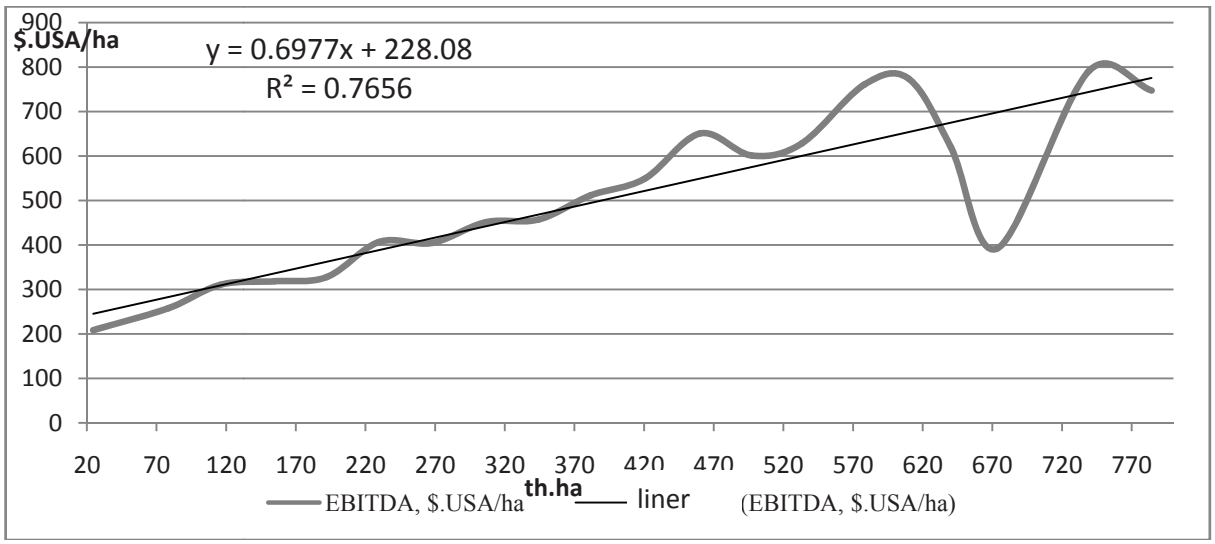

Fig. 2. **The dependence of EBITDA on the cultivated area according to the results of the simulation model**

Source: authors' development.

The level of determination of the model developed was 76.56% and, respectively, of the correlation 87.50%, indicating the sufficient level of its reliability.

Analysis of the clustered data (*Fig. 3—5*) (with used [23; 24]) of the simulation model of the dependence of EBITDA (USD/ha) on the LAE cultivated area show that the most of hits is in the range from 107 to 481 USD/ha. And the area in this range from 76 to 139 thousand ha with the increase in EBITDA (USD/ha). Note that «the remainder of losses» of the simulation model has the level of the LAE cultivated area to 61 thousand ha.

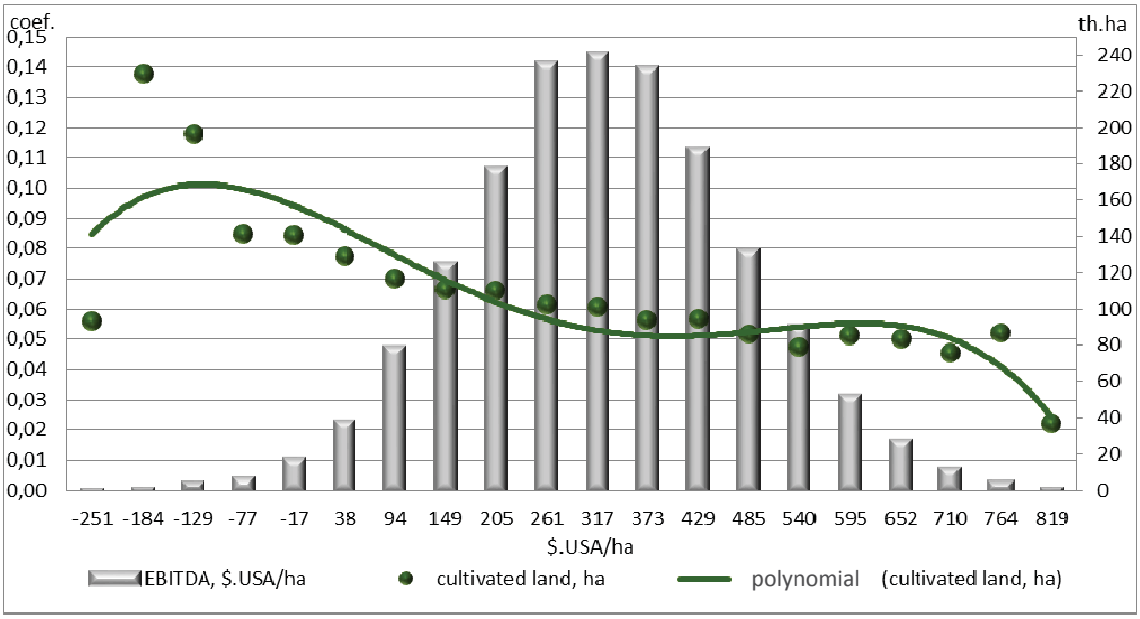

Fig. 3. T**he distribution of EBITDA and the cultivated area according to the results of the simulation model**

Source: authors' development.

The illustration (see *Fig. 4*) of the dependence of the cultivated area on EBITDA (USD/ha) allows to conclude that LAEs with more land allotments have a high level of the efficiency. In particular, higher levels of the efficiency (from 1196 to 1384 USD/ha) are observed in clusters with an average land area up to 297 thousand ha.

