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Methodological Approach to Forecasting Economic Development of Agrarian Sector in Cherkasy Region

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Abstract

In the process of scheming scenarios for the development of agro-industrial production of the region, the method of scenario analysis was used for certain factors, outlined the possible states in which the main factors may be selected, set many of all possible configurations of states. Since the two most significant factors are identified, according to the formula for calculating the power of the morphological space, it is possible to generate four different configurations of states that are irreconcilable and can be realized in the long run.

Based on the constructed topology, it is revealed that with the implementation of scenario K1, the largest growth of gross regional product (5%) can be achieved provided that such factors as growth of capital investments in agriculture, growth of gross agricultural output, growth of capital investments in food industry are constantly increasing. If capital investment is sufficient to ensure simple reproduction (increase by 15-20%), agricultural output (more than 15%), capital investment in the food industry (more than 10%), then the gross regional product will grow by 2%. The probability of such development is 60%.

The results of the study showed that investments in the volume of not less than 40 percent of the production volume should be attracted to the expanded reproduction in the economy. For the simple one – at the level of 30 percent. This assumption was the basis of the forecast to determine the economic development prospects of the agricultural sector in the region. The information base of the study is the most complete time series of significant indicators of socio-economic development of the Cherkasy region for 2007–2016. It should be noted that the most significant are the free member of the model and the first principal component, with a coefficient of determination equal to 0.85, i.e. the model takes into account 85% of the change in the data. The model has acceptable characteristics: SKP = 0.02, SKV = 0.04, and provides the proper quality of the forecast.

Keywords: *Strategy, Economics, Agrarian Enterprises, Modeling, Foresight.*

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I. INTRODUCTION

The relevance research is that to date, the problems requiring scientifically-grounded solutions to forecast the economic development of the regional agricultural sector, the objective need for comprehension of a complex strategic analysis and the development of relevant strategic decisions determined. The research is especially important while forming the conditions and scenario parameters, and it is a preliminary stage when

potential sources of information are being worked out to create the scenario conditions.

The purpose of this article is to study, analyze and implement the proposed methodology for forecasting of economic development of the agricultural sector of the region's economy, which envisages complementing the existing system of macroeconomic planning and forecasting of the use of predictive modeling, means of intellectual data analysis, methods of system analysis, etc.

Thus, for the development of economic development forecast of the agricultural sector of Cherkasy region it was offered to use the method of scenario analysis, the article outlines possible states, in which the main selected factors may be, and a set of all possible configurations of states was formed. The proposed model has the acceptable characteristics, and provides the proper quality of the forecast. On the basis of the forecast, it is established that in the positive development scenario, the prospects for ensuring a simple reproduction in the agricultural sector of the region's economy are possible in 2026, and for the expanded one – in 2031.

Thus, practical significance allows further research in connection with the new market conditions with a functional need to forecast the economic development of regional strategic management in the agricultural sector in terms of purpose, focus, demand, mode, composition and structure of information. This requires the creation of a more modern advanced information system for regional strategic management in the agricultural sector.

II. LITERATURE REVIEW

The literary review confirms the fact that in Ukraine, forecasting in the field of regional development is at the stage of development and formation. The systemic problems of regional development, the absence of mutually beneficial links between the state and regions, the obsolete methods of state regulation of the development of regions, the violation of economic ties between regions and other economic and regional issues that have not been resolved for a long time, have provided the basis for finding the latest innovative methods of forecasting by regions in order to give them incentives for active self-development and rational use of available potential. Building a new economic form of forecasting in the state, which will give all regions of Ukraine, in particular local self-government, much more rights and powers, will lead to the regions becoming the real subjects of economic relations and will play an increasingly important role in socio-economic development of society.

New economic conditions forced the researchers L. Tranchenko (2015), R..Kozhukhivska, N. Parubok (2017), A. N. Marjuta, N. Y. Redyna, Ju. A. Dolghorukov.(2005), and yje practitioners P.I, Bidiuk, O.M. Terentiev, T.I Prosiankina-Zharova, V.V. Efendiiev (2017), V.S. Ponomarenko, S. V. Mukhin, O.M. Besedovsjkyj (2005) in our country to search for adequate forms, methods and tools of forecasting in the region, in particular, they tried to apply the principles and methods of strategic management, to implement adaptation to regional systems on the experience of foreign countries at the enterprise level. Thus, a direct analogy between the regional socio-economic and economic systems, which a corporation (firm) is, is hard to conduct, but the study of foreign theory and methodology of strategic management and forecasting is necessary for the development of a domestic concept of economic development and adaptive methodological work at the level of regional research.

