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DETERMINANTS OF PERFORMANCE INDICATORS OF AGRICULTURAL ENTERPRISES

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Abstract
The currently formed system of the agricultural sector in Ukraine in recent years has been characterized by low social and economic problems due to the insufficient level of prognostic indicators of the development of agricultural enterprises.
For agricultural enterprises, maintaining a competitive position in the information market is one of the successes, so forecasting their activities ensures a reliable need for it. Several factors were investigated for their influence on the variability of net earnings, including the number of enterprises, the area of farmland, the number of employees, and the complete expenditure on agricultural products and services. The forecast showed the growth of net profit with small reductions and its further stabilization until 2030.
Scientifically innovative research is the substantiation of the possibility of using the STELLA program for a further attempt to forecast the progress of agrarian business entities. The assessment of the cumulative effect of factors on the change in the net profit of agricultural enterprises has been carried out.

Keywords: *agricultural enterprises, production, indicators, STELLA program.*
JEL Codes: *H82, O21, Q12.*

Introduction

Starting in the 1990s, the agricultural sector in Ukraine has been experiencing transformative changes, resulting in fundamental structural shifts in its economic landscape that continue to this day. The collective farm and state farm system was restructured with the formation of entrepreneurial entities of various organizational forms of management. The established enterprises function in the conditions of a competitive market, on the basis of self-management and self-financing. The decisive factor for their competitiveness and efficiency in the market institutional

environment was the creation of conditions for building a complete system of social relations, as well as economic relations based on a balanced combination of functions and interests.

The creation of a new economic system was intended to enable effective and competitive growth for agrarian business entities of various forms of organization and business management, however, frequent changes in institutional conditions, turbulence of a social and economic nature, and in the recent history of Ukraine the military factor - constantly become deterrent factors for the realization of their abilities to function effectively.

The effectiveness of production and business operations, as well as entrepreneurial activity, is significantly impacted by the availability of resources that are essential for the growth and success of agricultural enterprises of varying legal and organizational structures. Improving the results of enterprise management is possible with an optimal combination of human, intellectual, material and financial resources. Elements of resource provision of agricultural enterprises are: land, human capital, material and technical and financial resources, on which their effective production and economic activity depends. The main performance indicators of agricultural enterprises, which were taken for our scientific research, were net profit and profitability.

The purpose of this study is:

– determination of relationships, as well as trends between the volume of profits, the number of agricultural enterprises, the number of employees, the area of agricultural land, and the total cost of products and services in agricultural enterprises of Ukraine;

– the influence of factors on increasing the profitability of agricultural enterprises in modern economic conditions;

– show the possibilities of using the STELLA program for the analysis of variables.

Using the STELLA modeling environment developed by HPS (High Performance Systems), a US-based company, this study employs system dynamics to forecast the net profit of agricultural associations in Ukraine. The STELLA program enables the creation and analysis of original economic models (Kwaśniecki, 1998; Sokolovska and Pryitenko, 2016; Savka, 2022; Aschepkova, 2002; Sokolovska and Klepikova, 2015; Kozak and Parpan, 2009; Halloran, 2011).

System dynamics models are characterized by feedback loops and temporal processes. The latter is achieved at the expense of the presence of a specific discrete variable – "time". The user can set as a term simulation – total simulation time, and simulation step – timed simulation step (elementary unit of time). The model of system dynamics can be expressed mathematically as a system of differential equations, which are solved using numerical integration algorithms like Euler or Runge-Kutta with a constant step size and predefined initial values. Modeling for method of system dynamics is carried out using diagrams of causal relationships. Diagrams determine which relations are between variables and represent are marked graphs (Sokolovska, 2011; Blahun and Blahun, 2020, Ștefan et. al. 2022.

We opted for STELLA due to its cost-effectiveness, intuitive and user-friendly interface (which does not require programming expertise), and well-established modelling symbols. (Costanza and Gottlieb, 1998; Costanza and Voinov, 2001; Costanza et all., 1998; Richmond, 2001, Walters et al., 2016).

The methods of system dynamics (SD) are promising and are used in the article. As argued by Donella Meadows, one of the SD researchers (Meadows, 2018), it is necessary applying system thinking. Donella Meadows argues that a system is much more than the sum of its components. The system also implements information flows (Meadows, 2018).