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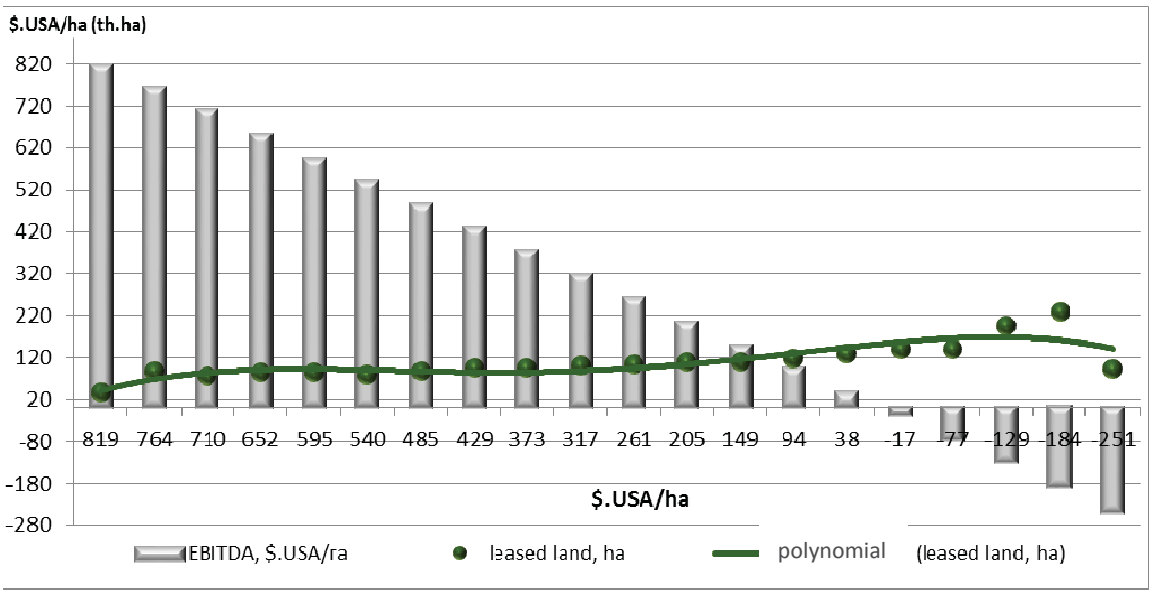

Fig. 4. **The distribution of the cultivated area on EBITDA according to the results of the simulation model**

Source: authors' development.

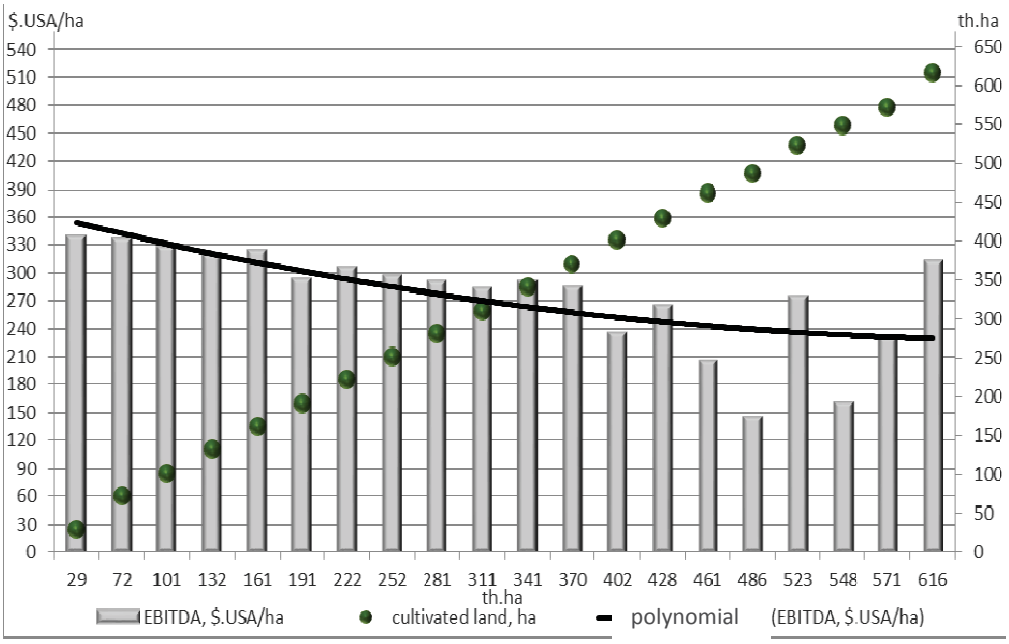

Fig. 5. **The dependence of EBITDA on the LAE cultivated area according to the results of the simulation model (clustered in 20 pcs)**

Source: authors' development.

The clustered results of the simulation on the cultivated area are shown in *Fig. 5* and confirm the above conclusion and allow us to state that the efficiency level has a positive trend with an increase in the cultivated area.

Conclusions. On the basis of the information presented and illustrated, as well as the calculated correlation-regression models and the developed simulation model we can make a conclusion about the dependence of the efficiency on the scale of large-scale agro-industrial entities:

- the dependence between the efficiency and scale of large-scale agro-industrial entities exists, but at the middle level that is proved by diagram and economic, mathematical and analytic methods;
- the «large» large-scale agro-industrial entities (more than 165 thousand ha) can have a higher level of the efficiency than the «medium» large-scale agro-industrial entities (from 67 to 165 thousand ha) that is proved by diagram, economic and mathematical and expert and analytic methods, but only in the case of a high level of integration.

Noticeably, sustainable development of the functioning efficiency of the «medium-scale» large-scale agro-industrial entities, as a rule, is the result of the more compact layout of the production facilities and correspondingly higher level of manageability due to the lack of a separate middle management (regional) between the parent company and production units.

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