In the studies of foreign: K. R. Thomson (1990), K. J. Hatten (1988), J. M. Higgins (1983), G.D. Smith (1988,) D. R. Arnold, B. G. Bizzel (1988) and domestic authors S.O. Dovhyi, P.I. Bidiuk, O.M. Trofymchuk, O.I. Savenkov (2011) a great attention is paid to the forecasting of economic development, where it is mainly considered as one of the fundamental stages of strategic planning. However, the methodological basis for conducting strategic analysis is mainly developed for enterprises (firms). Therefore, the problem of economic development

forecasting of a regional socio-economic system requires its solution, both methodologically and methodically.

Some theoretical and practical aspects of forecasting of economic development of the regional agricultural sector were reflected in the work of such scientists as V.S. Ponomarenko, S.V. Mukhin, O.M. Besedovskyi (2005), A.N. Mariuta, N.I. Redyna, Yu.A. Dolhorukov (2005), M.Z. Shvydenko, (2013), O. M. Tranchenko (2013) and representatives of public authorities. The general idea is that in Ukraine there should be a modern system of state regulation of the regional economic development forecasting, based on the decentralization of power and financial resources. These allegations are based largely on the experience of countries with a developed market economy, where the indirect mechanisms of central government influence on the development of the economy of individual territories are used extensively.

The problems requiring scientifically-grounded solutions to forecast the economic development of the regional agricultural sector, the objective need for comprehension of a complex strategic analysis and the development of relevant strategic decisions determined the choice of topic and the purpose of the study.

III. RESEARCH METHODOLOGY

The theoretical and methodological foundations of the study were the text analysis tools, in particular textmining, which allowed us to confirm the assumption that a significant place in the economy belongs to holdings and other integrated production structures, which performance in the region is difficult to estimate using only statistical data. After all, the results of economic activity of integrated structures of different types, the synergistic effect of cooperation and integration of enterprises of various spheres of the agricultural sector significantly affect the formation of the sectoral structure, the efficiency of the economy functioning of the districts and cities of the region.

To solve this problem, a method of multicriterial two-level analysis was used, which special feature is that in the first level mainly qualitative characteristics are used, and in the second level the quantitative ones. When creating relevant search queries, appropriate alternatives have been generated and grouped according to the levels of analysis. In the case when different experts participate in the development of the strategy in the process of selection of alternatives, the set of alternatives can vary considerably, therefore, to reduce the human factor's influence in the process of selecting alternatives, the text body analysis used is used and SAS TextualAnalyticsSuit. The comparison of alternatives has been done using the hierarchy analysis method, according to the rating scale developed and agreed by the experts. For further use in the process of scenario development, the alternatives were selected according to the criterion of the maximum value of the mathematical expectation and the minimum standard deviation.

Analysis of the dynamics and complexity of the external environment is fundamentally important in the choice of research methods. It is obvious that with the growth of dynamics and complexity the role of formal methods of forecasting decreases and the value of informal expert assessments and forecasts increases. The first and most important element of the analysis of the general environment is the analysis of the economic environment, which includes forecasts of changes in the economy, expressed in terms of inflation, employment rates, business activity cycles, money circulation, etc. Dominant is the gross national product.

Using SWOT analysis, you can identify, on the one hand, your own strengths and weaknesses (internal environment), and on the other – to identify the opportunities and threats that exist in the external environment. At the next stage, the classification of strengths and weaknesses is carried out for those that are best implemented taking into account existing external capabilities and those that need to be strengthened and cease to be strong, taking into

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account the external threats. The main task of strategic analysis is to find the strengths that ensure the uniqueness of competitive advantages, taking into account the enabling environments.

The information obtained during the strategic analysis process is used to determine the so-called "growth stages" of the region. The growth can be a branch, an enterprise, a project that can meet the growing need and can initiate the long-term development of regional infrastructure (roads, telecommunications and communications), related industries and small businesses, provide additional revenues to the budget, create new jobs.