It should be noted that domestic researchers attach great importance to the organizational and economic plane of the raised problem. It is noted that "the transformation of collective and state property, denationalization of land and

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property in agriculture ensured the formation of an agrarian market, the basic component of which became the modern structure of economic forms. In this way, the processes of promoting such results as: progressive development of agriculture, formation of the socio-economic well-being of the village, development of the infrastructure of rural areas are carried out; gradual spread of promising business models of sustainable development", which means progress towards balancing economic and social interests (Pylypiv).

Gaining a clear understanding of the concept of "net profit" is essential to establishing balance in the agricultural sector. Examining and analyzing this concept reveals its interrelationships and interactions within the functioning of agricultural businesses operating in a market-driven environment.

Net profit is interpreted as an entrepreneur's income for his innovative activity, which is a source of dynamic changes and development of the economic system (Schumpeter, 1982). Profit as an entrepreneur's reward for refraining from consumption.

Profit is an important component of the efficiency of its use by a business entity, the incentive and financial basis for extended reproduction and further development of entrepreneurial activity (Onehina, 2015).

Melnik L.L. (2015) characterizes profit as a positive production and financial result of a business entity. The direct impact of the price of resources directly affects the cost of manufactured products and profit (Shelenko D. 2021). The activity of agricultural enterprises requires them to subordinate the strategy and tactics of their activity to the main goal of profit maximization (Prokopa, 2012).

The profitability of agricultural enterprises hinges on the effective implementation of a financial management policy that fosters industry growth and development (Solianik and Pryitenko, 2016). The fundamental characteristic of agricultural businesses is their focus on generating profit in their production and economic activities, as without it, their ability to function is compromised (Shelenko, 2022). Therefore, profit is an economic guarantee of the stability of the enterprise and the result of its management, which requires detailed study and forecasting.

Research methods

Graphical construction of elements in the structure of the model allows you to automatically create a system of differential equations that describe the behavior of the object under study. The STELLA program automatically generates equations by using information about the model's structure and parameter values that are inputted sequentially. The model functions on the basis of detailed equations describing the behavior of the studied system.

The methodology of our research is based on the principles of systematicity. Currently, it is appropriate to learn the fundamentals of the implementation of systemic measures aimed at timely and effective overcoming of shortcomings, an objective assessment of the origins of the negative past. At the same time, it is important to foresee ways to prevent similar mistakes in the future.

Systematicity is considered as a category in which, firstly, all elements (components) are included in the process at the same time or in a technologically or organizationally specified order, or at a clearly defined time; secondly, they all perform certain target functions, the unity and correlation of which determines the nature and completeness (or, conversely, the limitations) of scientific and methodological support for post-reform development; thirdly, they must act in one, final direction as a single coherent, comprehensively justified mechanism. The examination of the principles of systematicity permitted us to process data in the Statistica 13.1 statistical program while accounting for the interrelationship between the most significant indicators that impact the net profit and variations in the agricultural land area of farming enterprises.

However, understanding the essence of the problem alone is not enough. No less important is its other component - organizational (organizational and providing). As an experience shows, in order for any system, including post-reform development, to justify its intended purpose, it must act (function) on the following organizational principles:

- the proper functioning of a system and its subsystems relies on all components working together towards a common goal and in a coordinated direction;
- simultaneous or in a clearly technologically or organizationally determined order of inclusion of all components of the system in the production process;
- the performance of each of its elements of a certain target function: the degree of their unity and justified correlation determines the nature, completeness and depth of scientific and methodological support for the development of the agro-industrial complex;
- the efficient operation of a system requires all its components to be directed towards achieving the system's ultimate goal in the most effective manner at every stage of their participation.

By applying system analysis to economic problems in the agricultural sector, it becomes possible to tackle loosely structured problems and examine the distribution of values for integral indices that typically range from 0 to 1, with an average value of 0.5. In this context, statistical tests for probability, such as $p \leq 0.05$, are commonly used. The use of system analysis in agricultural development enables the processing of large volumes of information and the creation of algorithms and models for predicting future outcomes.

