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IMPROVING THE SYSTEM OF ADAPTIVE MANAGEMENT OF AGRICULTURAL ENTERPRISES ON THE BASIS OF CONTROLLING

The article is devoted to solving the problem of improving the efficiency of the adaptive management system of an agricultural enterprise on the basis of controlling. The necessity of introducing a management system aimed at ensuring a phased management of enterprise processes, taking into account the specifics of functioning with a high level of efficiency, flexibility and efficiency, has been substantiated. A retrospective analysis of the formation and development of the control system in industrialized countries has bee carried out. The results of the analysis made it possible to highlight the main concepts of controlling in accordance with their orientation. The peculiarities of the organization of the controlling system at agricultural enterprises of Ukraine in the conditions of seasonal market fluctuations have beenare determined. Seasonal fluctuations have a direct impact on the intensity of the use of financial, material and technical, labor, energy and other types of resources of agricultural enterprises in certain periods of time during the calendar year. Thus, they impede the effective planning of the financial and economic activities of agricultural enterprises. This requires the improvement of the management system of an agricultural enterprise based on controlling to balance financial flows between all links of the agro-industrial complex.

A mathematical model describing time parameters has been presented. Within the framework of the presented model, controlling actions aimed at ensuring the basic conditions for the functioning of an agricultural enterprise and preventing the phenomenon of shortage of funds during the "low" market period have been proposed.

The model allows timely detection of problems and making appropriate corrections in management decisions in order to minimize the destabilizing influence of environmental factors and eliminate unwanted deviations.

Key words: controlling, financial management, adaptive management, cash flows, agricultural enterprises.
JEL: G32, Q13, Q14

Стаття присвячена проблемі підвищення ефективності адаптивної системи управління сільськогосподарським підприємством на засадах контролінгу. Обґрунтовано необхідність впровадження системи контролінгу, спрямованої на забезпечення поетапного управління процесами функціонування та розвитку підприємства з урахуванням специфіки його діяльності з високою оперативністю, достатньою гнучкістю та ефективністю. Здійснено ретроспективний аналіз формування та розвитку системи контролінгу в промислово розвинутих країнах, за результатами якого виокремлено основні концепції контролінгу відповідно до їх орієнтації. Визначено особливості організації системи контролінгу на українських сільськогосподарських підприємствах в умовах сезонних коливань ринкової кон'юнктури. Сезонні коливання здійснюють безпосередній вплив на інтенсивність використання фінансових, матеріально-технічних, трудових, енергетичних та інших видів ресурсів сільськогосподарських підприємств в окремі періоди часу протягом календарного року. Тим самим вони перешкоджають ефективному плануванню фінансово-господарської діяльності сільськогосподарських підприємств. Це потребує удосконалення системи управління сільськогосподарським підприємством на засадах контролінгу для збалансування фінансових потоків між всіма ланками агропромислового комплексу.

Представлено математичну модель, що описує часові параметри. В рамках представленої моделі запропоновано контролінгові дії, спрямовані на забезпечення принципових умови функціонування сільськогосподарського підприємства та запобігання явища дефіциту коштів протягом періоду "низького" ринку.

Модель дозволяє вчасно виявляти проблеми і вносити відповідні корективи в управлінські рішення з метою мінімізації дестабілізуючого впливу факторів навколишнього середовища та усунення небажаних відхилень.

