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Article



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ON THE IMPORTANCE OF FOOD SECURITY AS A FACTOR IN SAVING THE SMALL INDIGENOUS POPULATIONS OF THE ARCTIC REGIONS

Abstract: The article examines issues related to the population, demographic processes and population of the world Arctic. It is noted that many problems have accumulated in the Arctic from socio-demographic to settlement. Each country solves these problems in its own way, using both universal and specific approaches. The article analyzes the approaches used in Russian and foreign practice in studying demographic processes and settlement of the World Arctic: demographic zoning, gender, geopolitical, qualitative, combined, intersectoral, descriptive and historical, statistical, network, systemic, socio-psychological, sociological, technical and economic, ecological and biological and a number of others. Using these approaches, the process of settlement/colonization, the system of population settlement, demographic trends in the World Arctic were studied. It is noted that the colonization of the European North of Russia took place from the 10th to the 17th centuries, Siberia and the Far East - from the end of the 16th to the middle of the 19th century. The settlement was carried out by its own people, Russia did not need to attract settlers from other countries. Based on the demographic approach, it was concluded that by the beginning of the 20th century the colonization process had been completed, natural demographic development and further development of the outlying territories had begun. In the foreign Arctic, colonization was initially of a commercial and industrial nature, then raw materials were extracted. Since the first half of the 20th century, military interest began to dominate, while today economic interest prevails in the development of the Arctic. Two opposite trends are observed in demographic development: the declining dynamics of the population in the Russian Arctic and its constant growth in the foreign one. The settlement network of the Russian Arctic was formed by cities of different sizes, in the foreign Arctic, small settlements were created in the initial period, and now the network of medium and large cities is expanding. In recent years, the shift method has become more widely used in the World Arctic.

Key words: World Arctic, population, demographic processes, settlement territories, approaches, features.

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Introduction

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The article presents an analysis of state policy in the field of food security as applied to indigenous peoples living in the Arctic region; key problems are identified, strategic approaches to their solution are defined. The most promising areas are:

development of biotechnologies that create demand for the procurement of plant raw materials;

transition to modern technologies for reindeer feeding and development of reindeer herding;

preserving the tundra environment from overgrazing;

monitoring the consumption of traditional foods and the medical and social well-being of the indigenous population;

creation of economically advantageous conditions for reindeer herders to supply reindeer meat to national villages.

A comprehensive solution to the problems of traditional economic activities, as well as reasonable participation in providing food to the territories of indigenous peoples will create favorable conditions for reducing the threat to food security and preserving the indigenous population of the Arctic region. The specifics of food supply for the population of the Arctic territories are revealed. Trends in agricultural development are considered. The influence of market reforms on self-sufficiency in food is shown. Conceptual directions for food supply for the population of the Arctic zone are proposed. The article is devoted to the current problems of preserving the food traditions of indigenous peoples. The features of processing and consumption of one of the main food resources - fish - are considered. The conclusion is substantiated about the need to preserve traditional knowledge about the food systems of indigenous peoples, since they are balanced and are a tool for adaptation to the harsh natural and climatic conditions of the North. The Arctic zone of Western Siberia is the homeland of indigenous peoples engaged in traditional reindeer herding and fishing. Preservation of traditional nutrition (venison and local fish) by the aboriginal population is the main way to prevent the development of chronic diseases. A total of 1,015 people were examined, including 796 indigenous villagers and 219 indigenous tundra residents. All patients underwent the following: dietary data collection, examination by a therapist, cardiologist, and pulmonologist. An analysis of the dynamics and monitoring of venison and local fish consumption was

performed for the period 2018–2023. Over a five-year period, there was a decrease in local fish consumption by 50.0% and venison by 40.0%. The highest incidence of hypertension was observed in the Tazovsky District, and overweight in the Nadym District. Depending on the travel routes, an increase in the prevalence of chronic non-obstructive bronchitis due to the severity of the climate (an increase in the north-eastern direction) and overweight depending on the availability of imported products (an increase near large settlements) was found. The use of animal and plant raw materials from the Arctic zone is not only a contribution to the health of the Arctic inhabitants, but also an important social project that allows the indigenous population to be provided with work and, at the same time, to preserve the traditional way of life.