Feedback, both positive and negative, is presented in the STELLA program. In this program, the user has the opportunity to set both the simulation term – the total simulation time, and the simulation step – the simulation time step (an elementary unit of time).

Our analysis showed that the model fits the actual data of 2017 by 95-100%.

To properly evaluate the economic efficiency of agricultural enterprises, it is important to consider a range of key indicators including net profit, the number of agricultural enterprises, the area of agricultural land, the number of employees, and the total cost of agricultural products and services. Focusing solely on one or a few of these indicators may result in an incomplete or biased analysis. Therefore, it is crucial to take a holistic approach and consider all relevant indicators in order to accurately assess the efficiency of agricultural enterprises.

Research results and discussion

For the reliability of the results of scientific research, the model is built on the basis of statistical data and may also contain additional sample information. For the accuracy of the calculations, the model must also have a mathematical basis that provides an effective solution to structured, mixed and unstructured tasks of organizational management with possible alternatives and a combination of different resources.

Table 1 shows the calculation of expressed in the regression function for the net financial result of agricultural enterprises. As a result, p values that are almost close to zero appear in this table. In the process of analysis of 4 parameters, statistically significant results were obtained with $p \leq 0.05$.

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Table 1. Count of regression function for the net financial result (NET PROFIT) of agricultural enterprises

Dependent Variable	Test of SS Whole Model vs. SS Residual (Arkusz1 in RASOM CH PIDP)										
	Multiple R	Multiple R2	Adjusted R2	SS Model	df Model	MS Model	SS Residual	df Residual	MS Residual	F	p
NET PROFIT	0,963853	0,929012	0,907170	1,306768E+10	4	3,266920E+09	998530069	13	76810005	42,53248	0,000000

**Source: authors' own calculations based on statistical information.*

Table 2 shows the primary beta testing results for land area, enterprises, employees and cost price. It is substantiated that such variables as the number of employees and the cost of production affect the organization of net profit. Further, in the materials of the article, we have equalized the values of the obtained indicators.

Table 2. Beta testing results for land area, enterprises, employees and cost price

Effect	Parameter Estimates (Arkusz1 in RASOM CH PIDP) Sigma-restricted parameterization									
	NET PROFIT Param.	NET PROFIT Std.Err	NET PROFIT t	NET PROFIT p	-95,00% Cnf.Lmt	+95,00% Cnf.Lmt	NET PROFIT Beta (ß)	NET PROFIT St.Err.ß	-95,00% Cnf.Lmt	+95,00% Cnf.Lmt
Intercept	31202,42	26768,35	1,16565	0,264699	-26627,1	89031,92				
AREA	1,04	2,17	0,47807	0,640536	-3,7	5,73	0,085143	0,178097	-0,299611	0,469898
ENTERPRISES	-9,44	3,75	-2,51699	0,025750	-17,5	-1,34	-0,515932	0,204980	-0,958764	-0,073100
EMPLOYEES	0,03	0,01	2,61358	0,021446	0,0	0,06	0,561410	0,214805	0,097353	1,025467
COST PRICE	0,45	0,04	9,94432	0,000000	0,3	0,54	1,195228	0,120192	0,935569	1,454887

**Source: authors' own calculations based on statistical information.*

The economic and mathematical model of regression analysis shown in Figure 1 reveals the lack of significant deviations of the data that depend on the net profit variable.

Formula formed in Statistica 13.1:

*net profit = 31202.4158009+1.0378983435*area 9.43532999083*enterprises+0.0338834706677*employees+0.445274541881*cost price*

