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Rational allocation of agricultural production in the region

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Abstract. The paper proposes an original approach to determining the optimal allocation of agricultural production in the region; the approach includes the methodological substantiation of the necessity to differentiate consumers when addressing food security issues in the region. It was proposed to allocate three levels: level 1 – the provision of food to socially vulnerable layers, level 2 – the provision with food at the subsistence level, and level 3 – the provision of the total population of the region with food.

A preliminary forecast was made for each municipality; it analyzed possible changes in the number of the socially vulnerable up to 2020; in accordance with medical standards and norms of the subsistence level the volumes of food were calculated, which in turn were compared with the actual production output. The difference between the actual volume and the volume of evidence-based requirements represented the very increase in the volume of production, the achievement of which requires certain investments on the basis of capital-output ratio. After that the regional market was divided into three sub-regional markets depending on distance, number of consumers and suppliers. This allowed us to calculate the amount of transport costs based on the type and lot size of the transported product, taking into account the distance to each sub-market. As a criterion of transportation expediency we took into account the share of transport costs in the price of the product not exceeding 30%. Otherwise, it is required to concentrate the production in order to increase the lot transported or to carry out a deeper processing of the product. The proposed methodology served as the basis for choosing the most effective option of spatial location of agricultural production.

Key words: food security, agriculture, Far North, ecological production, rural development, production efficiency, agricultural policy, optimal allocation, regional market.

The rational distribution of agricultural production involves the organization of its functioning in a particular area according to the prevailing agro-climatic conditions and the transportation costs for shipping the product to the nearest market in order to use land, labor, material and financial resources most efficiently. As for agricultural production, an enterprise is interested in greater profit and the society – in solving the problem of food security.

It is necessary to manufacture the product, requiring the lowest costs in accordance with agroclimatic conditions. The transportation costs to deliver the product to the market are part of the full costs. The optimal ratio of industries is taken into account for more uniform use of resources, primarily labor, within a one year period.

For example, in the practice of the Soviet economy of the northern territories the agricultural workers, working in fields in summer, in winter, as a rule, were busy harvesting and processing of wood used for household needs of the enterprise.

In addition, the rational allocation of agricultural production depends on the population dynamics on the regional markets, large settlements, towns and cities. It is influenced by the development of the industry and other sectors of the economy, the number of current job and the creation of new ones. So, the Komi Republic is setting up new industrial projects on oil, titanium and wood processing and planning to develop nickel ores in the longer term. The increase in the number of new jobs leads to the greater volume of consumed food. Environmentally friendly food can be produced only within a certain distance from the point of consumption.

The need to avoid depopulation is a significant factor in the territorial location of production. This requires special support of the areas with adverse agro-climatic

conditions, improvement of the living conditions in rural areas, prevention of the outflow of people employed in agriculture, improvement of the demographic structure in rural areas.

The study is aimed at determining the basic criteria applicable to justify the rational allocation of agricultural production in the region. The novelty of the work lies in the fact that this justification concerns the specific region – the Komi Republic.

For these purposes we analyze the main trends in the regional food market development, examine its sources, volumes of consumption, including their variation in per capita terms.

The optimization of agricultural production distribution on the territory of the republic should take into account the significant transportation costs associated with large distances (the length of the republic from the North to the South is 785 km, from the South-West to the North-East – 1275 km, from the West to the East – 695 km), low population density and other factors limiting the development of regional agriculture – children and the sick, including those in healthcare and education establishments (kindergartens, hospitals, schools).

Special attention should be given to the provision of quality food to socially vulnerable layers of the population.

We make a forecast for the changes in the number of population by 2020 for each administrative region [8]. Further, based on the forecast data, medical nutrition standards and nutrition standards at the subsistence minimum level we calculate the required amount of products, primarily milk and fresh meat [5, 6]. The comparison of the actual production volume and the minimum amount help calculate the required production volumes for each district. Then on the basis of productivity we justify the increase in livestock and, considering the investment price of a cattle stall, calculate the amount of investment required for agricultural production in 2015–2017. The problem to provide socially unprotected layers of the population with quality food at the expense of local production should be solved during this period. On the basis of the forecast data we substantiate the maximum possible production volumes and the amounts of production at the subsistence minimum level. Then we calculate the required amount of investment in agriculture in the region in 2018–2020., i.e. in the period when it will be possible to solve the problem of food security of the republic's population by main agricultural products.