Ключові слова: *контролінг, управління фінансами, адаптивне управління, потоки грошових коштів, сільськогосподарські підприємства*
JEL: *G32, Q13, Q14*

Introduction and problem statement. Globalization, European integration processes and transformational strategic changes in the economy of Ukraine determine the vector of development of the national economy as a whole, its individual industries and business entities. Under such conditions, domestic enterprises need, on the one hand, to focus on changes in the external environment and respond to them as quickly as possible with the minimum necessary costs, and on the other hand, constantly increase the effectiveness of their own activities, which requires the search for effective methods of financial management, which can confidently include the control system. Without an effective control system, it is impossible to ensure the effective implementation of plans, progress towards the goals set. The control system consistently combines the functions of analysis, evaluation, planning, control, regulation and motivation into a comprehensive enterprise management system. This allows us to identify problems in a timely manner, respond to unwanted course of events and make appropriate adjustments to management decisions in order to minimize the destabilizing impact of environmental and internal factors and ensure the effectiveness of the functioning and development of enterprises taking into account the specifics of the activity. The problem is of particular relevance for enterprises whose activities constantly have a seasonal impact on production processes and the formation of demand for products, in particular, agricultural enterprises, which play a decisive role in shaping the country's food security and export potential. The seasonality of agricultural production directly affects the intensity of the use of financial, material, technical, labor, energy and other resources of the enterprise in certain periods of time during the calendar year. Taking into account the fact that agricultural enterprises are the proactive link in the real sector of the economy, the seasonal nature of production determines the parameters of the activities of industries that produce and service agricultural products,

harvest, preserve, process and sell crops. agricultural products. This actualizes the need to improve the management of agro-industrial enterprises based on control over the balancing of financial flows between all links of the agro-industrial complex.

Research methods. The theoretical basis of the study was the work of domestic and foreign scientists on the development of financial control principles, and the factual basis – the peculiarities of the formation of primary statistical reporting of agricultural enterprises, the current legislation of Ukraine regulating economic activity, the results of the authors' own research.

The publication covering methodological and practical principles of financial management of agricultural enterprises on the basis of control used general scientific and special methods: theoretical generalization and comparison – to substantiate the the theoretical provisions of controlling; historical analysis – when studying the stages and features of the development of the control system at Ukrainian agricultural enterprises; statistical and economic – to determine "high" and "low" seasons of agricultural enterprises; economic and mathematical modeling – when developing a model for controlling the financial flows of an agricultural enterprise, taking into account market fluctuations in the short-term; system-target – in order to improve the adaptive system of financial management of agricultural enterprises; abstract-logical – to formulate the conclusions of the study.

Literature review. The problem of forming an effective management system of the enterprise on the basis of control is in the focus of attention of both Ukrainian and foreign scientists. .

The most common in the economic literature is the statement about the origin of the term "controlling" from the verb "to control", which means to manage. According an alternative view, its appearance is associated with the Latin words "contra" – against, "rotulus" – the swee and the further development in French language of the word "control", which means a register or list, which is maintained in two copies. Historically,

the emergence of control dates back to the XV century and is associated with a person who had the title of "Countrollour auf Accounts", whose duties included checking the correctness of cash and commodity flows at the court of the King of England.

In America, the practice of controlling was developed in the XIX century. The Anglo-Saxon (American) concept of the control system is aimed at solving the problems of both external (financial) and internal (production) accounting. Despite the English-language roots of the term "controlling", the difference between the representation of its system by American scientists such as Atkinson, A.A., Kaplan R.S., & Young S.M. [1], Drury K. [2], Horngren C. [3], Hosking A. [4] and others is that they usually operate with the concept of "management accounting".

Control was further developed in post-war Europe and was associated with the formation in the 50s of the XX century its German (European/continental) concept. In accordance with this concept, the control system is focused on the internal (production) accounting of the enterprise. Instead, financial accounting and external reporting did not belong to the sphere of control, but relied on accounting. The interpretation of controlling also differs in the interpretation of German-speaking scientists such as Amman K. [5], A. Deyhle [6], Horvath P. [7], Hahn D. [8], Kupper H. [9], Mann R., Mayer E. [10], Siegwart H. [11], Weber J., Schaffer U [12] ets., who use it to determine the system of planning and control in the management of the enterprise, maintain operational management decisions, master epy economic situation in the market and find out the opportunities and risks associated with making a profit.