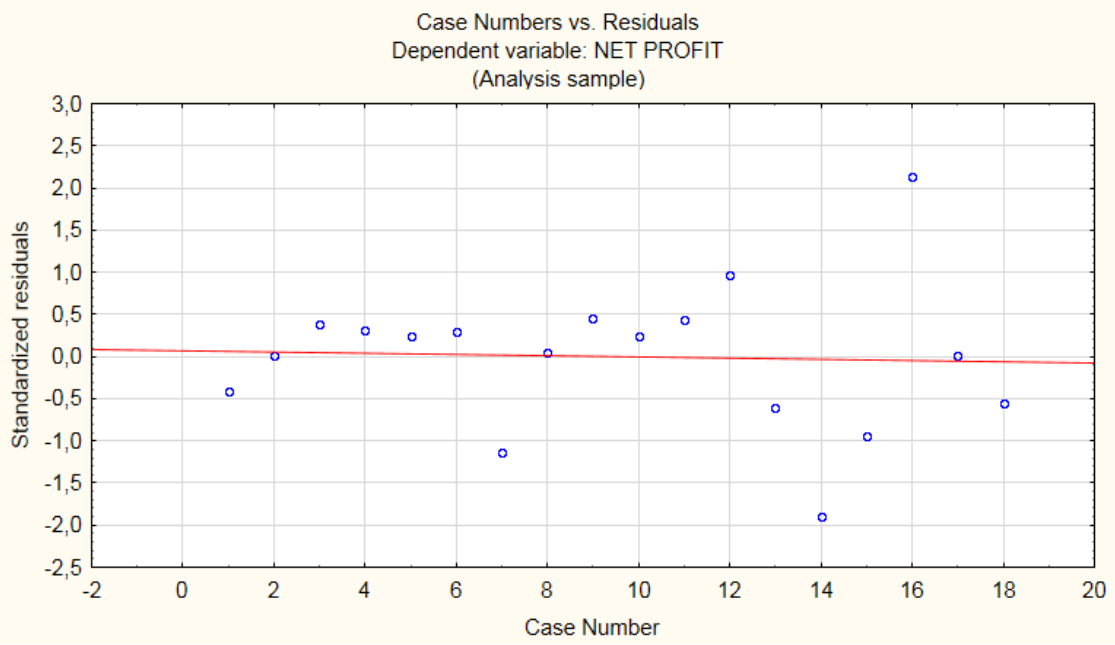

Figure 1. Count of regression function for the depending on the on the shift NET PROFIT in agricultural enterprises

**Source: authors' own graphic display.*

To the Inflow NP element was added the results of Formula 1 and displays the relationship between the variables. The appearance of the graphic model is shown in Figure 2.

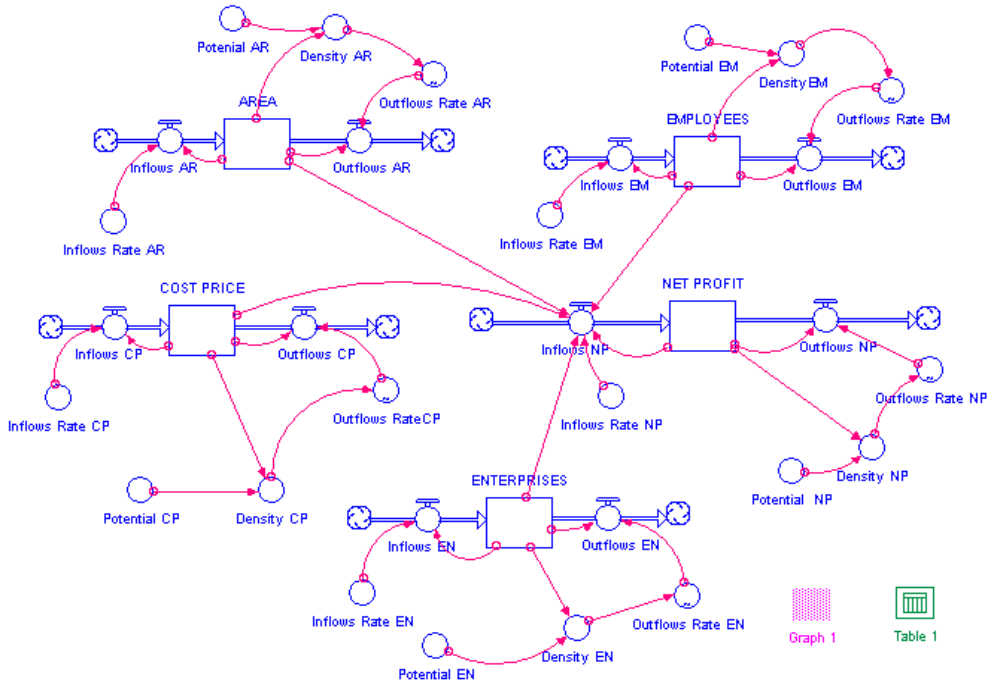

Figure 2. The model was formed in the STELLA program

**Source: authors' own graphic display formed in STELLA program.*

The basis for growing high yields is fertile agricultural land. However, there are problems with the protection of land that is used by agricultural enterprises: there is degradation of the ecosystem of agricultural land as a result of their inefficient use; humus is lost and the quality of arable land deteriorates; soils are polluted. For the modern stage of agricultural development, an important task will be to prevent land degradation and promote the effective use of agricultural land.