The study specifies the formation of 3 sub-regional markets in the Komi Republic: Syktyvkar (over 300,000 consumers), Ukhta-Sosnogorsk (about 200,000 consumers) and the market of northern cities (about 200,000 consumers).

Taking into account transport costs, we reclassify producers to each sub-market and offer the promising specialization of producers by products.

The total volume of the regional food market in current prices amounts to more

than 55 billion rubles, of which more than half – to the livestock. In 2000–2012 despite the reduction in the total number of consumers the market increased by 26%. During this period the population of the republic decreased by 21% from 1136.3 to 889.9 thousand people, however, the growth of solvent demand of the population led to greater consumption per capita: milk and dairy products by 40%, meat and meat products – 65%, eggs – by 12%, vegetables – 14% (*tab. 1*). Consumption growth was caused by food import. Thus, the share of external sources rose.

The table provides a list of products that are imported to the republic's market and, at the same time, are specialization objects of most local producers.

According to the 2012 data, the republic produced 112 thousand tons of potatoes, of which the share of commercial farms accounted for only 4.6 thousand tons (4%) and the share of peasant farms (PF) – about 3 thousand tons (2.6%). The production of vegetables amounted to 22.5 thousand tons. The share of commercial farms accounted for 4.8 thousand tons (22%), PF – 2.5%. It should be noted that in 2009–2013 the latter increased the production of potatoes by almost 2.5 times and vegetables – 5 times. Given their lack of technical equipment, it can be assumed that the promotion of positive trends requires cooperation, primarily in the storage and primary processing of potatoes and vegetables.

Table 1. Dynamics of external and internal sources of the Komi Republic food market in 2000–2012

Products	2000				2012				Consumed per capita, kg	
	Import	Local production	Total*	Share of local production	Import	Local production	Total*	Share of local production	2000	2012
Milk and dairy products, thousand tons	133.4	105.9	239.3	44	188	61.7	270.5	23	196	276
Livestock and poultry, thousand tons	41.6	14.5	56.1	26	57	20.4	71.1	27	49	81
Eggs, million units	115.3	172.8	288.1	60	120	133.3	261.3	51	241	271
Potatoes, thousand tons	0.5	268.2	268.7	99.8	2.4	112	114	98	118	56
Vegetables, thousand tons	60.6	38.6	99.2	39	64.5	22.5	87	26	84	96
Volume of the regional market in comparable prices, million rubles	18161.200	12208.600	34280.300	40	36408.000	19147.000	55 555	35		

* With regard to resources at the beginning of the year.
* Includes an incomplete list of products.

The overall trend shows a decrease in the share and significance of local producers in the provision of agricultural products, especially milk. During the study period the local commodity producers decreased the volume of production by 42%. Their share on the national market of milk and dairy products declined from 44% in 2000 to 23% in 2012 due to the decrease in production at citizens' farms.

However, the local producers' production of meat maintains the same. The proportion of own production reaches 27%. This is a significant amount that allows the authorities to regulate prices on the regional market, but does not solve the problem of food security and, in particular, the provision of quality food to vulnerable segments of the population. In addition, the rate of meat consumption per capita, amounting to 81 kg, does not reach medical standards required for the northern territories. Moreover, it is an average level of consumption, therefore, some groups of population are characterized by lower rates.

Almost 80% of the meat produced in the republic accounts for one enterprise – OJSC "Poultry Farm Zelenetskaya", which specializes in the production of poultry and pork. This concentration significantly increases the risk of excessive dependence on the changing market conditions. Peasant farm enterprises, specializing mainly in the production of pork and beef, ensure the diversification in meat production (meat of goats, sheep, rabbits, geese, etc).