In the Ukrainian economic literature, the authours use term "management accounting" and the term "controlling". The works of Bayura D. [13], Hovorushko T., Kronikovskyi D. [14], Ivakhnenkov S., Melykh O. [15], Pushkar M., Pushkar R. [16], Tereshchenko O. [17] are deveted to the study of certain aspects of the organization of control and internal audit. The problems of the pe-

culiarities of the formation of the system of control of agricultural enterprises are highlighted in the works of Ukrainian scientists in the context of the study of the theoretical aspects of control and its importance in the management system of agricultural enterprises [18], [19], representing control as a tool for rehabilitation [20], as an accounting and analytical function of management [21], the formation of an adaptive control system in the management of agricultural enterprises [22], the introduction of a controlling service [23], staff control [24].

However, the analysis of scientific papers shows that organizational and methodological issues of controlling of agricultural enterprises have not been sufficiently studied. Practical aspects of the formation of a control system at Ukrainian agricultural enterprises, which are aimed at functional support of management, can be introduced only if they are carefully studied. Thus, the problem of accounting for seasonal fluctuations in production and sales of products in the adaptive management system of agricultural enterprises, as well as improving management by introducing measures to eliminate the imbalance of financial flows, remains relevant.

The aim of the paper. The purpose of the article is to develop the theorical and methodological principles for the formation of an adaptive management system for agricultural enterprises on the basis of control, which takes into account the time and volume parameters of seasonal fluctuations in funds.

The main material of the study. The main feature that determines the specifics of the activities of enterprises for growing crops is the interweaving of economic and natural production processes in agriculture. Cultivation of crops, in contrast to the production of other industries, has such a feature as seasonality, which leads to the implementation of a significant amount of work in a short time and is associated with a significant increase in the intensity of the use of financial resources.

For example, Sokhatska G.V. argues that the impact of seasonality "greatly complicates the process of working capital planning, requires adjustment of operational activities and the use of enterprise assets" [25, p. 80]. Seasonal fluctuations impede the effective planning of the financial and economic activities of the enterprise, reduce the level of its liquidity, create an imbalance between financial flows, reduce profits and slow down economic development.

The seasonality factor affects the financial and economic activities of an agricultural enterprise due to the fact that during the calendar year the enterprise bears nonstant costs for wages, costs associated with the purchase of raw materials, maintenance of fixed assets, deductions, rent, payment of interest on credit funds, etc. At the same time, due to uneven cash flow (Fig. 1), the company is forced to reduce the staff and refuse certain services.

In such circumstances, an adaptive control system should ensure the fulfillment of the function of timely detection of a problem, response to unwanted events and making appropriate adjustments to management decisions in order to eliminate undesirable deviations and the negative impact of the seasonality factor. At the same time, each employee acts independently within the limits of his competence. When deviations exceed the level of his competence, he applies to a higher level of management. On the other hand, the control system makes it possible to identify the positive aspects and strengths of the enterprise.

The area of control includes the definition and documentation of actual indicators as the results of the implementation of management decisions, their comparison with planned indicators to determine the effectiveness of activities, comparison of expected indicators (adjusted budget, forecast) and the actual implementation of the budget. D. Hahn refers verification of the admissibility of initial prerequisites to the area of control and control of methodical and meaningful consistency of the planned process [8].