The ecological development of Ukraine faces several challenges, including the extensive nature of agriculture that contributes to man-made factors and the deterioration of the environment. Additionally, there is a lack of consideration for environmental resources and inadequate implementation of advanced technologies. Insufficient funding is also a problem when it comes to the processes of natural resource reproduction and restoration.

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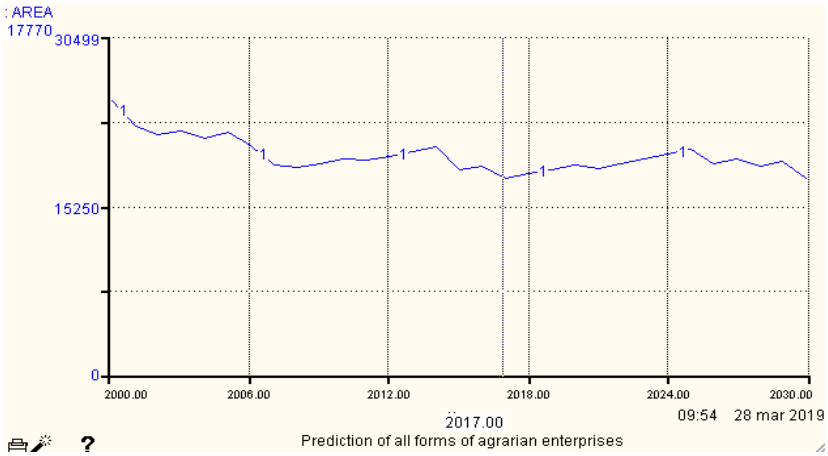

Figure 3. Schedule of projected AREA changes in agricultural enterprises of the STELLA program

**Source: authors' own graphic display formed in STELLA program.*

The model predicts a possible decrease in the area of AREA agricultural land (Fig. 3) from 24,797 thousand ha in 2000 to 17,714.72 thousand ha in 2030 (Table 3) (a special symbol in Table 3 separates thousands of values). Checking with real statistical data for 2017, we see that they corresponded to the indicator of 17,213 thousand hectares and in the model, they were simulated for verification this year – 17,770 thousand ha.

Table 3. The forecasting results for the area of agricultural land (AREA) are presented in tabular form

Years	AREA
2000	24†797.00
2001	22†516.78
2002	21†654.69
2003	22†008.42
2004	21†414.84
2005	21†883.82
2006	20†747.90
2007	18†938.32
2008	18†694.26
2009	19†103.67
2010	19†522.04
2011	19†373.12
2012	19†695.07
2013	20†126.39
2014	20†567.16
2015	18†490.32
2016	18†895.25
2017	17†770.28
2018	18†159.45
2019	18†557.14
2020	18†963.54
2021	18†672.11
2022	19†081.03
2023	19†498.90
2024	19†925.93
2025	20†362.30
2026	19†083.46
2027	19†501.39
2028	18†828.79
2029	19†241.14
Final	17†714.72

**Source: authors' own calculations from STELLA program.*

This regularity in the change in the area of agricultural land can be explained by the influence of various factors: reformation, social, economic, demographic, geographical (Balaniuk, 2013).

The graphical results of forecasting changes in the number of agricultural enterprises (Fig. 4) indicate their decrease from 13,160 in 2000 to 9,018 enterprises in 2030. In 2017, there were 11,021 enterprises with statistical data, and 11,363 enterprises were modeled for verification this year, respectively. The main reason for such changes in the number of agricultural enterprises is their insufficient resource provision, imperfect forecasting of needs in the production of agricultural products, lack of management experience in a specific environment, their merger and consolidation, reorganization and liquidation.