Northern reindeer herding in the Russian Federation retains its socio-economic and ethnocultural significance for the indigenous peoples of the North. Commercial reindeer herding is preserved only in 4 regions, and venison production in the Arctic zone is picking up speed again after a slight decline. This has become possible due to the ongoing restoration of the livestock population. In 2023, reindeer production for slaughter in live weight in farms of all categories was estimated at 16.9 thousand tons, which is 62.5% or 6.5 thousand tons more than in 2018. In 2018-2023, production will grow at a more moderate pace - by 2.2-4.7% per year. Russian venison exports are growing, and are expected to reach 600 tons in 2025. The Republic of Sakha (Yakutia), Chukotka Autonomous Okrug, Magadan Region, Kamchatka Krai, and Evenki Municipal District have particularly good prospects for increasing the herd. Unique dietary characteristics of venison: relatively low fat content, prevalence of biologically active microelements – copper, zinc, iron, absence of hormones, pesticides, and antibiotics. In terms of toxic substance content: dioxins, chlorine, lead, cadmium, nitrates, and nitrites, venison is the healthiest type of meat. In the Arctic zone, about half of venison is obtained from slaughtering six-month-old animals. There is an opinion that at this age, their meat is less valuable in its biochemical, nutritional, and taste qualities compared to meat from animals of older age groups. The comparative analysis showed that the meat of 18-month-old reindeer is superior to that obtained from slaughtering 6-month-old calves in terms of fat content, amino acids, protein quality indicator and organoleptic indicators. The slaughter yield and

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amino acid index of reindeer change insignificantly with age. Due to the low content of metabolic energy, oxyproline and high amino acid index, venison can be used as a dietary product. To produce high-quality meat, reindeer should be slaughtered at the age of 16-18 months. Mass slaughter of young animals at the age of 6 months allows to significantly reduce the cost of venison production, and in case of a shortage of winter pastures, to reduce the load on them. The latter is especially important for the overloaded tundra pastures of the Yamalo-Nenets and Nenets Autonomous Okrugs.

We find it very difficult to describe the famine in the Arctic zone of Western Siberia, if this zone is understood strictly from a physical-geographical point of view, for the reason that the available historical information, if it did reflect serious food problems in the history of the region, then these problems, as a rule, were caused either by very temporary natural conditions and did not last long, or by exceptional personal circumstances of the place and time of a small group of people or individuals, or by the actions of the state. The elemental composition of biosubstrates (hair) of residents of the Yamal and Priural'sky districts of the Yamalo-Nenets Autonomous Okrug (YaNAO) was studied. Average levels of content of 25 elements were established. The results of the analysis revealed chemical elements with maximum average concentration values: zinc (55.75 ± 14.14 mg/kg), iron (20.96 ± 6.90 mg/kg), copper (11.95 ± 2.97 mg/kg), aluminum (10.76 ± 5.55 mg/kg). Intraregional features of accumulation of chemical elements in tissues of examined residents consist of increased content of chromium, strontium, tin, barium. Low concentration coefficients and insignificant average accumulation levels indicate a natural source of accumulation of these elements in hair. During geomagnetic disturbances, Arctic residents experience disturbances in the nervous system, which leads to decreased performance, memory impairment and sleep disturbances. The qualitative composition of fats in the diet increases the adaptive capacity of the nervous system to the geomagnetic factor. An experimental study was conducted with the participation of 105 sexually mature male Wistar rats. The animals received standard diets enriched with olive, flaxseed, butter, schekur fat (*Coregonus nasus* Pallas), pork and deer fats. The behavioral activity of animals was studied daily in the open field test automatically using the EtchoVisionXT9 device. The studies were conducted during magnetic disturbances. It was found that behavioral activity and horizontal activity indices were 2 times higher in the group receiving schekur fat and significantly differed from the control group. Animal stress was the lowest in the group receiving schekur fat ($p = 0.001$). The obtained data can be used to develop diets that enhance adaptation to geomagnetic disturbances for broad groups of people

