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Formation of Environmental Food Potential of Sumy Region of Ukraine Based on Logistic Management

Margarita Lyshenko*[1], Nataliia Makarenko [2], Valentina Mushtai [3], Victoria Makarova [4], Inna Kharchenko[5],

[1,2,3,4,5] *Department of Marketing Marketing and Logistics,*
[5] *Department of Forensic Law and Ukrainian Studies*
Sumy National Agrarian University, 160, H. Kondratiiev St., Sumy, (Ukraine);
E-mail : * lm_1980@ukr.net, margarita.lyshenko@snau.edu.ua
nmakar165@ukr.net, nataliia.makarenko@snau.edu.ua
vamushtai@gmail.com, valentina.mushtai@snau.edu.ua
victoria.makarova24@ukr.net, victoria.makarova@snau.edu.ua
kharchenko-inna@ukr.net , inna.kharchenko@snau.edu.ua

Abstract

In Ukraine, the problem of providing food to the population is particularly acute today. Because of the decline in the food supply potential of the agro industrial complex, there was a fall in production and a decrease in the quality of agricultural products. This situation has led to the fact that imported agricultural products are gradually displacing domestic products from the market, which leads to higher prices and a shortage of high quality products.

One of the main reasons that impedes the proper functioning of the market is the problem of managing food flows in the sales area. In this situation, there is a certain threat to food security in the regional market, so to meet the needs of the population in food products it is necessary to form a methodology for studying the regional food market based on the principles of logistical management of food flows. At the same time, the external environment of agricultural producers is becoming more dynamic, uncertain and complex, requiring a high level of adaptation and stability of the formed flow control systems. That is why the current practice of flow management in agricultural enterprises characterized by an intensive transition from coordination of individual logistics functions or operations to integrated management of logistics business processes, as well as ensures the development of production and logistics management in the direction of concentration and increase the value chain of agribusiness products.

The purpose of the article. Formation of methodological bases for the search for innovative models of formation and management of food potential, which will allow to carry out a thorough assessment of the ability of enterprises in the market for their innovative development when applying a logistic approach to flow management, which is an important condition for achieving sustainable competitiveness of the agricultural industry.

Results. The achievement of food security requires the formulation, planning and implementation of food policies that ensure the adequacy and stability of food supply. Nevertheless, the most serious changes occur with a further decline in income levels - the abandonment of staple foods, replacing them in the diet with cheaper and less nutritious foods. This raises the problem of making foods that would be available both physically and economically, i.e. products of the same quality, but cheaper. In this regard, the task was proposed to optimize the structure of the acreage to achieve food security for the region. This task was solved in two stages. In the first stage, based on the actual crop yield, the model of crop structure of Sumy region was optimized to provide the population with the last necessary minimum food. In the second stage, based on the interests of the region, managerial logistical decisions are made on the structure of the crops grown, taking into account their yields for each region. Calculations of additional funds released are being proposed for purchase of other types of food. This model reflects the way in which existing cultivated areas are distributed to reach the area's food supply.

The implementation of this model makes it possible to claim that in such a survey the regions are able to provide themselves with food and even create their overproduction, which will allow them to obtain additional

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funds for the purchase of other types of food.
Conclusion. The results of the study indicate that the food market is a key market that affects the quality and standard of living of the population, as well as the self-sufficiency of the region. This is because food markets are one of the primary human needs - the need for food. Managerial logistical decisions to optimize the structure of cultivated crops have made it possible to calculate the additional released funds that are proposed to be channeled to other types of food in the context of predicting internal and external threats to food security. The proposed methodology for exploring the potential of the regional food market by applying a logistic approach will increase its efficiency and help meet the external needs of consumers and the internal needs of agricultural production with the necessary intensity and the lowest possible logistical costs, based on the interests of the region. At the same time, the basic principles of logistical management were formed in the context of formation of the food potential of the region, namely support to the process of ensuring the satisfaction of external needs of consumers in finished agro-production, internal production needs in the resources of industrial and agricultural origin; required intensity of biological, material and other flows and formation of optimal logistics costs.
Key words: *food potential; food safety, food streams; crop capacity; crop area; price; costs; food; gross income; Sumy region; agricultural production; logistics chain; logistics management.*
JEL Classification: *C53; M11; O13; Q18.*

Introduction

Analysis of the latest studies and publications. The problem of creating the food potential of the region has been researched by many scholars as before and today. It is important to mention V.M. Mikityuk and O.V. Skidan (2005) [1], O.O. Zelenska (2012) [2], O.M. Volnova (2010) [3] among researchers who investigated the factors that influence the formation of food potential in the region and highlighted the production and logistics components. O.V. Zhemoyda and S.M. Kvasha (2012) [4] believes that the main indicator of food supply is the level of satisfaction of the physiological needs of the population, which depends on the physical and economic availability of food products for various social strata of the population. In addition, in their opinion, the main source of guarantee of physical availability of food is the agro-industrial complex. Moreover, such authors as O.L. Popova (2009) [5] and O.V. Klimenko [6] considers in detail the problems of agro-industrial production.