IV. RESULTS

The region's economy has a well-established structure, which is a central component of agriculture. The current set of data describing the development of agricultural production contains 42 variables. The xorrelation and regression analysis showed that 23 of them are the most significant: x01 (financial result before taxation, million UAH), x02 (capital investments in agriculture, forestry and fisheries, thousand UAH), x03 (financial result of industry, thousand UAH), x06 (number of agricultural enterprises, units), x17 (gross agricultural output at prices in 2010, million UAH), x19 (indices of gross agricultural output, percentages to the previous year), x20 (gross output of plant growing, million UAH), x21 (profitability level of agricultural production of agricultural enterprises, %), x22 (area of agricultural lands used by agricultural enterprises and households, thousand hectares), x23 (relative share of the region in the production of grain and leguminous plants, percent), x24 (relative share of the region in sugar beet production, percent), x25 (gross agricultural output at actual prices, million UAH), x26 (cattle population, heads), x27 (cow population, heads), x28 (pig population, heads), x29 (poultry population, heads), x30 (relative share of the region in meat production, percent), x31 (relative share of the region in milk production, percent), x32 (capital investments in actual prices, thousand UAH), x33 (capital investment per capita, UAH), x35 (import-export coverage ratio), x36 (foreign direct investment per capita, USD), x38 (number of rural population, thousand), x41 (workload, persons), x42 (average monthly nominal salary).

Using the principal components method, the space of input variables was reduced, which, as the study showed, can be represented as a 7-dimensional basis, will take into account 89% of the variability of the input variables. The graph of variance in the values of the main components is shown in (Fig. 1).

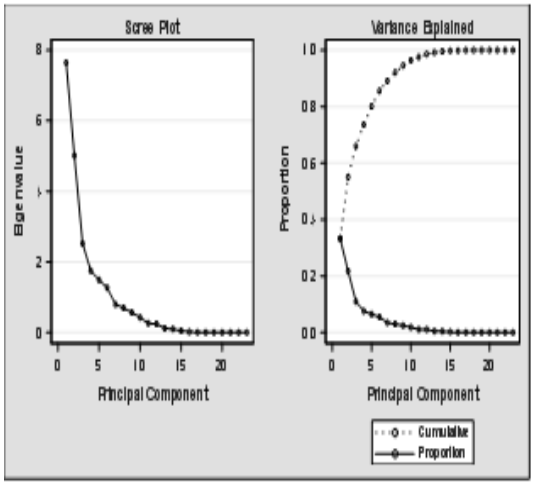

Figure 1. Graph of the values of the principal components change*

Source: author's development

The main factor loading falls on two principal components (Fig. 2).

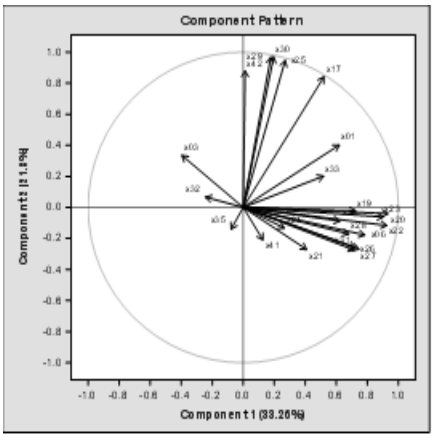

Figure 2. Graph of factor loadings for 1 and 2 principal variables *

Source: author's development

Thus, most of the input variable-regressors of analysis is described by the first two principal components, and in some cases, they almost completely coincide (x19, x23, x20, x22) with the first principal component and (x06, x29, x42, x30, x25, x26, x27, x28, x30), with the second component.

For grouping the districts of the region, not statistical groupings but cluster analysis is used, which allows taking into account a greater number of grouping features. In order to determine the optimal number of clusters, the Ward method was used to overcome the number of clusters from 2 to 50. By the CCC criterion (cubic clustering criterion) the value of which for the data analysis is closer to 3 (the most optimal value of the CCC functional), it is determined that the optimal number of clusters is 4. That is, the method of automatically determining the optimal number of clusters suggests grouping the regions into 4 segments. Then, based on the k-means method, the clustering of the districts and cities of the region was completed in 4 clusters. Segmentation is performed by means of SAS EnterpriseGuide 7.1 and the SAS EnterpriseMiner14.1 data mining platform.