K. Drury compares the control system with a communication network "through which the activities of a firm (organization) are managed and which provides the basis for correct actions in the future" [26, p.
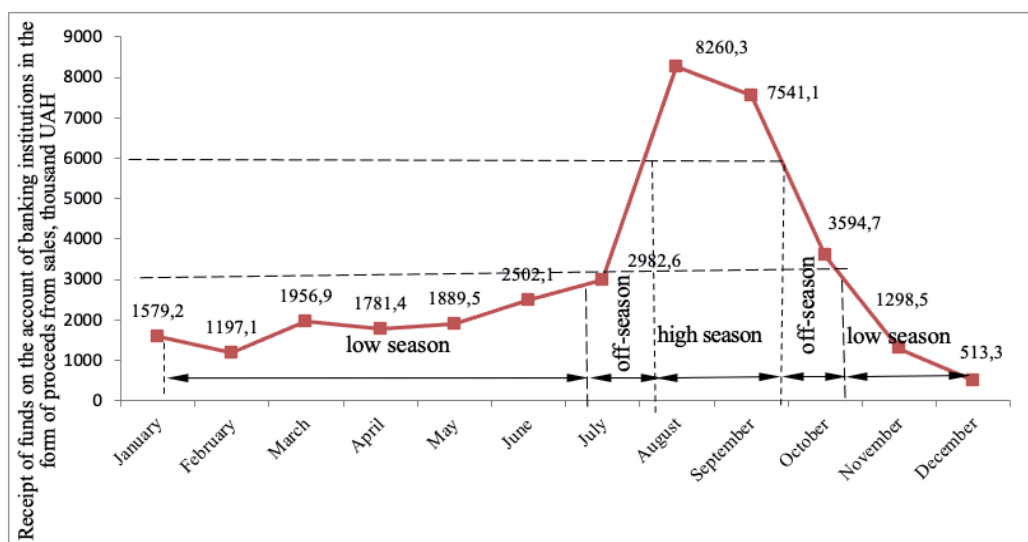
Fig. 1. Graphic interpretation of seasonal fluctuations in the activity of an agricultural enterprise

Source: devised by the authors on the basis of data from the Agricultural Production Cooperative "Frunze"

414]. Monitoring is based on feedback that provides the necessary information to identify the causes and eliminate deviations of actual indicators from planned ones. Comparison can be made at different intervals (quarter, month), or constantly, in real time. The frequency of adjustment of deviations has an impact on the planning horizon. The scheme is selected depending on the specifics of the enterprise. Work on adjusting production activities should begin with the formation of an annual plan of the enterprise with a quarterly breakdown. In the future, the plan of the first quarter should be detailed in the monthly plans, and the first monthly plan – in a weekly context. Thus, the planned perspective "slips" in time (Fig. 2).

The next stage combines the functions of operational (weekly) control. This is the basic when describing the processes of control. Based on the received data, control is carried out and operational management is carried out. As a result, we get a comprehensive model of planning and controlling the activities of the enterprise. The created models must be documented in the form of text reports, for further use in the implementation of the developed processes. At the same time, the powers and responsibilities of employees should be changed, job descriptions should be developed (changed), typical forms of planned and reporting documents should be approved, the document management system should be updated.

The basis for the construction of an adaptive system of control of agricultural producers in the conditions of seasonal fluctuations in production and demand for products is the structure and objective proportions between monetary funds and the flow of funds of the enterprise. Schematic description of the activities of an agricultural enterprise in the short term is described in accordance with the modified model [27, pp. 319-331] using variable values considered as a function of time:

– company assets $(IG(t) + CCE(t))$,

where $IG(t)$ – inventories; $CCE(t)$ – cash and cash equivalents;

– equity and liabilities $(CL(t) + C)$,

where $CL(t)$ is the accounts payable of current liabilities; C – constant value of own funds (statutory fund);

– intensity of cost movement in streams per unit time:

$f_{spc}(t)$ – funds received from the sale of products at a cost of production; $f_{gs}(t)$ – delivery; $f_{pd}(t) = f_{gs}(t - T_k)$ – payment for

Fig. 2. Frequency of adjustment of financial indicators in the control system
Source: developed by authors

deliveries (taking into account the deferred payment T_k).