According to such authors as M.V. Prisyazhnyuk, M.V. Zubets and P.T. Sabluk (2017) [7] the formation of the food potential of the region depends on the ability of self-sufficiency of food, and therefore the most informative is the indicator of the share of own grocery production in consumption, the limit value of which should be 75-80%. M.A. Lisak and V.I. Vlasov (2009) [8] identified a list of indicators that have the greatest impact on the formation of food potential in the regions, namely indicators of average prices, energy consumption, productivity of products. M.M. Odintsov [9], in assessing food security, uses indicators such as the purchasing power index of household income; the share of expenditure on food in the structure of expenditures; the ratio of consumption of expensive and cheap food; share of population with per capita income, lower living wage; calorie consumption and consumer price index for food products. O.R. Kondra (2014) [10] identifies the following four main indicators: human rationality of the main types of products, economic availability of products, capacity of the internal market of individual products, food independence of a particular product.

Many scientists have done extensive research on the design and maintenance of food security around the world. In particular, Berlina A. highlighted the problems of food security through the example Baltic Sea Region [11].

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Carl H. Fulda described the advantages and disadvantages of food distribution in the United States [12]. Gale F. analysed the features of agrarian policy and issues of food legislation in China [13]. Clark F. L. researched the directions of food policy and norm of consumption of food on example of Great Britain [14].

A number of researchers are considering food security issues in conjunction with the ever-growing population. Among scientists, it is possible to distinguish scientific works Von Engeln O. D. [15], AM K. [16], Russell E. J. [17], Bennett M. K. [18], Bender A. E. [19]. The gradual restriction of the production of unhealthy food and thus the enhancement of the environmental and social orientation of agriculture is explored in publications Gunther F. A., Jeppson L. R. [20], Taylor A. E. [21], Forbes E. B. [22]. In turn, Page H. J. focused on the optimal use of fertilizers [23].

The development of a regional food security system is impossible without state support, without creating the conditions for the development of all economic modes and forms of ownership, since the food security system that shapes the region's food security is the prerogative of the state. This is emphasized in researches of Harry G.C. [24], Kellogg C. E. [25], Boyd-Orr, L. J. [26], and Schoening H. W. [27].

O.M. Volnova (2010) [3] points out that the general concept of production and distribution system management is based on a logistic approach, but does not give precise meaning to this concept. L.V. Zaburanna and O.M. Glushchenko (2013) [28] consider the functioning of logistics management in view of the combination of internal and external functioning of the region for its further effective activity. Positive experience of using logistic approach in managing the country's food security is reflected in post-war publications of Leighton R. M., Coakley, R. W. [29] and Eccles H. E. [30]. In turn, in the publications of modern scientists Wilson W.W., Dahl B.L. [31], Wallenburg C.M. [32], Wang Shufeng W., Liya, M. & Wei, W [33] disclosed components of agricultural logistics and innovative services in agriculture.

Selection of previously unsettled parts of the general problem. In Ukraine, the problem of providing food to the population is particularly acute today. Because of the decline in the food supply potential of the agro industrial complex, there was a fall in production and a decrease in the quality of agricultural products. This situation has led to the fact that imported agricultural products are gradually displacing domestic products from the market, which leads to higher prices and a shortage of high quality products.

One of the main reasons that impedes the proper functioning of the market is the problem of managing food flows in the sales area. Much of the agricultural industry is having trouble in this area, as there are widespread online shops in the regions, which are limited by barriers to access to agricultural businesses. In such circumstances, it is difficult for agricultural enterprises to expand production, improve product quality, expand the range, and increase volumes. As a result, the shortage of domestic food products is offset by imported goods, whose share in the domestic food market is increasing every year.

In this situation, there is a certain threat to food security in the regional market, so to meet the needs of the population in food products it is necessary to form a methodology for studying the regional food market based on the principles of logistical management of food flows. At the same time, the external environment of agricultural producers is becoming more dynamic, uncertain and complex, requiring a high level of adaptation and stability of the formed flow control systems. That is why the current practice of flow management in agricultural enterprises characterized by an intensive transition from coordination of individual logistics functions or operations to integrated management of logistics business processes, as well as ensures the development of production and logistics management in the direction of concentration and increasing the value

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chain of agricultural products.

The purpose

Formation of methodological bases for the search for innovative models of formation and management of food potential, which will allow to carry out a thorough assessment of the ability of enterprises in the market for their innovative development when applying a logistic approach to flow management, which is an important condition for achieving sustainable competitiveness of the agricultural industry.

Materials and methods

The following general and applied research methods were used in the research process: analysis and synthesis - were carried out on the basis of secondary information in Ukraine and Sumy collected by the cabinet method of research, deduction and induction - were used in determining the factors that influence on the formation of food potential when applying the elements of logistics management; systematization and generalization - to calculate the level of efficiency of food potential based on absolute and relative indicators according to data of the Main Statistical Office in Sumy region; expert assessments - in determining the main goals of logistical management in formation of food potential of the region based on the results of the expert evaluation of researchers in this field; monographic methods - for in-depth study objectives to improve security of food resources of the population of the region; abstract-logical methods - for the theoretical generalization of the state and results of studies of foreign and domestic researchers, as well as in formulating conclusions and suggestions.