living and working in the Arctic. The territory of the Yamal-Nenets Autonomous Okrug is home to indigenous peoples engaged in reindeer herding and traditional fishing. Most researchers rightly associate the amazing endurance, health, and adaptability of Arctic residents with the consumption of traditional foods. A cross-sectional study of local fish consumption was conducted among 1,382 people of the Nenets population (average age 42.2 years). All patients were examined by a therapist and a cardiologist to exclude severe somatic pathology. The diet was analyzed using frequency and questionnaire methods. To build risk models, nonlinear logit regression with stepwise inclusion of variables using the maximum likelihood method was used. In our opinion, the leading and modifiable risk factor for hypertension is a violation of alimentary behavior, namely, a decrease in the consumption of local fish. We found a reliable effect of such a factor as local fish consumption on the development of hypertension ($\chi^2 = 6.3$; $p < 0.01$; OR = 2.1; 95% CI - 1.1-4.5). A decrease in fish consumption in the traditional diet of the population of the Arctic zone naturally leads to an increase in carbohydrate consumption and the development of hypertension.

Main part

Food security is an important component of national economic security of both the country as a whole and a separate region. In accordance with the program documents of the Food and Agriculture Organization of the United Nations (FAO) and the "Food Security Doctrine of the Russian Federation" (2021), this concept is used to characterize the state of the national or global food market and is interpreted as "conditions under which people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary and nutritional needs and preferences for an active and healthy life" (FAO, 2021). Its constituent elements are food independence, physical and economic availability of food, its safety for the consumer. Food security involves solving the following main tasks, namely:

- providing the population of the territory with food products according to scientifically based standards without infringing on the competitiveness of the domestic food market and the interests of economic security;

- protection of the population from poor-quality imported and domestic food products, ensured on the basis of control of quality characteristics according to established parameters in monitoring mode;

- continuous improvement of nutritional standards for age and gender groups of the population, especially in ecologically unfavorable regions, and stimulation of consumer interests in purchasing products that improve human health;

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formation of the necessary size of reserve food funds for use in the event of extreme situations (natural disasters, poor harvest years, military conflict, etc.).

Despite the existence of policy documents that establish the priority status of the food security problem in the Russian Federation, in some regions (especially in the Arctic) it is very acute. Moreover, according to Professor V.A. Ivanov, "in terms of the degree of provision of the population with medical nutrition standards through its own production, Russia is one of the countries that does not ensure the food security of the state." This increases the significance of this problem and requires the development of emergency measures not only at the local but also at the federal level. Food security in the Russian Federation should be considered in a diversified manner even at the regional level, if it is identified with the concept of a federal subject. This is especially relevant in the Arctic zone of the Russian Federation, where there is a significant differentiation in the standard and quality of life of the permanent population living in populated areas and indigenous peoples leading a nomadic lifestyle. The importance of such a distinction is noted by the Food and Agriculture Organization of the United Nations within the framework of the FAO Policy on Indigenous and Tribal Peoples. She estimates that indigenous peoples make up approximately 5% of the world's population (and 15% of the total population in the Russian Arctic), but they account for 15% of the total number of people living below the poverty line. Indigenous peoples are at higher risk of food insecurity than other population groups "due to the high incidence of poverty, reduced availability of resources and increasing reliance on cheaper, highly processed foods." At the World Food Summit in November 2009, FAO member states committed to "actively promoting the consumption of foods, especially locally available foods, that contribute to dietary diversification and balance, as the best means of addressing micronutrient deficiencies and other forms of malnutrition, particularly among vulnerable groups." For indigenous peoples, food security also means the right to choose their food and how to prepare it in accordance with traditional methods. A sustainable diet using local foods ensures the preservation of indigenous ecosystems and traditions. Thus, the right to food is closely linked to the realization of cultural rights, and both rights must be realized together.