It should be noted that, as shown by cluster analysis in Cherkasy region, there are two groups of territorially close districts that can be considered as production clusters. The first group of districts: Zolotoniskyi, Drabivskyi, Chornobaivskyi districts and the second one: Umanskyi, Mankivskyi, Zhashkivskyi districts. The districts in these groups have similar production specialization in agriculture and production relations. That is, when developing a strategy for the agricultural sector in the region, it is necessary to take into account these features.

Therefore, by performing a preliminary data analysis, as foreseen by the first stages of forsight research, it is necessary to carry out a more detailed analysis of the system and means of qualitative analysis, traditional for economic analysis, and using methods such as expert conclusions, econometric methods, Group Method of Data Handling, neural networks, probabilistic modeling, hierarchy analysis method, and more.

Despite the existence of a sufficiently elaborate set of techniques, mathematical models for forecasting the development of economic processes are still used in the economy quite limited. This is due to the lack of skills of the specialists-economists of using the mathematical apparatus, as well as the peculiarity of information provision for forecasting the development of agro-industrial production in the future. As for many other spheres of the economy, it is characterized by the absence of long time series of statistical characteristics of these processes. When developing the mathematical models, there is a problem of predictive modeling on short data sets, known as “the curse of dimensionality”.

Therefore, when forecasting the indices of agricultural production development, statistical parameters and methods for preliminary selection of the most significant variables of the process, such as the R-squared criterion, p-value, xi-squared, the value of mutual information for the vertices of the Bayesian networks, methods for reducing the dimension on the basis of the transformation by the principal components method and their various modifications are used.

Due to the large dimensionality of the problem, the principal components method was used at the stage of the previous analysis to reduce the dimension of the variable space. For further analysis of the factors influencing the development of the agricultural sector and for predictive modeling, adaptive modeling using the Bayesian network and regression analysis was used.

The study was carried out as follows. At the first stage, the topology of the Bayesian network is developed to identify the cause-and-effect relationships between the variables and the strength of these relationships. During this stage the deviations between the current and the previous

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values for all variables are calculated. This is done in order to get rid of the trend component in the variables, since this operation is in a rough approximation equivalent to finding the first derivative. Further, the deviations found are converted into nominal variables due to the use of quantile transformation. The quantitative transformation is chosen as the most effective and robust to the quasipolar analysis values. For this task four quantiles were given. Next, the topology of the Bayesian network with the settings is built. The technological scheme of the process is shown in (Fig. 3).

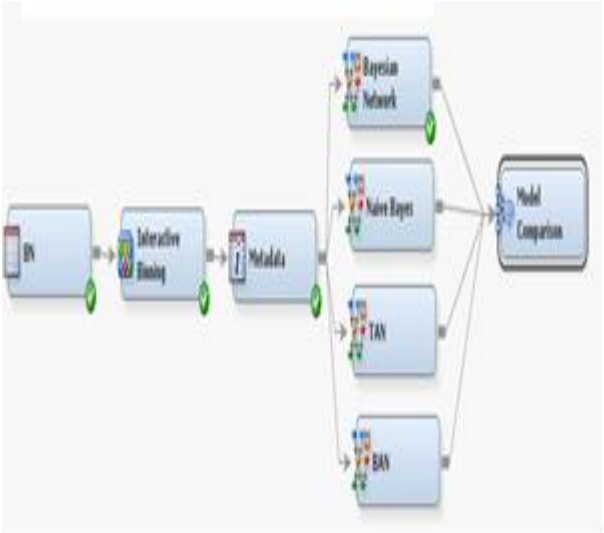

Figure 3. Technological scheme of the process of construction of probabilistic models using the components of High Performance Bayes Net

Source: author's development

Based on the developed topology of the Bayesian network, the most significant variables affecting the target one are determined. The production of gross agricultural products as the most relevant in terms of economic conformity of trends determining in the region was selected as the target variable. After that, a multiple regression equation with forced inclusion of the detected variables in the model is developed.

To build the topology of the Bayesian network, developed to model the scenarios belonging to the corresponding segment, the GeNIe 2.0 software with the following settings was used: the methods Greedy Thick Thinning, PC, Naive; the maximum number of ancestors - from 5 to 8; optimization criterion – minimal entropy.

The model parameters estimation is made on the basis of the recursive least squares method.