Results

Ukraine is an agrarian state and has significant potential for the development and prosperity of the agrarian sector. The cultivation of agricultural products is oriented on consumer inquiries into the structure of food. Agrarian products are extremely advantageous for exporting abroad not only because of the fact that they are a source of food security of the state, but also because of the ability to maintain long-term storage and high transportability of its main types. However, despite significant prospects, there is an under-financing of agriculture by the state, excessive taxation and depletion of land due to non-crop rotation. One of the reasons for reducing the costs of the agricultural sector is the result of agro-logistics and optimization of agro-logistic chains. The main object of logistics management in the agrarian sector of the economy, as well as in other branches of business, is the material flow. However, some scholars point out that in agriculture, many material flows have a biological nature. To achieve food security, it is necessary to formulate, plan and implement a food policy that ensures the adequacy and stability of food supply. The adequacy of food supply means that the total volume of material flows (revenues) in this area should potentially cover the total volume of needs for quantitative (energy-rich) and qualitative (the presence of all essential nutrients) measurement. The concept of stability is immanently linked to the notion of sufficient food or food security, since it involves the availability of food for both present and future generations [28].

The availability of food means physical and economic availability. However, physical accessibility to food does not yet mean actual availability. The right to food must be in accordance with the right to the resources to ensure its receipt. Many diet-related, high-fat or sugar-related diseases arise precisely because of prevailing consumption patterns, or because of poverty when only fats and sugar represent a source of calories (energy). Consequently, physical accessibility to food is inextricably linked to economic affordability.

Parameters that characterize the economic availability of food are the volume and structure of the purchase of

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food products by different groups of population in comparison with the norm, with the prevailing prices, incomes, as well as resources of personal (family) and peasant (farmer) farms. Typically, the primary objective of most economic reform is to improve the welfare of poor people. If such evolutionary and economic processes are unsatisfactory, they acquire a political orientation and essence, leading to disintegration and polarization of society. At the same time, the success or failure of such transformations depends, first of all, on the degree of support by the majority of the population. Society can understand and accept the need for temporary difficulties related to restructuring the economy if there is confidence in the future. In the absence of such assurances or doubts, society initially gains disappointment, and then (with further deterioration of life) - the resistance to the reforms and the rejection of power structures [34].

Since the main condition of livelihoods is nutrition, solving this problem for a person is a priority task. In case of inappropriate living wage, a person refuses most expenses for a meal. With further reduction of purchasing power of the population, it is compelled to refuse from the most expensive products, artificially reducing the value of the diet. If this process affects only the disabled (by age) part of the population, this leads to a reduction in the length of their lives. However, if it affects children and young people, then it threatens the level of fertility and quality of the gene pool of the nation [35].

It should be noted that the described trends in changing consumer spending as income declines are confirmed by official statistics. Thus, during the period of reforms and the growth of poverty associated with it, a large part of the population of Ukraine has experienced a significant increase in the share of food expenditure - from about 55% in 2014 to almost 75% in 2018. At the same time, the share of funds has decreased, which are sent for the purchase of non-food products (especially clothing and footwear) [36].

Determining the minimum or optimal size of the living standard of the average citizen of the country has always remained a rather difficult task. Its decision has always been complicated by a variety of opinions in various segments of society about financial priorities, especially given the income received, the social, cultural and educational level, place of residence and occupation. It is necessary to take into account long-term or national traditions, way of life and family status, climatic and many other reasons when determining the degree of importance of financial costs.

Many countries that are moving through world transformations in recent decades have formed a well-defined gradation, which allows (with a certain share of conditionality) to determine and compare the state of the average citizen. In the simplest form, the living wage consists of three expenditures: foodstuffs - 50%; industrial goods - 35% and for various types of services - 15%. It is worth to indicate in advance the trend, which is confirmed by the statistics both before and recently. With a decrease in the income part or its insufficiency at the same time there is an increase in the relative share of the cost of food [37]. Despite the last two articles, we will calculate the required minimum food for the average citizen (table 1).

Table 1. Calculation of food expenditure in Ukraine based on consumption standards of February 1, 2019

Product groups	Rate of consumption per month, kg	Average price, $	Costs, $
Bread products	8.4	0.72	6.05
Potato	10.3	0.35	3.61
Vegetables and melons	13.4	0.51	6.83
Fruits and berries	7.5	0.35	2.63

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Sugar, confectionery	3.2	0.52	1.66
Meat and meat products	6.9	3.79	26.15
Fish and fish products	1.7	2.76	4.69
Milk and dairy products	31.7	2.23	70.69
Eggs, units	24.2	0.09	2.18
Oil	1.1	1.30	1.43
Total	-	-	1,265.92

Source: calculated by authors based on [37]

Data table 1 indicates that the population's expenditures on food constitute the average wage in Ukraine, while the income of the population does not remain for two other expenditures. As for the Sumy region, the population was 1,081,400 people as of 1 January 2020 (including the urban population - 747,900 people and the rural population - 333,600 people). At the same time with the results of 2019, the salary in the region increased by 17.1% compared to 2018 and amounted to $ 317.7, which is 2.1 times higher than the minimum salary. As a result, the purchasing power of the Sumy region's population for food in 2019 reached the level of 2013. A particularly sharp decrease was observed in 2014 (124%) and already in 2018 (155%) (Table 2).