In 2018, FAO prepared a regional overview of the state of food security issues in Europe and Central Asia for 2015 and 2016. The analysis of statistical data showed that there are a number of issues requiring attention, including the deterioration of rural areas, persistent poverty, distress-related migration, unsustainable use of natural resources and threats posed by climate change, as well as changing

diets. In such circumstances, policy responses should be aimed at consistently addressing the main economic, social and environmental challenges in the field of food security through the implementation of measures at the national and local levels. However, FAO's conclusions with regard to Russia are based mainly on statistical data collected at the level of federal subjects, and, therefore, do not reflect the real differentiation of the "degree" of food security problems in urban and rural areas, among the permanent population of municipalities and indigenous peoples leading a traditional way of life. Monitoring data on the standard and quality of life of the latter is practically absent in the Arctic region. The exception is a significant body of publications on the problems of nutrition and food security among the indigenous people of Alaska, as well as scientific works by employees of the State Institution of the Yamal-Nenets Autonomous Okrug "Scientific Center for Arctic Studies".

According to FAO and the World Health Organization (WHO), global factors affecting food supply security, including for indigenous peoples, include:

- 1) Rapidly rising fuel prices have a dual effect: increasing production costs and increasing sales costs.
- 2) Extreme weather conditions in major cereal-producing countries.
- 3) Global cereal stocks are declining as rising demand has gradually (especially since 2005) outpaced supply.
- 4) Growing demand for biofuel products.
- 5) Growing demand for food in emerging economies.
- 6) Impacts of climate change on agriculture, fisheries, hunting and gathering.

Along with these problems, food security takes on specific features for the indigenous peoples of the Arctic. Thus, in May 2012, the Inuit Circumpolar Council (Canada) prepared a background document of the Steering Committee in the area of the Inuit Circumpolar Health Strategy "Food Security in the Arctic Region", which formulated two main problems in this area for the indigenous peoples living in the Arctic region, namely:

- 1) high prices, often combined with economic vulnerability;
- 2) a decrease in the consumption of products provided by flora and fauna. The situation is complicated by environmental pollution and global climate change.

When developing specific ways to solve the problem of food security for the population of Arctic territories, it is necessary to take into account its specific features. The most significant of these include:

- low food self-sufficiency due to limited production capabilities in extreme natural conditions

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and dependence of the population's food supply on imports;

- small rural population and poor availability of agricultural resources;
- insufficient development of the agro-food sector and rural infrastructure;
- the lack of stable links with areas of production of food products imported into the Arctic and subarctic regions;
- focal nature of settlement and seasonal delivery of food to remote areas.

However, the development of logistics infrastructure and provision of regular food supplies will not completely solve the problems of food security for the indigenous peoples of the Arctic region. The guarantee of their preservation can be, first of all, the preservation of traditional food patterns. This is possible only under the condition of development and support of traditional types of economic activity of the nomadic population (reindeer herding and fishing). And this, in turn, means the need to solve a set of strategic problems:

- Development of biotechnologies that create demand for the procurement of plant raw materials, which will allow the indigenous population leaving reindeer herding to switch to the procurement of raw materials, while continuing to lead a traditional way of life in the tundra. Increasing the profitability of the procurement of reindeer products.

- Support for traditional farming focused on venison harvesting, or integration into the global economy through the development of antler reindeer herding.

- Transition to modern technologies for reindeer feeding and development of reindeer herding.

- Preservation of tundra nature from overgrazing.

- Following the historically established principle of common use of pastures, or the transition to land surveying and the introduction of the concept of "ancestral lands".

- Creation of a risk management system in reindeer herding based on the development of a scheme for the optimal use of pastures, forecasting overgrazing, preventing epizootics and reindeer deaths based on remote monitoring of the state of pastures, the movement of reindeer herding families and herds of reindeer.

- Monitoring the consumption of traditional food products and the medical and social well-being of the indigenous population. Development of consumption standards for different population groups. Study of ways to enrich the diet while reducing the consumption of traditional food products.

- Analysis of family economy indicators of tundra and national villages residents. Study of reindeer herding culture transformation.

- Creating economically advantageous conditions for reindeer herders to supply reindeer meat to national villages.