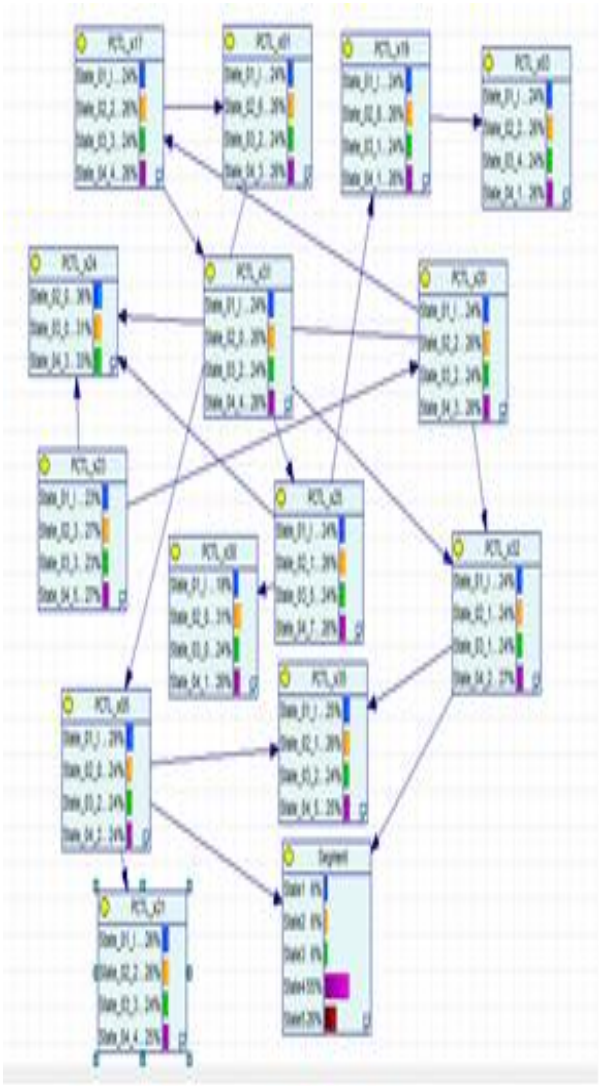

Figure 4. Topology of the Bayesian network developed for modeling scenarios of belonging to the corresponding segment (fragment)

Source: author's development

As can be seen from the given topology of the Bayesian network, the variables X05 (profitability level of operating activity, %) and x32 (capital investments in actual prices, thousand UAH), are primarily affected by the region's belonging to the corresponding segment. If necessary, a more sophisticated approach (Table 1), based on the

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Greedy Thick Thinning method, can be applied, also implemented in the GeNIe 2.0 software. Its application provides better predictive characteristics, compared with the application of the naive Bayesian network.

Table 1. Comparison of the statistical characteristics of the test sample of Bayes networks constructed by different methods in the system

The name of the model	Percentage of incorrectly classified observations	ROC index	GINI Coefficient
Greedy Thick Thinning	20,1	0,81	0,62
PC	22,3	0,75	0,5
Naïve	21,5	0,77	0,54

Source: author's development

In order to sample the numerical variables in relation to regressors, the procedure of quantile transformation into groups was applied. As a result of probabilistic simulation, it has been discovered that the most probable transformation in the sectoral structure of the agricultural sector of Cherkasy region is the formation of production clusters around the cities Cherkasy and Kaniv.

It is also established that the most significant for the further development of agricultural production is the creation of conditions for profitable activity of agricultural enterprises and ensuring the inflow of investments into the regional economy. It should be noted that as a result of predictive modeling, for the agricultural sector of the regional economy, inflow of capital investments yields a significant return, but for a long period to be taken into account when constructing the relevant strategy.

The analysis of the factors influencing the development of the agricultural sector of the region, carried out by the expert estimation method, allowed to reveal also qualitative characteristics that will have a significant effect on it over a long period of time. Such factors are the optimization of the regional level of public administration and the synergistic effect from the integrated agro-industrial formations. Regarding the change in these factors in perspective, there is a significant uncertainty, though, due to the use of probabilistic modeling, one can predict that they can be in two states: the volumes of investments directed to agro-industrial production may be sufficient for reproduction or insufficient; profitability of agricultural production of formation of effective integrated formations in agroindustrial production.