Table 2. Incomes and expenditures of the Sumy region's population in 2016–2018 at actual prices

Indicators	2016 year	2017 year	2018 year	2018 y. in % to 2016 y.
Total Incomes, million $	1946.3	2431.9	2957.3	151.9
Total expenditures, million $	1774.1	2276.4	2751.2	155.1
Total available income, million $	1482.0	1804.8	2249.5	151.8
Available income per 1 person, $	1336.5	1641.6	2067.7	154.7
Real available income (% to previous year)	101.5	105.9	108.2	-

Source: calculated by authors based on [37]

It is also worth noting that the overall consumer price index was also the highest in 2014-2015 (126%, 144% respectively) and in 2018 – 119%, which is not a sufficiently positive indicator of the regional economy development. According to world standards, if the share of expenditures on food purchases exceeds the limit of 50%, this indicates about low standard of living and is one of the indicators of poverty. According to our calculations, the population of Sumy region in 2015–2019 spent an average of 56.6% of the total expenditures on food purchases. If we compare this indicator with the values of foreign countries, we can see that in the US it is 10%, in EU countries - 15%, in Poland - 30%. An assessment of the level of physical availability of food in the Sumy region for 2019 showed that the region provides itself with virtually all food groups. The highest level of agrarian and food self-sufficiency were noted in such categories as potatoes (295.0%), cereals (277.4%) and vegetables (223.8%). At the same time, there is an insufficient availability of meat and meat products for citizens of Sumy region (only 92.7%). It should be noted that the level of self-sufficiency of the region with products of animal origin practically coincides with the level of self-sufficiency in Ukraine in general. However, in the case of providing citizens with crop production, the volume of such products in Sumy region far exceed the fund of consumption.

Nevertheless, the most serious changes occur with a further reduction in income levels - the refusal of major food products, replacing them with cheaper and less nutritious. In this case, it is difficult to determine the limit on which malnutrition or half-starving existence begins. As a result, there is a problem of developing food products that would be available both physically and economically. This means products of the same quality,

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but much cheaper. This problem is reduced to the cost of production. In our opinion, the correct statement is that the cost of crop production in the largest extent inversely proportional yield crops which produced. With an increase in yields on the same quality of land, there is a reduction in the cost. Conversely, because the technology of growing the same and the same costs.

Various fertility plots cause significant fluctuations in the yield of agricultural crops grown on them. Thus, grain yields in 2018 year in the districts ranged from 38.3 centners per hectare in Yampilsky district to 79.3 centners per hectare in Sumy district, yield of sugar beets - from 101.4 centners per hectare in Seredino-Budsky district to 573.2 centners per hectare in Konotopsky district, yield of potatoes - from 38.9 centners per hectare in Burinsky district to 253.8 centners per hectare in Glukhivsky district (table 3). In this regard, farms receive fewer products, which lead to a deficit, and increase its cost.

Table 3. Crop yields in districts of Sumy region in 2018, centners per hectare

Districts	Types of cultures				
	Crops	Sugar beets	Sunflower	Potato	Vegetables
Bilopilsky	63.4	405.6	18.3	71.7	203.9
Burinsky	56.0	436.5	17.7	38.9	50.9
Velikopisarivsky	63.1	264.5	30.6	42.3	47.3
Glukhivsky	62.4	352.7	24.2	253.8	98.3
Konotopsky	69.5	573.2	32.0	98.1	81.9
Krasnopilsky	78.0	410.0	28.5	11.7	100.2
Krolevetsky	51.8	321.9	27.9	203.0	131.1
Lebedinsky	77.9	529.1	32.0	162.4	112.9
Lipovodolinsky	75.2	352.7	34.9	72.8	54.6
Nedrigailovsky	76.6	462.9	28.2	96.4	142.0
Okhtyrsky	73.7	401.2	34.9	111.6	345.9
Putivlsky	58.1	462.9	43.6	65.9	103.7
Romensky	67.4	484.9	25.0	123.5	112.9
Seredino-Budsky	40.4	101.4	16.0	123.4	67.4
Sumsky	79.3	529.1	33.7	172.6	273.1
Trostyanetsky	79.2	348.3	35.5	123.5	76.5
Shostkinsky	45.4	299.8	17.5	62.6	189.4
Yampilsky	38.3	286.6	13.4	162.4	116.5
Total in the region	70.9	440.9	29.1	169.2	182.1

Source: Compiled by the authors in accordance [38]

However, this is not always due to the fertility of the land. It is well known fact, that not every culture gives an equally high yield even at the best quality of the soil. Without going into the details of adherence to agro technologies in farms, but relying only on figures of statistics, one can state that farms are sometimes grown in large areas that grow poorly, determining the balance between individual crops at their own discretion. Thus, grain yield in Trostyanetsky district in 1.7 times higher then in Bilopilsky district, but sown area is less than 1.1 times. The yield of sugar beets in Bilopilsky district in 1.2 times more than in Trostyanetsky district, but sown area is only 1.03 times higher. The yield of grain in the Burinsky district exceeds 1.4 times against the Yampilsky district, but significantly less potato yield (4.2 times) and vegetables (2.3 times). There are many similar facts. In connection with this very important task is to optimize the structure of sown areas in order to

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achieve food security in the region. This problem should be solved in two stages. At the first stage, it is necessary to construct a model for optimizing the structure of the crops area of the sub-regions to provide the population with the necessary minimum of food based on the actual yield of crops.