A comprehensive solution to the problems of traditional economic activities, as well as reasonable participation in providing food to the territories of indigenous peoples will create favorable conditions for reducing the threat to food security and preserving the indigenous population of the Arctic region. Involvement of the Arctic territories in economic circulation, which are a resource storehouse of the Russian economy, causes population growth. Fruitful life in extreme climatic conditions is possible with adequate nutrition. Affordable high-quality food supply to the population of the Arctic zone of the Russian Federation (AZRF) is based on both local agricultural production and fishing, and on the import of food from other territories. This determines the specifics of food security in the Arctic territories. The term "food security" accepted in world practice is used to characterize the state of the food market of a country, region and the world food market. In the materials of the Food and Agriculture Organization of the United Nations (FAO), "Doctrine of Food Security of the Russian Federation", the constituent elements of food security are food independence, physical availability of food, economic availability of food, food safety for the consumer. Theoretical and methodological aspects of food security are constantly evolving. Currently, food security is interpreted as satisfying each social group of the population with quality food at rational consumption rates. The principle of food independence is unacceptable for regional food security. Self-sufficiency of a region is possible only with those food products for the production of which there is a high bioclimatic potential, land and labor resources. Self-sufficiency in food is unattainable in regions with unfavorable conditions for the development of agriculture, especially in the Arctic zone. Thus, the level of self-sufficiency of the population in food consumption in the Murmansk Region in 2023 amounted to 6.2% for potatoes, 0.4 for vegetables, 7.8 for meat, 8.1 for milk, 3.8% for eggs, in the Chukotka Autonomous Okrug - 0.3%; 6.5; 34.9; 0.2 and 2.4%, respectively. When substantiating the approaches and aspects of food supply for the population of the Arctic territories, the following features must be taken into account:

- low self-sufficiency in food due to limited opportunities for local agricultural production;

- dependence of the population's food supply on imports;

- low rural population and availability of biological resources;

- the lack of stable connections with areas of production of food products imported into the Arctic regions;

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- focal nature of settlement and seasonal delivery of food to remote areas.

Due to unfavorable extreme conditions for development, local agricultural production is not able to provide the population with its own food. The basis of food supply for the population of the North and the Arctic is formed by the import of food products from other regions of the country and from abroad. An analysis of food imports to the Komi Republic showed that in 2023, 46.7 thousand tons of meat and meat products were imported to the region, which is 221% of its own production, 174.7 thousand tons of milk and dairy products (309%), 134.2 million units of grain (1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of dairy products, 1.5 million tons of processed meat ...

eggs (113, 59.7 thousand tons of vegetables and melons (280%). Currently, the share of imported food products of animal origin from the volume of domestic production significantly exceeds this figure in 2018. The Arctic Zone of the Russian Federation is characterized by a low rural population. If in Russia as a whole the share of the rural population is 26%, then in the Arctic zone it is only 12% (Table 1). With a small share of the rural population, its size in the subjects whose territories are entirely within the North and Arctic zone decreased by 461.6 thousand people in 1990–2024. When analyzing the current and future state of food self-sufficiency of the population of the Arctic, one should, first of all, proceed from their natural and resource potential. Here, compared to Russia, the provision of biological resources is significantly lower, with the exception of the number of reindeer per capita (Table 2).

Table 1. Rural population share as of January 1, %

Country, region	2001	2006	2011	2014	2015	2016
Russia	27	27	26	26	26	26
Regions of the Far North and equivalent localities	23	23	22	22	21	21
Arctic zone*	12	11	12	12	12	12

Table 2. Availability of agricultural resources (per 100 people) in 2023

Country, region	Cultivated area, ha			Cattle	Including cows	Pigs, head.	Reindeer, head.
	cereals	potato	vegetables				
Russia	31.9	1.5	0.5	13.0	5.7	14.7	1,1
Regions of the Far North and equivalent localities	0.8	0.8	0.2	8.7	3.8	2.4	16.1
Arctic zone	-	0.07	0,0	0.7	0.3	0.8	80.5