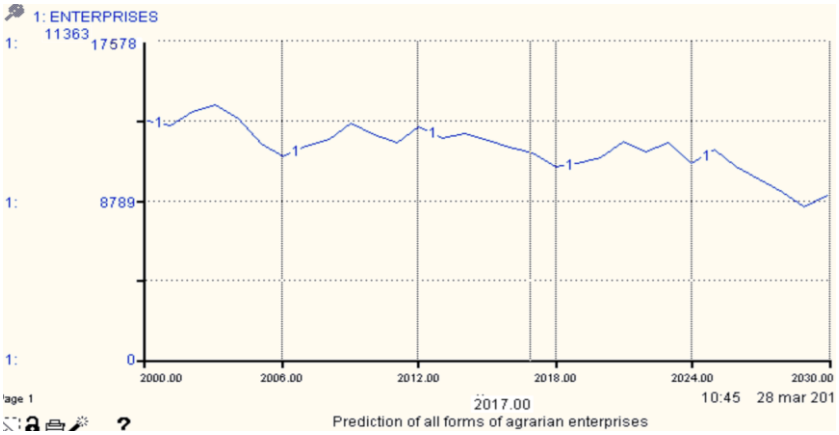

Figure 4. Results of forecasting changes in the number of agricultural enterprises (ENTERPRISES) in the STELLA program

**Source: authors' own calculations from STELLA program.*

As a result of the difficult situation that has developed in the country's agriculture in recent years, agricultural enterprises have suffered large economic losses, and their social function has also been significantly narrowed. The social and industrial base of rural areas does not provide an opportunity to maintain the employment of its employees, to raise wages, and partly to train the necessary specialists and qualified workers directly in the production professions at its own expense.

The determining factor in the development of agricultural enterprises is the human factor, or human capital. Thanks to the involvement of qualified workers in the activity and through the optimization and innovation of ways of using types of resources, it is possible to achieve high results of economic and entrepreneurial activities.

The forecast (Fig. 5) reflects a likely reduction in the number of employees from 1930512 in 2000 to 99239 people in 2030.

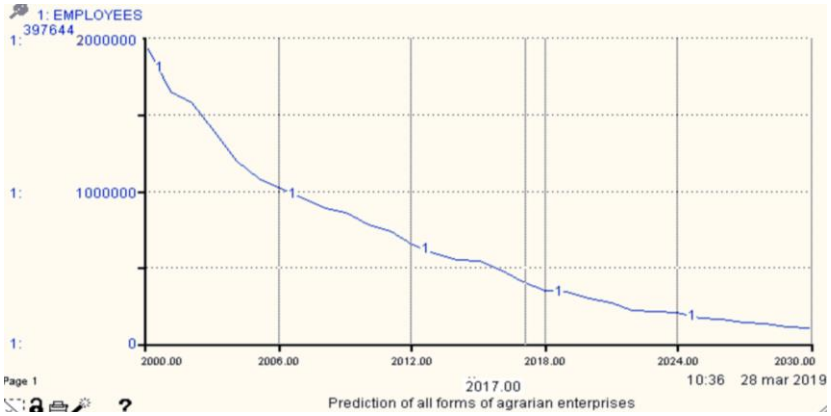

Figure 5. Visual display of the results of forecasting the number of employees of agricultural enterprises using the STELLA software

**Source: authors' own calculations from STELLA program.*

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Summarizing the above mentioned, we note that agricultural enterprises in Ukraine failed to reach the level of indicators of 2000. In most agricultural enterprises, the number of employees decreases every year.

In connection with the situation that developed in the first post-reform years in agrarian enterprises, positive changes are taking place slowly, and in many cases, on the contrary, very low dynamics prevail or even negative trends are manifested. The complex interplay of social and economic factors in the agricultural sector during that period is the root cause of this trend. This confirms the high sensitivity of net profit growth to economic stability.

At the same time, there is a forecast of an increase in the cost price (Fig. 6) from 15,371 in 2001 to 1,729,729 in 2030. In 2017, the collected statistical data amounted to 263,986.1 million UAH and were simulated in the model for verification this year, respectively, 265,333.87 million hryvnias after that, the model predicted the next cost increase.