In the process of developing scenarios for the development of agro-industrial production in the region, the method of scenario analysis has been used for the determined factors, the possible states in which the selected principal factors may be, the set of all possible configurations of states is formed. Since two of the most significant factors have been identified, according to the formula for calculating the capacity of the morphological space, four different configurations of states can be generated, which are non-contradictory and can be implemented in the long-term perspective. Possible configurations of the space of factors that form the corresponding scenarios are given in Table 2.

Table 2. Configuration of the space of factors that form the relevant scenarios for the development of investment activities in agro-industrial production*

Scenario	Scenario content
K1 Efficient functioning of agricultural enterprises, optimal investment support	Investment resources involved in the region's economy provide enhanced reproduction, strategic management decisions are made in the region, agricultural production is cost-effective, decentralization is implemented.
K2 Insufficient investment resources for expanded reproduction, efficient functioning of agricultural enterprises	The volume of funds directed to agricultural production is sufficient for reproduction, most of agrarian enterprises are profitable, decentralization is implemented

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K3 Diversification of resources	The volumes of investments, directed at agro-industrial production, are insufficient for reproduction, agricultural enterprises use only their own resources
K4 Centralization of all resources	There are no funds for engaging in agro-industrial production, investments are insufficient for reproduction, strategic management is fully centralized

* Built by the author on the basis of a literary source [16]

The method of expert evaluations was used to determine the influence of the configurations of the factors of the agricultural sector development in the region on the revealed factors. The degree of influence on the factors that have the greatest influence on the development of agro-industrial production is determined according to the scale that verbally characterizes the degree of factors influence. The scale looks like [-3;-2;-1;0;1;2;3]. The values on the scale correspond to the characteristics of the impact: -3 – significant negative impact, -2 – strong negative impact, -1 – slight negative impact, 0 – no affect, 1 – weak positive effect, 2 – positive effect, 3 – significant positive impact. The results of the study of the influence on key factors are given in Table 3.

Table 3. Assessment of the impact on the key factors of strategic development of the agricultural sector of the region *

Factors	Configurations			
	K_1	K_2	K_3	K_4
Demographic loading	-1	0	-2	-3
Labor compensationin agriculture	1	1	1	0
Profitability of operating activities of agricultural enterprises	3	2	3	1
Cargo turnover of motor transport enterprises	-1	-2	-2	-3
Volume of direct foreign investments	3	2	3	1
Volume of capital investments	2	1	3	1

* Source: author's development

The developed configuration for the development of agro-industrial production in the region is: {K1: -1,1,3, -1,3,2}, {K2: 0,1,2, -2,1}, {K3: -2,1,3 , -2.3.3}, {K4: -3.0.1, -3.1.1}. The following scenarios for the development of agro-industrial production in Cherkasy region have been received under the influence of certain factors.

K1 – (Effective functioning of agricultural enterprises, optimal investment provision) – the volume of investments directed to agricultural production is sufficient for reproduction, strategic management of the economy is effective, powers are distributed proportional, the decentralization is implemented in full, regional level of economic management has the authority to ensure the autonomy of strategic management decision making. This scenario involves the receipt of investment resources in agro-industrial production (including foreign direct investment) in the amounts sufficient to provide expanded reproduction. The filling of local budgets will ensure their financial autonomy, local self-government bodies will encourage investment in agricultural production. The majority of agricultural enterprises will be profitable. In agro-industrial production the integration processes will continue. The scenario can be considered as stable, because the own funds of enterprises and the effect of cooperation in the agricultural sector will ensure the development of the economy of the region.

K2 – (investment resources are sufficient for reproduction, efficient functioning of agricultural enterprises), the volume of investments directed to agro-industrial production is sufficient for simple reproduction, decentralization is implemented only partially. Under this scenario it is anticipated that agricultural production will be provided with investment resources, the work of most agricultural enterprises will be profitable, the filling of local budgets will be limited, they will require state transfers, the investment climate will be favorable, the volume of foreign investment will increase, but

there is a risk of lowering the revenue part of local budgets for The expense of social protection, strategic management of the economy continues to current trends. This scenario is realistic in view of the current trends.