The actual values of funds at the moment of time are calculated as an increasing summary of the change in the initial value of the balanced amounts of the enterprise under the influence of inflow and outflow of outgoing cash flows during the observation time t:

    – stock of goods:

$$IG(t) = I(0) + \int_0^t [f_{gs}(t) - f_{spc}(t)]dt \rightarrow \frac{dI(t)}{dt} = f_{gs}(t) - f_{spc}(t), \quad (1)$$

    – cash:

$$CCE(t) = CCE(0) + \int_0^t [f_{spc}(t) - f_{pd}(t)]dt \rightarrow \frac{dCCE(t)}{dt} = f_{spc}(t) - f_{pd}(t), \quad (2)$$

Achieving maximum sales involves the speedy conversion of all available funds into a stock of goods (impulse reduction of funds to zero level).

The logic of constructing a mathematical model assumes that even with an unlimited high intensity of the flow of one-step purchase of goods, the impulse area determined by integrals (1) and (2) is equal to the value of the batch of the purchased goods.

The formation of an adaptive system of financial control of an agricultural enterprise should take into account the proportions that determine the ratio between monetary funds and flows of funds of certain periods of its production and sales activities in the short term, which are shown in Fig 3.

The availability of stocks is an essential element in ensuring the normal functioning of any enterprise. The need for stocks of finished products and cash reserves is largely determined by the specifics of manufactured products, the characteristics of consumer demand, and the nature of the production process. Taking into account the specifics of the activities of agricultural enterprises, two states are fundamental for the enterprise.

The first state, which is called the "high" market state, is characterized by smaller, compared with the maximum allowable sales, enterprise capabilities. To optimize the sale of agricultural products, the task of controlling in this case is to establish control over the size of the stock of products and its timely replenishment.

The "low" market is a state when the capabilities of the enterprise exceed the volume of real sales, which are significantly limited by the ratio of the volume of stocks and the speed of their sale:

$$f_{spc}(t) \leq \frac{IG(t)}{T_{IG}} \leq r(t), \quad (3)$$

where T_{IG} is an indicator of the turnover of the stock of goods per unit of time, the rate of turnover (in days); $r(t)$ – the maximum possible value of the intensity of sales flow, which can be achieved in the current market demand.

At point t_1 of Figure 2, the market decreases, and the sales intensity achieved in the past becomes redundant. In this case, the controlling actions should be aimed at implementing one of the two scenarios. According to the first scenario, the received revenue should be immediately directed to replenish the stock, as happened under the conditions of a "high" market. At the same time, the intensity of the product flow, as well as the payment for supplies, should be maintained at the maximum possible level r_1. This variant of events corresponds to the segment [t_1, t_2] in area 2 of Fig. 3.

The second scenario provides for a temporary cessation of supply of products and synchronous payment starting from point t_2. Due to this, there is a decrease in commodity stock. At the same time, the sale of products should reach the maximum possible level r_1. Such control actions are aimed at reducing the stock of goods at the same rate, but only to the value of r_1T_{IG}. The result should be a restriction on the sale of products in accordance with actual demand. The time during which deliveries are suspended, T_k, is calculated by dependencies (4):

$$T_k = \frac{ES}{r_1}, \qquad (4)$$

where ES is the value of excess stock of agricultural products.

In order to maintain the necessary stock of agricultural products, control measures after the resumption of supplies provide for the intensity of sales and supply flows at the level of r_1. It is assumed that before reaching point t_3, the enterprise functions as in the period 1.

On the segment [t_3, t_4], that is, until the end of period 3, the intensity of sales and supply flows, and therefore the value of stocks, remain unchanged. The provision of deferral for the T_k period is reflected in Fig. 3 as a temporary absence on the segment [t_3, t_3+T_k] of payment for supplies. The result is an increase in funds and the simultaneous occurrence of accounts payable. At the same time, the absolute value of accounts payable in this period also varies linearly, reaches a negative value (due to outflow of funds in the absence of an inflow) and numerically equals the amount of increase in the fund of funds of the enterprise.

In accordance with the formation of a new state of an agricultural enterprise on plot 3, it is possible to increase the volume of sources of funds (accounts payable) as a result of obtaining a commodity loan, an increase in assets by the same amount. With an increase in assets and an unchanged level of stock, sales and supplies, it creates the possibility of increasing sales while converting funds into a stock of products. The most acceptable option for controlling actions in this case may be a one-time supply of a batch of agricultural products at the time of t_4. The result of such actions should be to achieve maximum sales, provided that the value of the batch of products is greater than the available amount of funds.