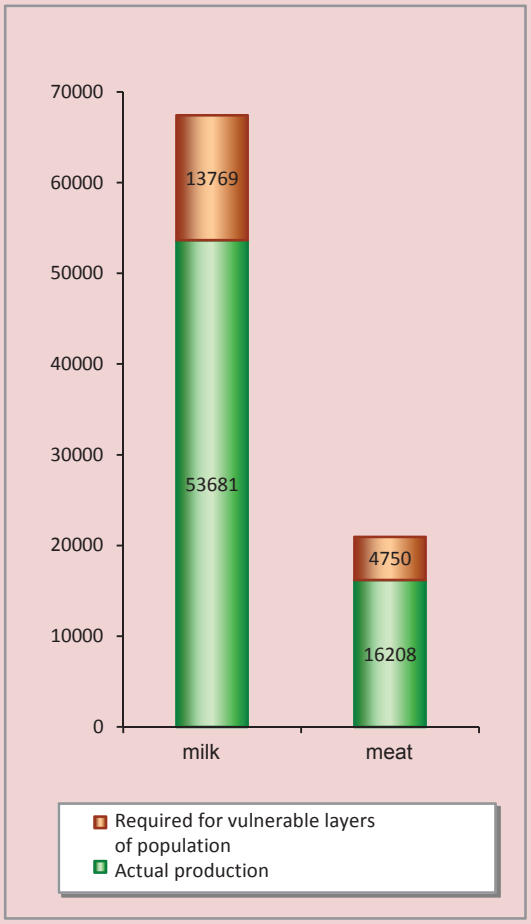
The trend analysis shows the reduction in beef production and the increase in the share of poultry meat in the consumption structure. Two-three kg of beef is produced per 1 consumer, though, according to the consumption standards, the amount should be 25 kg (even taking into account the share of local production, 5–6 kg should be produced). The relative scarcity of beef creates the accelerated growth of prices for it. In the future it can become an attractive investment product. However, at the moment the industry development is constrained by the lack of modern equipment and the current financial support of the industry. Over 95% of beef produced in the republic is the cattle out of the reproductive cycle in dairy cattle husbandry. The republic does not raise cattle for meat.

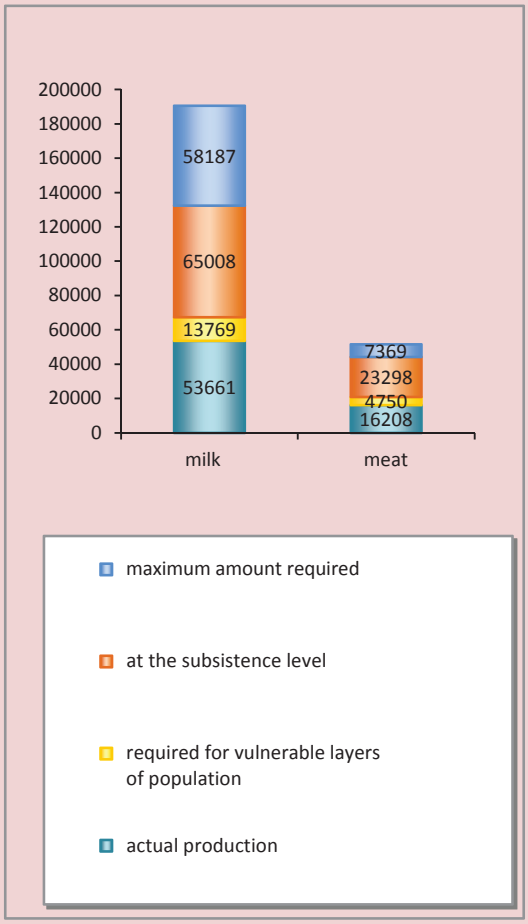
The comparison of actual volumes of production and different levels of needs makes it possible to calculate the required volume of production and investment for each district.