K3 – (diversification of resources), the volumes of investments directed to agro-industrial production in the region are not sufficient for reproduction,regional level of economic management involves realization of autonomy in strategic decision making. This scenario assumes that the investment support will remain practically at the existing level, but decentralization reforms are actively being implemented, the autonomy of local self-government is provided. Under this scenario it is anticipated that investment resources will suffice for simple reproduction, business entities with the support of local governments and the state will intensify their activity on attraction of external investments and optimization of use of internal investment resources at the level of regions and enterprises.

K4 – (centralization of resources), the volume of investments directed to agro-industrial production is not sufficient for reproduction, strategic management of the agro-industrial production development in the region is concentrated at the level of the ministry. Under this scenario the investment resources attracted to the agricultural sector of the region will not be restored, strategic management will be implemented at the national level, budget funding will be limited, the autonomy of local budgets will be low, the overall investment attractiveness of the agricultural sector of the region will be reduced, as strategic decisions will be exclusively the responsibility of of the national level of management.

To assess the validity of this statement and outline ways to optimize the investment environment in the region, the trends of ensuring reproduction in the economy and agribusiness in Cherkasy region are analyzed. To estimate the probability of implementing the proposed scenarios, probabilistic models are developed in the form of a Bayesian network. A set of the most significant factors selected at the preliminary stage of the study was used.

On the basis of the developed topology, it was discovered that the implementation of scenario K1 of the largest increase of the gross regional product (5%) can be achieved with the growth of such factors as the volume of capital investments in agriculture (more than 36%), the growth of gross agricultural output (more than 30%), the growth of the volume of capital investment in the food industry (more than 50%). The likelihood of implementing such a scenario is rather low – 10%. If the volume of capital investments will be sufficient to ensure simple reproduction (increase by 15-20%), the volume of agricultural products (more than 15%), the volume of capital investments in the food industry (more than 10%), then the gross regional product will increase by 2%. The probability of such scenario realization is 60%.

In order to determine the strategic prospects for the agricultural sector development in the region's economy, under the realistic scenario of development, the ratio of investments (capital investments) and gross agricultural products to the long-term and medium-term perspective is projected. It is known that in order to ensure the extended reproduction in the economy, it is necessary to attract investments in volume not less than 40 percent of the volume of production. For a simple one – at the level of 30 percent. This assumption was the basis for the forecast for determining the prospects for economic development of the agricultural sector of the region. The information base of the research is the most complete time series of significant indicators of socio-economic development of Cherkasy region for 2007-2016 [1].

According to the specified parameters, the orthonormal base space consisting of two principal

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components using the principal components method. was calculated. The first principal component is formed of such components as the unemployment rate, % (x3), personal income, UAH mln (x5), wages in agriculture, UAH (x6), wages in industry, UAH (x7), share of capital investments to agriculture, percent of total volume (x10), share of capital investments to industry, percent of total volume (x11), volume of industrial products sold, UAH mln (x12), industrial production sold per capita, UAH (x13), volume of agricultural products produced at agricultural enterprises, UAH mln (x14), labor productivity at agricultural enterprises for 1 employed in agriculture, UAH (x17), gross regional product per person, UAH (x26), gross value added in agriculture in actual prices, UAH mln (x27), gross value added of processing industry, UAH mln. (x29).

The principal component is formed on the basis of the influence of regressors: the capital investments, total, thsousand UAH (x1), workloading, persons (x2), production of agricultural products per person UAH (x15), average carrying distance of one ton of goods by road, km (x19), consumer price index, % (x20), goods exports mln USD (x21), foreign direct investment, mln USD (x23), foreign direct investment per capita, USD (x24). The model used to forecast the reproduction of the agricultural sector, has the form of formula (1):

$$Y = 0.12536 + 0.01515 * Z1 + 0.01471 * Z2 \quad (1)$$

where Y is the ratio of capital investments and gross agricultural output; Z1 is the first principal component, which is described by the formula: Z1= 0,19 * x03+0,26 * x05 + 0,26 *x06 + 0,26 *x07+0,24 * x10 -0,21 * x11 +0,26 * x12 +0,26 * x13+0,24 * x14 + 0,24 * x17 + 0,27 * x26 – 0,26 * x27 +025*x29; Z2 is the second principal component, which is described by the formula:Z2=

= -0,35 * x01+0,22 * x04+0,23 * x16+ 0,3 *x19 + 0,42 *x20+0,31 * x21+0,29 * x23 +0,27 * x24.