In accordance with the condition (3) there is an increase in sales intensity due to an increase in the level of product stock at point t_4. The task of the control system after the moment t4 is to balance the stock of products by maintaining at the level of increased intensity of the sales flow. Due to the delay in payment of delivery, it is advisable to control the costs of one-step amounts for payment of a batch of products at a time of $t_4 + T_k$. Due to this, the intensity of the flow should reach the level of a new increased intensity of supplies. The control system should ensure that the amount does not exceed the amount of cash at the time of payment $t_4 + T_k$. Accordingly, the maximum possible amount of a batch of products q and the maximum increase in sales are determined. The amount of cash at the time $t_4 + T_k$ consists of the amount corresponding to area 3 and the linear incre capital gain on the segment [t_4, $t_4 + T_k$]. The increase is due to an excess of cash flow over the outflow: the inflow increases as a result of the delivery of the batch and the increase in the stock of products, and the outflow remains in the past, an understated level of plot 3, since during the T_k period deliveries of the previous level of intensity were paid. The intensity of the sales flow on plot 4 is as following:

$$\frac{q + IG(t)}{T_{IG}}, \qquad (5)$$
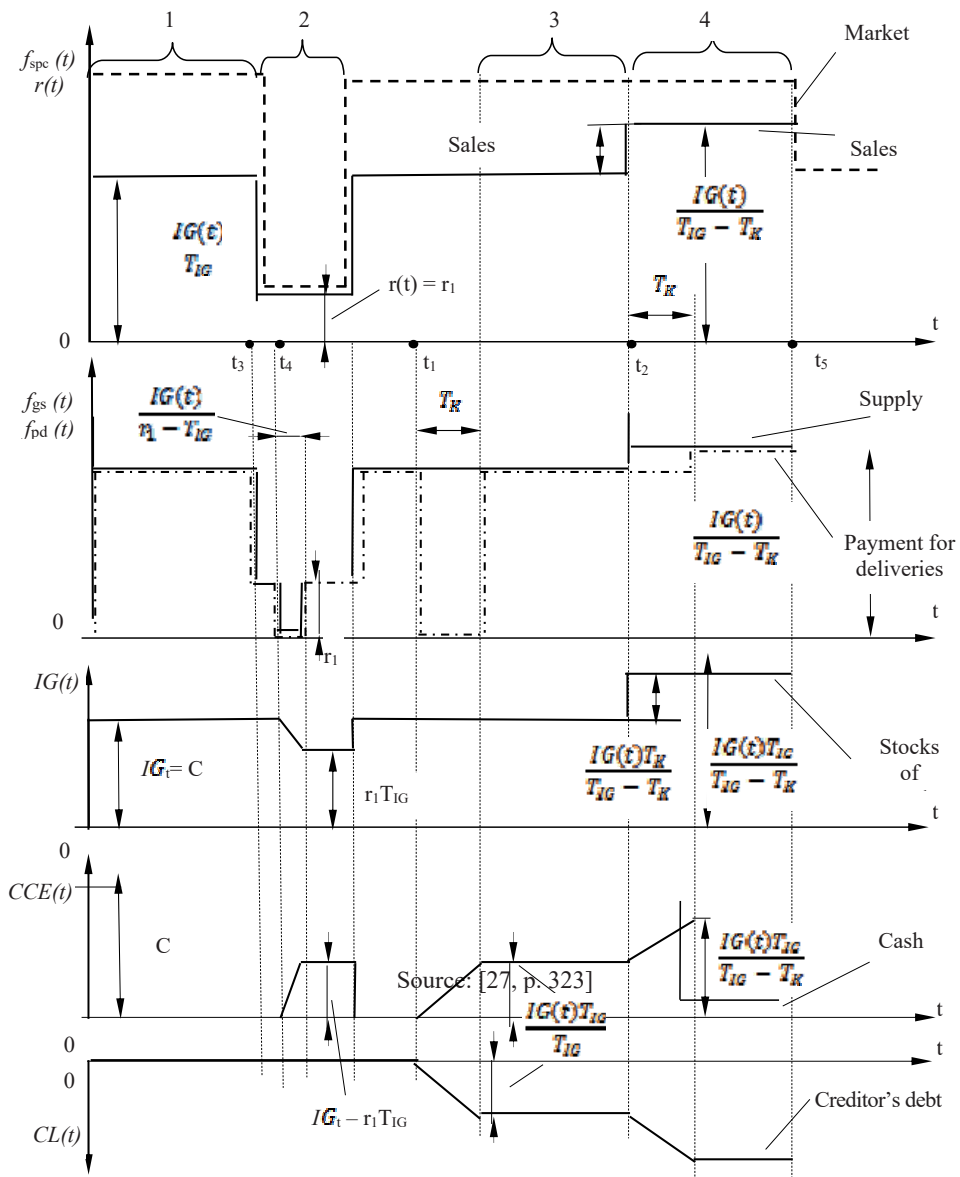
**Fig. 3. Controlling indicators of the company's activity during
the period of market fluctuations in the short-term period**