In the whole republic (*figure*) additional production of 13,769 tons of milk is required to meet the minimum needs for milk. Milk productivity amounting to 5 tons is optimal, that is why additional 2,754 heads of cattle are required. Besides, it is necessary to increase meat production by 4,750 tons and livestock by 12,500 heads.

The authors believe that the task to provide the socially vulnerable layers of the population with milk and meat should be solved in 2015–2017. In 2018–2020 the government should address the problem of providing milk and meat at the subsistence minimum level and at the level of medical consumption rates for the total population. At the first stage (2015–2017) 385 million

Provision of the Komi Republic population with milk and meat to satisfy all levels of needs





rubles of investment will be necessary to meet the needs of socially vulnerable population for milk and 1.132 billion rubles – in meat. The second stage aimed at ensure the needs at the subsistence minimum level will require additional 2.191 billion rubles to boost milk production and 6.729 billion – meat production. To meet the maximum needs investment is required in the dairy and meat sector – 3.833 billion and 8.205 billion rubles, respectively. It should be noted that the investment amount is presented in the lower price range, i.e. on the basis of the data of certain implemented investment projects, the total amount of which will amount to 12.038 billion. According to the Ministry of Agriculture and Food of the Komi Republic, i.e. in the upper price range, this amount of investment will be 22.451 billion rubles. So, the second stage involves significant financial investment, which is unlikely to be allocated; however, these figures are a guideline for the industry development.

Given the current specialization and the perspectives for regional agricultural development, we propose to carry out specialization on the basis of the cluster approach, stipulating the satisfaction of needs of local markets first, sub-regional markets then, the interregional market last of all.

There are following sub-regional markets:

• The first market (Syktyvkar): Syktyvkar, Priluzsky, Sysolsky, Koygorodsky, Ust-Kulomsky, Udorsky, Kortkerossky, Syktyvdinsky, Ust-Vymsky, Knyazhpogostsky districts.

• The second market (Ukhta, Sosnogorsk): Ukhta, Sosnogorsk, Vuktylsky, Izhemsky, Ust-Tsilemsky, Troitsko-Pechorsky districts.

• The third market (Northern cities): Pechora, Usinsk, Inta, Vorkuta.

The minimum requirements for milk and meat production are substantiated for each sub-market. Of course, the level of full satisfaction is unattainable, but it shows the limits for possible growth. The justification of production volumes necessary to meet minimum requirements, needs at the subsistence minimum level and maximum requirements in the context of sub-regional markets are shown in *table 2* (taking into account the internal distribution by sub-regional markets among municipalities).

Table 2. Calculation of minimum, sub-sistence and maximum requirements for milk and meat in terms of sub-regional markets of the Komi Republic

Sub-regional markets	Factual production 2013	Minimum requirement*		Subsistence requirement**		Maximum requirement***	
		Required according to the recommended standard, tons	+ above standard, - – below standard	Required according to the recommended standard, tons	+ above standard	Required according to the recommended standard, tons	+ above standard
First sub-regional market							
Milk	34817	15618	+19239	45868	-11051	68981	-34164
Meat	14025.9	3436	+10589	12349	+1676	15173	-1148
Second sub-regional market							
Milk	14885	14469	-4838	45872	-31265	68984	-54099
Meat	1214.9	3152	-1938	12349	-11135	15173	-13959
Third sub-regional market							
Milk	3959	11281	-7322	34066	-30107	51231	-47272
Meat	967.6	2481	-1514	9167	-8200	11268	-10301

* The minimum requirement is calculated on the basis of the Order of the Ministry of Healthcare and Social Development of the Russian Federation "On approval of the recommendations for rational standards of food products consumption that meet modern requirements of a healthy diet" of August 2, 2010 No 593n and the demographic forecast for the number of vulnerable segments of the population.
** Needs at the subsistence minimum level are calculated on the basis of the Decree of the RF Government "On approval of the methodical recommendations for consumer basket determination for the main socio-demographic groups of population in subjects of the Russian Federation" of January 28, 2013 No. 54 and the demographic forecast for the total population.
*** The maximum demand is calculated on the basis of the Order of the Ministry of Healthcare and Social Development of the Russian Federation "On approval of the recommendations for rational standards of food products consumption that meet modern requirements of a healthy diet" of August 2, 2010 No 593n and and the demographic forecast for the total population.