Table 4. Comparison of results of forecasting the ratio of investments and gross agricultural output *

Year	Correlation:		Deviation from predicted values, + -
	under the calculation	predicted	
2007	26,512	24,642	1,87
2008	23,142	20,596	2,546
2009	14,821	16,693	-1,872
2010	9,844	14,079	-4,235
2011	9,345	10,563	-1,218
2012	9,526	9,841	-0,315
2013	8,625	5,695	2,93
2014	6,772	8,661	-1,889
2015	7,094	8,743	-1,649
2016	9,677	5,846	3,831
2017		10,8	
2018		11,9	
2019		13,1	
2020		14,9	
2021		17,1	
2022		19,4	
2023		21,4	
2024		23,8	
2025		26,2	
2026		30,1	
2027		31,3	
2028		33,4	
2029		35,1	
2030		37,8	
2031		40,1	

* Source: author's development

It should be noted that the most important are the free member of the model and the first principal component, with the determination coefficient being equal to 0.85, that is, the model takes into account 85% of the data change. The model has acceptable characteristics: СКП=0,02, СКВ=0,04, and provides the proper quality of the forecast. Based on the forecast it is established that under the positive development scenario, the prospects of ensuring a simple reproduction in the agricultural sector of the region's economy are possible in 2026, and under the expanded one –in 2031.

V. CONCLUSION

Proven the forsight approach provides an opportunity to outline the prospects for the long-term forecast, take into account the impact of various groups of economic factors, rationally elaborate the research and predict the results specification of the forecast. The existing methodology for forecasting the regional development strategies is not directed to the conditions where there are difficult predictable structural changes, therefore, attempts to qualitatively describe the behavior of the system in the long run by a simple increase in the indicators relative to the previous period, doomed to failure. In addition, it is important to identify the tendency of the agricultural sector to undergo structural transformations, including the formation of integrated production units of various types, as one way to reduce transaction costs in agriculture, to accelerate the circulation of money in the agro-industrial complex and to ensure the active and balanced use of domestic investment resources enterprises.

The scale of analysis allowed to give in this article only the results of own research. In order to assess the probability of implementation of the proposed scenarios it was proposed, to use a model in the form of a Bayesian network, used during the implementation of the forsight process cycle. It is proved that the foresight approach gives an opportunity to outline the prospects for the long-term forecast, to take into account the influence of different groups of economic factors, rationally elaborate the research and predict the refinement of the results of the forecast. A set of the most significant factors selected at the preliminary stage of the study was used. On the basis of the developed topology, it was found that implementation of the K1 scenario of the largest growth of the gross regional product (5%) can be achieved with the growth of such factors as the volume of capital investments in agriculture (more than 36%), the growth of gross agricultural output (more than 30%), growth of capital investments volumes in the food industry (more than 50%). The probability of implementing such a scenario is rather low – 10%. If the volume of capital investments will be sufficient to ensure a simple reproduction (increase by 15-20%), the volume of agricultural products (more than 15%), the volume of capital investment in the food industry (more than 10%), then the gross regional product will increase by 2%. The probability of such a development is 60%.

According to the above mentioned indicators, using the principal components method, the orthonormal base space, consisting of two main components, was calculated. It should be noted that the most important are the free member of the model and the first principal component, with the determination coefficient equal to 0.85, that is, the model takes into account 85% of the data change. The model has acceptable characteristics: SCP = 0.02, SKV = 0.04, and ensures proper quality of the forecast. On the basis of the forecast, it is established that under the positive development scenario, the prospects for ensuring a simple reproduction in the agricultural sector of the region's economy are possible in 2026, and for the expanded one – in 2031.

It is impossible to solve this task only by means of economic analysis. However, the definition of the general prospects for the implementation of an extended and simple reproduction of the economy and its sectors and industries for the future through

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the use of modern tools of predictive modeling, as the study showed, provides satisfactory results and is scientifically substantiated. According to the results of the study, it has been established that forecasting of the economic development of agro-industrial production should be carried out on the basis of rational and purposeful use of methodological approaches, which provide for the addition of elements of system and multidimensional data analysis, artificial intelligence and data-mining. This allows us to determine not only prospective development opportunities, but also to reduce the negative impacts of risk factors, in particular those related to inefficient state administration and local self-government, increased international and domestic competition, political crises, etc.

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