establishing an increase in funds, defined as the difference between the intensity of sales and the intensity of payment:

$$\frac{q + IG(t)}{T_{IG}} - \frac{IG(t)}{T_{IG}} = \frac{q}{T_{IG}}. \tag{6}$$

The increase in cash on plot 4 during the time of T_K at the rate identified in the previous stages of the calculations is:

$$\frac{q}{T_{IG}} T_K, \tag{7}$$

At the moment t_5 there is a situation that is similar to the situation of a sharp reduction in demand in the case of a "low" market. This means that the latter decreases to a value less than the intensity of sales on plot 4. Inequality (3) is converted to the appearance of $f_{spc}(t) \leq r(t),$ that is, the factor of limiting

sales is determined not by the value of the stock, but by the market.

As a result of the decrease in the market, just near point t_5, sales become equal to the market demand and, at the same time, less than sales and supplies in plot 4. At the same time, payment for supplies remains at the level of deliveries on plot 4, that is, less sales, because payment lags behind the supply. Accordingly, the outflow of funds, in the form of payment, becomes a greater inflow in supply. Given that at the time of t_5 the reserve of money $D(t_5)$ is zero, there is a shortage of funds, there is a threat of insolvency, because supplies cannot be paid on time. The situation of the deficit does not depend on how significantly the market has changed compared to sales in the previous segment 4, since the cash in its draft is exactly 0. Having a certain stockpile of cash in plot 4, which could prevent cash shortages, would not allow to achieve maximum sales. General conclusion: the maximum sales on plot 4 is achieved by the price of an unacceptably high level of threat of bankruptcy, insolvency of the enterprise. These circumstances cause the question of the value of the necessary reserves of funds in plot 4, as well as the introduction of the necessary controlling actions to manage the flow of the enterprise during the transition to the "low" market. The issue cannot be resolved other than by deliberately losing sales on segment 4.

Assuming that the company operates with a certain sales intensity, which is less than the value of $\Delta_1 f_{spc}$ from the maximum possible $T_{IG} - T_K$, it forms a stock of cash due to "underperestance of maximum sales". There is a problem of determining the permissible decrease in sales of $\Delta_2 f_{spc}$ at the time of t_5 (in relation to the maximum possible level $\dfrac{c}{T_{IG}-T_K}$, in order to achieve some new constant level, provided that the stock of funds for this level of sales is maximum.

After the decline in sales, the inflow of funds will decrease, and the outflow in the form of payment for supplies T_K will remain higher. As a result, the stock of funds is evenly reduced to zero.