These statistics indicates that on the sub-regional market of Syktyvkar the minimum demand for milk has been reached, the excess amount to almost 19 thousand tons. Surely, part of the product will meet the needs of the whole population, but the achievement of the subsistence minimum level on this market requires almost 11 thousand tons. For the second and third sub-regional markets, the deficit is even greater. On the first sub-regional market the demand for meat is satisfied by the above-mentioned poultry "Zelenetskaya", the deficit is observed only in terms of maximum needs satisfaction (1,148 tons). The minimum requirement for meat is a satisfied in the region. On the second and third sub-regional markets the demand at all levels is not met.

The division into sub-regional markets helps analyze the trend of changes in the cost of milk production and marketing in terms of farms, belonging to one or another sub-regional market, as well as study the transport costs in terms of presented markets *(tab. 3)*.

The research shows the difference in cost parameters by sub-regional markets: the expenses are higher in the northward direction. For example, the price of milk (raw material) on the third sub-regional market is by 38% higher than on the first; the difference varies by 1.5 times by production costs.

Based on the factual data analysis, the authors calculate the transportation costs and their share in the sale price depending on the distance to the subregional market.

The share of sub-regional markets' expenses on the transportation in the price of milk is calculated as follows *(tab. 4)*. The authors multiply the normalized transport costs in the context of sub-regional markets (see tab. 4) by the average distance and then divide them by the average selling price of (raw) milk for appropriate groups of markets. As can be seen, the transportation of milk is useful when shipping 20 tons to a distance of not more than 300 km. The manufacturers that are located beyond this distance, should carry out more profound processing of products for their delivery to the sub-regional market.

Table 3. Sub-regional markets' prices for raw milk and transportation costs in the Komi Republic in 2013

Sub-regional market	Raw material, selling price, rubles/liters	Costs of goods sold, rubles/liters	Production costs, rubles/liters	Transportation costs, rubles/liters*	Distance from the manufacturer to the sub-regional market, kilometers	Normalized transport costs, rubles/kilometers
First sub-regional market (Syktyvkar)	19.21	28.01	22.60	5.2	256	0.02
Second sub-regional market (Ukhta, Sosnogorsk)	24.35	33.45	25.18	6.16	165	0.04
Third sub-regional market (Northern cities)	26.58	42.67	33.90	10.43	200	0.05

* Transportation costs also include cost of goods sold.

Table 4. Share of transportation costs in the product price on the first sub-regional market compared with other sub-regional markets

Indicator	Distance			
	Up tp 100 km	101–150 km	151–300 km	Свыше 300 km
Syktyvkar (milk)				
Cost per 1 kg, rubles.	2	2.52	4.52	6
Price, RUB.	19.21	19.21	19.21	19.21
Share of transportation costs in the price, %	10.4	13.1	23.5	31.2
Ukhta, Sosnogorsk (milk)				
Cost per 1 kg, rubles.	4	5.04	9.04	12
Price, RUB.	24.35	24.35	24.35	24.35
Share of transportation costs in the price, %	16.4	20.7	37.1	49.3
Northern cities (milk)				
Cost per 1 kg, rubles.	5	6.3	11.3	15
Price, RUB.	26.58	26.58	26.58	26.58
Share of transportation costs in the price, %	19	24	42	56

Similar calculations are performed for the second sub-regional market. Here, unlike the first, the transportation efficiency is achieved when shipping products to a distance less than 200 km.

The efficiency of milk transportation in the northern cities is assesssed (the third sub-regional market). It is reasonable to transport products to a distance of 150 km (by road transport); it can involve the use of other modes of transport, such as railway.