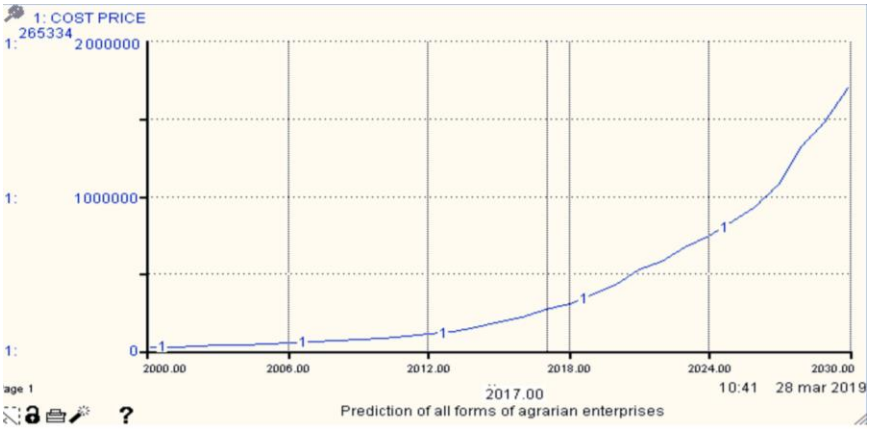

Figure 6. Visual display of the results of forecasting cost price forecasting in agricultural enterprises using the STELLA software

**Source: authors' own calculations from STELLA program.*

The increase in the prices of agrarian products and the increase in the volume of production will lead to an increase in the profits of enterprises (Onehina).

The calculations (Fig. 7) show an increase in the net financial result from UAH 1,410.9 million in 2000 to UAH 88,513 million in 2030.

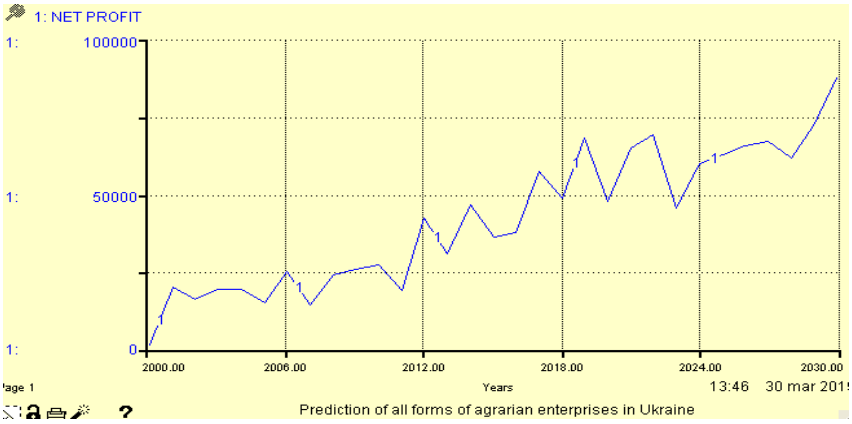

Figure 7. Graphic representation of forecasting net profit in agricultural enterprises using the STELLA software

**Source: authors' own calculations from STELLA program.*

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The simulation results indicate (Fig. 3-7) a probable increase in the size of the net profit of agricultural enterprises in the case of stabilization of the number of agricultural enterprises at the level of 9,018 units and the land area at the level of 17,714.72 thousand hectares, taking into account also the increase in the cost of products, works and services.

Discussion. The results of the study showed that after 2019, the growth of net profit is predicted, which deserves a high rating.

As we can see from the forecast in the STELLA program, we can also expect an increase in net profit with further growth until 2030. Other researchers have also confirmed the data we obtained through the use of the STELLA program. predicted data obtained by us using the STELLA program are confirmed by the research of other authors.

To ensure the effective utilization of agricultural land in Ukraine, several measures should be implemented. These include: promoting competition among land tenants and providing comprehensive protection of the rights of peasant landlords to enhance lease relationships; economic incentives for therational use and conservation of agricultural lands; improving land utilization efficiency and soil fertility through the adoption of organic farming practices; introducing environmentally sustainable farming technologies and expanding the use of soil-protective cultivation methods tailored to local features (Sabluk et al., 2009).