Formulation of the problem. In the area of n districts, which devote the area *Z* to cultivate m crops. The production of agricultural crops is associated with a large number of factors of influence: technical, agro technological, cost and other. However, in order to simplify the problem of optimizing the sown area, we will take into account the average yield of the *j*-crop in the *i*-th region Y_{ij}. A similar problem belongs to the class of tasks of numerical linear programming [39].

If you mark the area that will be allocated to the *i*-th district under the j-culture as *Vij*, then the total area *Z*, which will be allocated to the cultivation of crops, will be determined as $\sum_{j=1}^{n} V_{ij}$. At the same time in each separate district should be performed the next restriction $\sum_{j=1}^{n} V_{ij} \le Z$.

It is necessary to determine the areas V_{ij} that are allocated to each district for individual crops provided that the gross harvest will be maximized:

$$Q = \sum_{i=1}^{n} \prod_{j=1}^{m} Y_{ij} V_{ij} \to \max \quad (1)$$

Let's write the problem in terms of mathematical programming:

$$Q = \sum_{i=1}^{n} \prod_{j=1}^{m} Y_{ij} V_{ij} \to \max \quad (2)$$

$$\sum_{j=1}^{n} V_{ij} \le Z$$

if $i = \overline{1,n}$

$j = \overline{1,m}$ (3)

$V_{ij} \ge 0$

The solution to this problem in the Excel environment gave the following results of calculations, which are given in Table 4.

Table 4. Optimal sown areas of agricultural crops to provide food minimum in Sumy region, 2018, thousand hectare

Districts	Types of cultures					Total in district
	Crops	Sugar beets	Sunflower	Potato	Vegetables	
Bilopilsky	35.2	0.3	17.9	4.8	0.3	58.5
Burinsky	23.1	0.2	10.8	5.1	0.7	39.9
Velikopisarivsky	15.4	0.2	4.7	3.5	0.6	24.4
Glukhivsky	39.1	0.4	14.9	1.4	0.7	56.5
Konotopsky	70.9	0.5	22.7	7.7	1.8	103.6
Krasnopilsky	15.8	0.2	6.4	1.7	0.4	24.5
Krolevetsk	33.3	0.3	9.2	1.2	0.4	44.4

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y						
Lebedinsky	27.7	0.2	10.4	2.1	0.6	41.0
Lipovodolinsky	11.2	0.1	3.6	1.8	0.5	17.2
Nedrigailovsky	15.4	0.2	6.2	1.8	0.3	23.9
Okhtyrsky	40.6	0.4	12.8	4.0	0.3	58.1
Putivlsky	21.9	0.2	4.4	2.9	0.4	29.8
Romensky	51.5	0.4	20.5	4.3	0.9	77.6
Seredino-Budsky	20.6	0.4	7.3	1.0	0.4	29.7
Sumsky	122.2	1.4	30.8	11.2	1.3	166.9
Trostyanetsky	15.8	0.3	6.6	1.9	0.6	25.2
Shostkinsky	28.6	0.4	2.1	2.2	0.7	34.0
Yampilsky	28.8	0.2	5.0	1.0	0.1	35.1
Total in the region	617.1	6.3	196.3	59.6	11.0	890.3

Source: Compiled by the authors in accordance with http://agroua.net/statistics/

As shown in Table 4, most of the districts and region have enough sown areas to provide population with the food. Comparative data show that in the region, including districts, there is a significant reserve of natural resources for increasing the food potential. This model reflects how to distribute existing sown areas under cultivation in order to reach the food supply of the district. However, even in the case of optimization, not all districts have the necessary minimum areas for achieving food potential, even if is taken account of the possible increase in sown area. Therefore, in Shostkinsky district, due to insufficient number of sown area will be unproduced products: crops (12805 can be produced if necessary 54571.5 tons), sugar beets (41643.8 tons if necessary 64044.3 tons), potatoes (2007 tons if necessary 25807.3 tons). In Sumsky district, it can be produce sunflower 15585.7 tons if necessary 28129.7 tons, in Shostkinsky district in accordance to the model, sunflower is not recommended, since the available area is sufficient only for the production of vegetables. The data in Table 4 shows the minimum sown area to provide the minimum food yield for existing crop yields in the districts. However, in many cases, it is interesting to know how much of the sown area should be allocated for crops comparing with yield in advanced farms. Therefore, the highest grain yield in farms of Sumsky district (79.3 centners per hectare), sugar beets – in Konotopsky district (573.2 centners per hectare), sunflower – in Putivlsky district (43.6 centners per hectare), potato – in Glukhivsky district (253.8 centners per hectare), vegetables – in Okhtyrsky district (345.9 centners per hectare). Based on this we will calculate the required sown area by districts of the region to provide the food minimum (table 5).