To fulfill the condition for ensuring the solvency of the enterprise value T_{IG} should vary between 1.5-2.0. Adopting this ratio as a base means:

– first, a decrease in sales is permissible by a value equal to $\left(\dfrac{T_{IG}}{T_K} = 2{,}0\right)$ or is half $\left(\dfrac{T_{IG}}{T_K} = 1{,}5\right)$ output "under perming of maximum sales" $\Delta_2 f_{spc}$;

– secondly, the value of the mentioned "under perming of maximum sales" cannot make up a significant part of the maximum indicator.

As a result, we get a model of control over the financial flows of an agricultural enterprise, taking into account fluctuations in the market situation in the short-term period. The proposed controlling actions must be documented in the form of reports, for further use in the implementation of developed business processes.

Conclusions. Summing up, it should be noted that seasonal fluctuations in case of agricultural products have a significant impact on the intensity of the flow of funds that form indicators of its viability. As a result of the search for a solution to the problem, a mathematical model has been developed that describes the time parameters according to which it is advisable to carry out appropriate control actions to prevent and eliminate the consequences of early reduction of product sales until the expected "fall" of the market.

The proposed model determines the fundamental conditions for the functioning of an agricultural enterprise even under conditions of a sharp seasonal decrease in demand for products while maintaining sales at the maximum possible level during the period of increased demand, making it possible to prevent the phenomenon of shortages of funds, that is, the threat of bankruptcy, during the period of "low" market.

It is planned to further improve the proposed model. In particular, the study should focus on the development of the scope parameters of the model of controlling the financial flows of agricultural enterprises in the conditions of seasonal

market fluctuations. It is also planned to improve the model by developing a methodology for assessing seasonality risk and developing measures to eliminate it to achieve the planned results. In the future, the control process should be supplemented with modules of problem-oriented software packages that implement solutions made on the basis of the implementation of the proposed mathematical apparatus.

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IMPROVING THE SYSTEM OF ADAPTIVE MANAGEMENT OF AGRICULTURAL ENTERPRISES ON THE BASIS OF CONTROLLING

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The article is devoted to solving the problem of improving the efficiency of the adaptive management system of an agricultural enterprise on the basis of controlling. The necessity of introducing a management system aimed at ensuring a phased management of enterprise processes, taking into account the specifics of functioning with a high level of efficiency, flexibility and efficiency, has been substantiated. A retrospective analysis of the formation and development of the control system in industrialized countries has bee carried out. The results of the analysis made it possible to highlight the main concepts of controlling in accordance with their orientation. The peculiarities of the organization of the controlling system at agricultural enterprises of Ukraine in the conditions of seasonal market fluctuations have beenare determined.

Growing crops, unlike the production of products in other industries, has such a feature as seasonality. The seasonal nature of production of agricultural enterprises determines the parameters of the activities of industries that produce and maintain agricultural products, harvest, preserve, process and sell agricultural products.

Seasonal fluctuations have a direct impact on the intensity of the use of financial, material and technical, labor, energy and other types of resources of agricultural enterprises in certain periods of time during the calendar year. Thus, they impede the effective planning of the financial and economic activities of agricultural enterprises. This requires the improvement of the management system of an agricultural enterprise based on controlling to balance financial flows between all links of the agro-industrial complex.

A mathematical model describing time parameters has been presented. Within the framework of the presented model, controlling actions aimed at ensuring the basic conditions for the functioning of an agricultural enterprise and preventing the phenomenon of shortage of funds during the "low" market period have been proposed. The basis for the construction of the model is the structure and objective proportions that determine the ratio between monetary funds and flows of funds of the enterprise of certain periods of its production and sales activities in the short term. The model allows timely detection of problems and making appropriate corrections in management decisions in order to minimize the destabilizing influence of environmental factors and eliminate unwanted deviations. Controlling actions are formed in the form of reports for the purpose of further use in the process of implementing the developed business processes.

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