The implementation of reforms in the agricultural sector does not guarantee an increase in the production volume of agricultural products. Consequently, this leads to a considerable decrease in the number of individuals employed in agricultural enterprises (Lyndiuk, et al., 2011).

Reducing the number of employees is possible only partially be explained by the change in the number of agricultural enterprises, as well as by the increase in the level of technical equipment of production (Balaniuk, et al. 2021), (Yatsiv and Kolodiichuk, 2018).

Increasing the profit of agricultural enterprises will have a positive effect on the volume of investments in the future (Onehina, 2015). And without obtaining it, it is impossible to conduct effective financial and economic activities of agricultural enterprises.

As theoretical and practical studies show, the greater the amount of profit and, accordingly, the level of profitability and profitability, the greater opportunities will appear in agricultural enterprises to ensure their effective functioning, sustainable development and increase competitiveness (Melnik, 2015).

In the organization of production, the management factor includes the use of local and internal reserves and opportunities, compliance with the current legal framework, rational use of resources of agricultural enterprises, which are aimed at increasing profits.

A decrease in the number of agricultural enterprises could imply various scenarios such as merging, consolidating, or dissolving them.

The basis of the significant reduction in the number of agricultural enterprises with different legal and organizational forms is primarily caused by the instability of external socio-economic conditions and internal factors affecting their development, such as the level of resource provision (Stasiv, 2010), (Shpykuliak and Bilokinna, 2019).

Various factors have an influence on the reduction of the number of agricultural enterprises. In particular, according to data provided in (World Economic Forum, 2015), access to financing for agricultural enterprises (15,3%), corruption (14,0 %) and tax regulations (13,6 %). Furthermore, factors such as a severe political and economic crisis, ongoing conflicts, unstable and unpredictable government policies, insecurity of the rights of creditors and landowners, inefficient tax and land use reforms, insufficient funding for agriculture, and other factors hinder the attraction of external financing. Consequently, foreign investment inflow into the domestic agricultural sector is also limited (Proposition, 2019).

Conclusions

The effectiveness of agricultural enterprises is a crucial element of the sustainable development of territories and has a significant impact on the economy of the state. Profitability is a key factor in ensuring the efficiency of agricultural enterprises in a market environment. To study the trend of the main economic performance indicator of agricultural enterprises, namely net profit, we conducted research.

In this study, we developed an original model in the STELLA program to forecast the net profit of agricultural enterprises in Ukraine. The model was utilized to determine the factors that influence the formation of net profit. Our findings revealed cyclical trends in the changes of net profit, number of enterprises, number of employees, availability of agricultural land, and the total cost of agricultural products and services. The results of our study have implications for understanding the dynamics of the agricultural sector in Ukraine and can inform policies aimed at promoting the efficiency and profitability of agricultural enterprises.

As shown by the results of research for all agricultural enterprises of Ukraine (according to statistical data for 2000-2017), the amount of net profit according to the forecast until 2030, calculated using the model in the STELLA program, will increase compared to 2000 by 98,4% (62,7 times). With the increase in the amount of net profit, according to forecasts until 2030, there will be a decrease in: the number of agricultural enterprises by 31,5% (1,5 times); agricultural land area by 28,6% (1.4 times); of the number of employees by 94,9 % (19,5 times). Simultaneously, a substantial increase in the total cost of agricultural products and services by 99.1% (equivalent to a 112.5-fold increase) has been observed. That is, the actual values of the above-mentioned factors for 2000-2017, as well as their change in perspective, are able to ensure the growth of the net profit of agricultural enterprises until 2030.

In order to achieve forecast indicators of obtaining a net profit, agricultural enterprises of Ukraine need to: effectively and rationally use their land, property, labor and financial resources. It is also necessary to diversify production, motivate staff to achieve objectives, adopt a new managerial mindset, and introduce innovative technologies in line with the demands of the competitive market. Furthermore, enterprises should create favorable conditions for domestic and foreign market entry.

The achievement of forecasted net profit in agricultural enterprises is integral to the market-based management mechanism, and it is interconnected with state policies aimed at institutional and legal support for enterprise activities, activation of demand for environmentally-friendly agricultural products, provision of professional personnel training, creation of equal competitive conditions, and promotion of expansion of reproduction by manufacturers.

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