The authors suggest that with increasing shipments of milk the transportation costs (including cost of goods sold) will decrease by the percentage increase in traffic volume. For example, the growth in the shipment the consignment from 15 to 20 tons on the first sub-regional market (Syktyvkar), the rise in its volume will amount to 33%. Accordingly, the transportation costs (including cost of goods sold) in the third range will decrease by this value – to (4.52 rubles x (1-33)) = 3.03 rubles/kg, while the share of transportation costs in the price will amount to 15.8% instead of 23.5%. Consequently, there is an inverse correlation between the increase in shipments of milk and the transportation costs per unit of product.

As the authors suggest, transportation of primary processed products is reasonable if the share of transportation costs in the product price is not higher than 30%. Otherwise deeper processing at site or transportation of larger quantities is required. As for deliveries to the sub-regional market, it is necessary to concentrate production and sell products on the basis of the mechanism of producers' cooperation or existing commercial farms that already have recycling.

This will not only reduce transportation costs by supplying large quantities of milk, but will make local producers more reliable suppliers of the regional market and partners of large retail chains that can maintain a steady supply in accordance with the schedule.

Such cooperation is possible on the basis of commercial farms with the help of farm enterprises. The state should control pricing through the participation of its representatives in the creation of processing facilities at the expense of public investment.

In the future, two factors will have the most significant impact on food security in the region, such as dynamics of local production and reduction of the population in the republic.

If the current level and forms of state support remain unchanged, the situation with domestic food sources in the republic will deteriorate, according to our forecasts *(tab. 5)*.

According to this forecast, in 2020 the Komi Republic population will reduce by approximately 7%, milk production – by 12%, eggs – by 32%. The accelerated rate of decline in production will lead to the aggravated situation with food supply of the republic's population as a whole. In 2020 the per capita milk production will reduce by 5%, eggs – by 16%; in some municipalities the reduction will be even more significant. Judging by the forecasts, the production of meat, potatoes and vegetables will grow at a steady pace. Nonetheless, it is important to note that over 90% of the volume of potatoes and about 80% of vegetables are produced in private farms of the population, and in this case there is a high risk for sharp decline in production, because smallholders do not have a significant material and technological base and a well-functioning system of harvesting and marketing. Hence, it is necessary to strengthen the agricultural sector of the republic, and use its internal reserves rationally.

The article proposes basic methodological approaches to the rational placement of agricultural production in the region.

Table 5. Dynamics of per capita consumption of agricultural products, produced in the Komi Republic, with inertial development of the agricultural sector being maintained

Index	Total		Per capita consumption, kg (units)/years/persons	
	2013	2020	2013	2020
Population number, persons	880639	820812	-	-
Milk, tons	53661	47515	61	58
Store cattle and poultry (in live weight), tons	29464	33186	33	40
Potatoes, tons	104220	243534	118	297*
Vegetables, tons	12721	19933	14	24
Egg, thousand pieces	117149	80053	133	98

* Produced in the region per capita, but the consumption will be kept at the level of medical standards.

In particular, they involve the analysis of needs of the republic's population in the context of municipalities by basic foods. The authors take into account the level of food security, namely the level of socially vulnerable population. The state is obliged to provide these people with quality food at affordable prices and guarantee economically acceptable conditions for habilitation. The authors consider the criteria of milk transportation in the context of municipal formations and sub-regional markets. They take into account transportation costs per unit of product that determine the optimal size of shipments, and those, in turn, – the required size of production concentration.

Moreover, the article substantiates required investment to meet the needs of the republic's population for milk and meat. It points to the necessity of uniform distribution of production on the territory of the republic.

The rational placement of production is the most important factor in increasing the competitiveness of local products. It depends on many conditions, including agro-climatic, economic and political, but the determining factor is demographic – nutritional requirements of different consumer groups. In the work this need is divided into 2 levels. The first level concerns socially vulnerable people (children and patients). The state is obliged to ensure access to high quality products for them. The second level concerns needs at the subsistence minimum level. In this case it is necessary to ensure the protection of consumers' economic interests by maintaining a competitive environment. The availability of food at affordable prices is one of the important conditions of habitation on this territory, which is extremely important for the Komi Republic, characterized by the significant outflow of the population.

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