Table 5. - Sowing areas of production of the main types of food products to ensure the minimum food in the districts of the region at the highest yield, 2018, thousand hectare

Districts	Types of cultures					Total in district
	Crops	Sugar beets	Sunflower	Potato	Vegetables	
Bilopilsky	27.1	0.2	15.0	2.4	0.4	45.1
Burinsky	17.8	0.1	9.1	2.6	0.8	30.4
Velikopisarivsky	11.9	0.1	3.9	1.8	0.7	18.4

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Glukhivsky	30.1	0.3	12.5	0.7	0.8	44.4
Konotopsky	54.6	0.4	19.1	3.9	2.2	80.2
Krasnopilsky	12.2	0.2	5.4	0.8	0.5	19.1
Krolevetsky	25.6	0.2	7.7	0.6	0.5	34.6
Lebedinsky	21.3	0.2	8.7	1.1	0.7	32.0
Lipovodolinsky	8.6	0.1	3.0	0.9	0.6	13.2
Nedrigailovsky	11.9	0.1	5.2	1.0	0.4	18.6
Okhtyrsky	31.3	0.3	10.6	2.0	0.4	44.6
Putivlsky	16.9	0.1	3.7	1.5	0.5	22.7
Romensky	39.7	0.3	17.2	2.2	1.1	60.5
Seredino-Budsky	15.9	0.3	6.1	0.5	0.5	23.3
Sumsky	94.1	1.0	25.9	5.6	1.6	128.2
Trostyanetsky	12.2	0.2	5.5	0.9	0.7	19.5
Shostkinsky	22.0	0.3	1.8	1.0	0.6	25.7
Yampilsky	22.0	0.2	4.5	0.3	0.2	27.2
Total in the region	475.2	4.6	164.9	29.8	13.2	687.7

Source: Compiled by the authors in accordance with http://agroua.net/statistics/

The data in Table 5 again confirm the conclusions in Table 4 about insufficient sowing areas to achieve food potential in Sumsky and Shostkinsky districts. Thus, even with maximum level of yield Sumsky district needs 128.2 thousand hectares in the presence of the total sown area of 123.1 thousand hectares, Shostkinsky district - 25.7 thousand hectares in the presence of the total sown area of 16.4 thousand hectares. In this case, underexploited products should be restored to other areas, preferably with the highest yields by type of crop. However, if the farms of the region reach the highest yield, the sowing area of agricultural crops can be reduced by almost 2 times from 12885 thousand hectares to 687.7 thousand hectares with optimal sowing area, based on available yields to 890.3. Calculate the gross output of crop production with available sown area and highest yield (table 6).

Table 6. Gross output of the main types of food products in the districts of the region at existing sown areas and the highest yield, 2018, tons

Districts	Types of cultures				Total in district
	Crops	Sugar beets	Potato	Vegetables	
Bilopilsky	112,050.0	205,206.8	53,747.2	29,702.4	401,484.1
Burinsky	83,664.0	123,933.8	41,344.0	22,848.0	272,259.5
Velikopisarivsky	55,527.0	130,032.0	40,310.4	22,276.8	248,639.0
Glukhivsky	88,644.0	121,905.0	73,385.6	40,555.2	324,951.8
Konotopsky	114,540.0	148,317.8	90,956.8	50,265.6	404,642.3
Krasnopilsky	69,471.0	144,254.3	76,486.4	19,420.8	310,179.2
Krolevetsky	20,916.0	38,603.3	55,814.4	30,844.8	146,324.8
Lebedinsky	103,335.0	164,571.8	67,184.0	37,128.0	372,842.5
Lipovodolinsky	77,190.0	119,873.3	17,571.2	9,710.4	224,799.2
Nedrigailovsky	77,688.0	105,651.0	41,344.0	22,848.0	247,931.4
Okhtyrsky	83,664.0	205,206.8	65,116.8	37,128.0	391,893.3
Putivlsky	42,081.0	48,762.0	35,142.4	19,420.8	146,168.5
Romensky	130,725.0	201,143.3	76,486.4	42,268.8	451,378.1

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Seredino-Budsky	28,137.0	14,222.3	27,907.2	15,422.4	85,742.2
Sumsky	124,998.0	223,492.5	94,057.6	51,979.2	495,374.3
Trostyanetsky	55,278.0	103,619.3	33,075.2	51,979.2	244,344.4
Shostkinsky	43,326.0	16,254.0	40,310.4	22,276.8	122,228.8
Yampilsky	26,145.0	14,222.3	31,008.0	17,136.0	88,564.6
Total in the region	1,337,379.0	2,129,271.6	961,248.0	543,211.2	4,979,748.0

Source: Compiled by the authors in accordance with http://agroua.net/statistics/

Based on the gross output of crop production at the available sown areas and yields, the volume of necessary food supply in the districts of the Sumy region and wholesale prices for the main types of food, we have determined the amount of additional funds that can be used for purchase other types of food products (table 7).

Table 7. Cost and wholesale prices for the main types of products in 2018

Product name	Price for 1 tone, $	
	min	max
Wheat	163.8	190.0
Sugar beet	31.4	31.5
Potato	123.5	143.3
Vegetables	183.1	161.2

Source: Compiled by the authors in accordance with http://agroua.net/statistics/

At the second stage, based on the interests of the region, managerial logistic decisions should be made on the structure of cultivated crops, taking into account their yields for each region. We will calculate additional released funds, which can be used to purchase other types of food products (Table. 8).

Table 8. Amount of funds that can be released and aimed at purchasing other types of food products, thousand $

Districts	Types of cultures				Total in district
	Crops	Sugar beets	Potato	Vegetables	
Bilopilsky	776.7	6,689.4	3.0	84.7	7,553.8
Burinsky	622.9	4,057.3	2.5	78.1	4,760.7
Velikopisarivsky	400.3	4,500.9	2.5	86.1	1,388.9
Glukhivsky	527.1	3,279.9	4.3	134.4	3,945.7
Konotopsky	457.8	2,785.0	4.4	103.6	3,350.8
Krasnopilsky	498.3	4,897.6	5.1	62.3	5,463.2
Krolevetsky	-22.1	442.8	3.3	105.9	529.9
Lebedinsky	697.5	5,110.4	3.9	124.7	5,936.5
Lipovodolinsky	620.0	4,182.1	0.9	23.8	4,826.9
Nedrigailovsky	581.5	3,413.5	2.5	81.9	4,079.5
Okhtyrsky	411.5	6,281.4	3.4	98.1	6,720.3
Putivlsky	233.9	1,124.8	2.0	60.6	1,421.4
Romensky	790.7	5,739.9	4.0	108.8	6,643.4
Seredino-Budsky	164.1	66.4	1.7	54.2	286.4
Sumsky	-416.9	969.1	1.0	-143.1	410.1

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Trostyanetsky	320.1	3,085.2	1.7	222.9	3,663.2
Shostkinsky	-105.7	-1872.7	1.1	-16.8	-1,994.1
Yampilsky	99.0	-160.4	1.8	52.2	-7.4
Total in the region	6,656.7	54,518.6	49.2	1,322.4	62,546.8

Source: Compiled by the authors in accordance with http://agroua.net/statistics/

The food capacity in Lebedinsky, Lipovodolinsky, Okhtyrsky and Sumsky districts more than twice exceeds the need, so the problem of self-sufficiency can be solved at the proper level. In this regard, we have constructed a model for placement of main types of crops in the districts of the region based on their yields in order to provide population of areas with food products. Realization of this model makes it possible to conclude that the districts are able to provide themselves with food and even create their overproduction, which will give an opportunity to obtain additional funds for the purchase of other types of food products. In this case, agro-logistic regions are formed as intra-organization, inter-organization and mixed logistic entities, in some cases, as part of organizational logistic entities. Integration in agrarian business is carried out in order to control logistics chains through the creation of various systems for this. In view of this, the logistics organization of agrarian business is the construction of basic and auxiliary operational processes in the chain of creating the value of agrarian products, work or services using the concept of logistics. Therefore, entrepreneurs in business can focus on the synthesis of production and logistics management of any two or more directions. An example of the evolution of such management in the agro-industrial complex, in terms of concentration and length of the chain of value creation, is given in Fig. 1. Taking into account the above essence of agro-logistic management, the logistics organization of agrarian business is the construction of basic and auxiliary operational processes in the chain of creating the value of agricultural products, work or services using the concept of logistics [40]. At the same time, the «tree» of the main goals of logistics management should be built on the basis of a logistic mix (7 «R-s» - production, quantity, quality, place, time, consumer, costs) and specific features of the formation of flows of agribusiness (Fig.2).

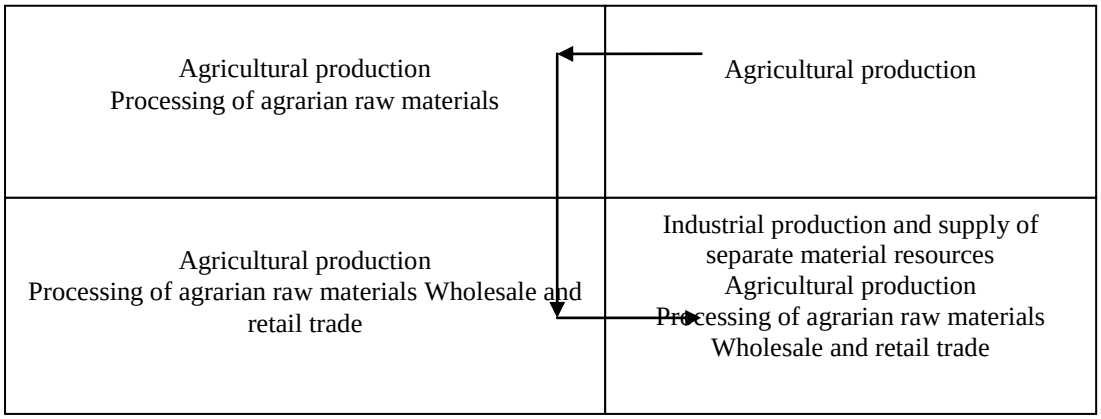

Figure 1. Development of directions of production and logistics management in the direction of concentration and increase in the length of the chain of creation of the value of agribusiness products

Source: Compiled by the authors

Ensuring the satisfaction of external consumer needs and domestic needs of agricultural production with the required intensity and the minimum possible logistics costs should be considered as the main goals of agrarian logistics management. The necessary level of intensity of flows of material, financial, information and biological (application of the appropriate varieties, breeds, biochemical growth stimulation, etc.) is important, because it directly affects the time of implementation of the order. Logistic costs are proposed to be allocated separately in the «tree» of goals, as this is one of the main factors of the efficiency of logistics management.

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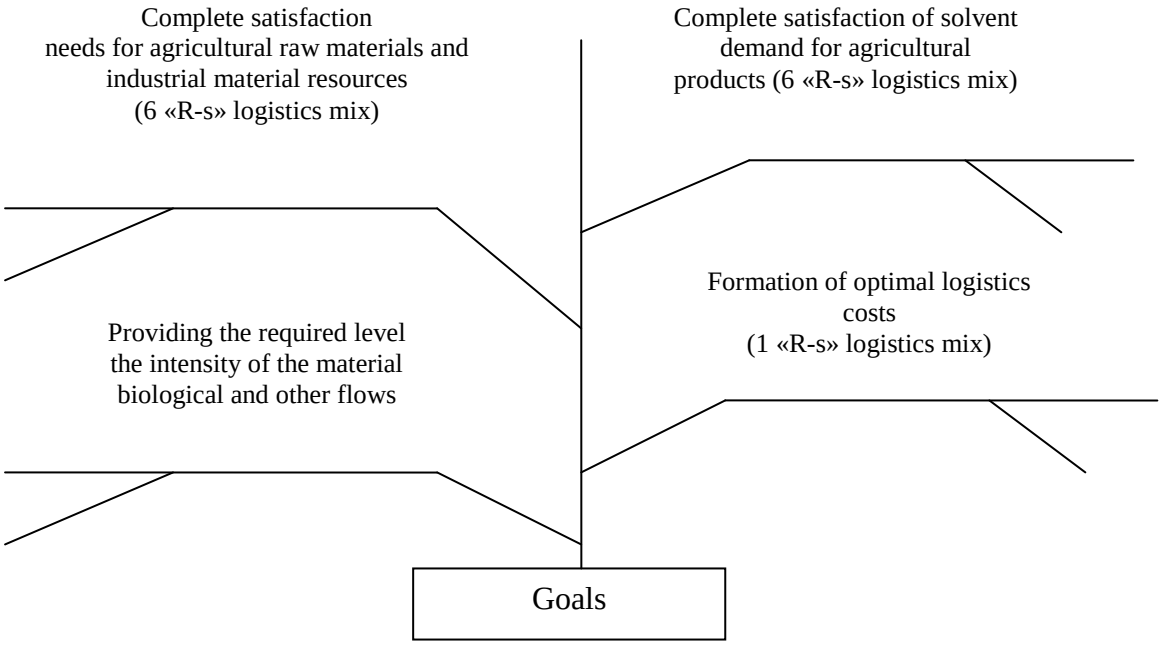

Figure 2. «Tree» of the main goals of logistic management of the formation of food potential of the region
Source: Compiled by the authors

Conclusion

The results of the study indicate that the food market is a key market that affects the quality and standard of living of the population, as well as the self-sufficiency of the region. This is due to the fact, that food markets are one of the primary human needs - the need for food. Managerial logistical decisions to optimize the structure of cultivated crops have made it possible to calculate the additional released funds that are proposed to be channel to other types of food in the context of predicting internal and external threats to food security. The proposed methodology for exploring the potential of the regional food market by applying a logistic approach will increase its efficiency and help meet the external needs of consumers and the internal needs of agricultural production with the necessary intensity and the lowest possible logistical costs, based on the interests of the region. At the same time, the basic principles of logistical management were formed in the context of formation of the food potential of the region, namely support to the process of ensuring the satisfaction of external needs of consumers in finished agro-production, internal production needs in the resources of industrial and agricultural origin; required intensity of biological, material and other flows and formation of optimal logistics costs.

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Short biographical note about the contributors at the end of the article (name, surname, academic title and scientific degree, duties, research interests):

Margarita LYSHENKO **-** Doctor of Economics, Professor, Head of the Department of Marketing and Logistics, Sumy National Agrarian University, Sumy, Ukraine.
ORCID ID: https://orcid.org/0000-0002-6321-5178
E-mail : * *lm_1980@ukr.net, margarita.lyshenko@snau.edu.ua*

Nataliia MAKARENKO ˙ PhD in Economic Sciences, Associate Professor, Department of Marketing and Logistics, Sumy National Agrarian University, Sumy, Ukraine.
ORCID ID: https://orcid.org/0000-0001-7354-5122
E-mail : *nmakar165@ukr.net*, *nataliia.makarenko@snau.edu.ua*

Valentina MUSHTAI ˙ PhD in Economic Sciences, Associate Professor, Department of Marketing and Logistics, Sumy National Agrarian University, Sumy, Ukraine.
ORCID ID: https://orcid.org/0000-0001-9042-0241
E-mail : *vamushtai@gmail.com*, *valentina.mushtai@snau.edu.ua*

Victoria MAKAROVA **-** PhD in Economic Sciences, Associate Professor, Department of Marketing and Logistics, Sumy National Agrarian University, Sumy, Ukraine.
ORCID ID: https://orcid.org/0000-0003-1076-9246
E-mail : victoria.makarova24@ukr.net, victoria.makarova@snau.edu.ua

Inna KHARCHENKO **-** PhD in Philological Sciences, Associate Professor, Department of Forensic Law and Ukrainian Studies, candidate for a master's degree in marketing, Sumy National Agrarian University, Sumy, Ukraine.
E-mail : *kharchenko-inna@ukr.net* , *inna.kharchenko@snau.edu.ua*

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