In the Arctic zone of the Komi Republic, compared to other territories, the per capita provision of agricultural land is 4.1 times lower, cattle - 430, pigs - 36 times. Moreover, with a 2-fold reduction in population over 1990-2023, the per capita provision of sown areas was 4 times. Low provision of biological resources, unfavorable conditions for agriculture (lack of heat, short growing season, poor soils, excessive moisture) hinder self-sufficiency of the population in local food products. Given the specifics of agricultural production in the Arctic zone, in the future it is necessary to focus on municipalities in the southern and central regions of the North with more favorable conditions for the functioning of agriculture, as well as on the formation of rear food bases located in favorable agricultural regions adjacent to the Northern zone. An important

role in the food supply of the population of the Arctic territories belongs to the agriculture and industrial economy. The local agricultural production and industrial economy here is aimed at providing the population with meat, milk, sea, river and lake fish, eggs and greenhouse vegetables, wild plants. These food products, as well as (cranberries, lingonberries, cloudberries, blueberries) are indispensable in the rational nutrition of the inhabitants of the Arctic, being at the same time medicines. The agriculture and industrial economy of the northern and Arctic territories has a centuries-old history. It developed together with the development of natural resources. Its specialization was formed under the influence of natural conditions, geographical location, natural-historical and socio-economic factors in the

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production of low-transport and perishable products and products of traditional industries.

The share of the North and Arctic zone in the population of the Russian Federation is 6.8%, the area of agricultural land is 2.5, the number of cattle is 4.5%. In the northern and Arctic territories, there are 1,605 thousand heads of domestic reindeer, or about 2/3 of the world population. Of the total

agricultural production of Russia, 3.3% of potatoes, 2.0% of vegetables, 2.3% of milk, 1.4% of meat (killed weight) were produced here in 2023. The share of fish catch of seafood was 50.6%. Due to the reduction in production, the share of the northern and Arctic territories in the total agricultural production of the country is decreasing (Figure 1).

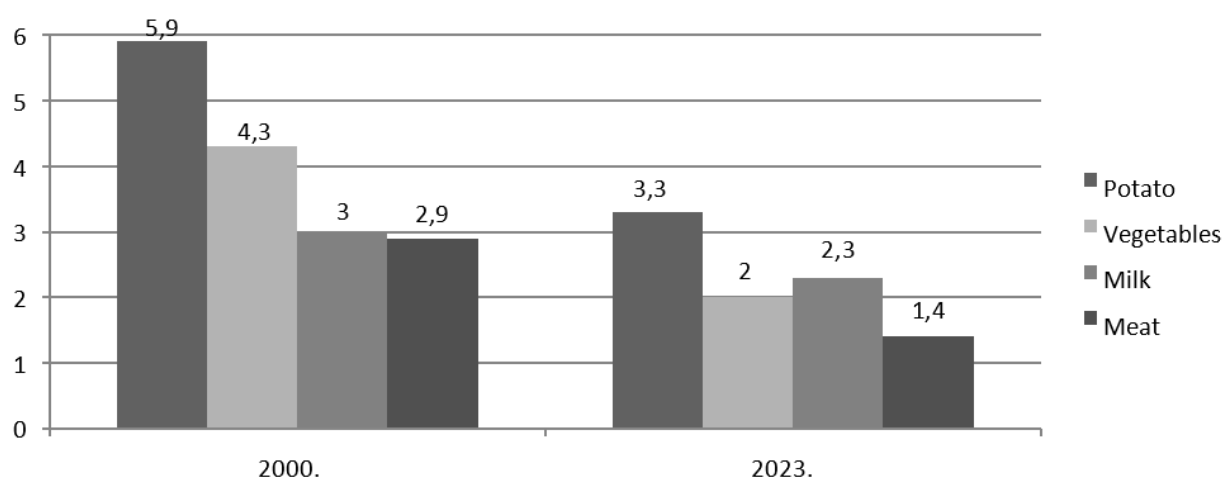


Figure 1. The share of production of basic agricultural products in the Northern and Arctic zones in the total production of goods in Russia.

Natural conditions in the Arctic zone hinder the development of agricultural production. Favorable conditions and competitive opportunities for agriculture are: long daylight hours during the growing season, good supply of moisture for plants; significant areas of forage lands, including floodplain meadows, labor resources; good opportunities for the production of organic products in ecologically clean areas; the industrial nature of the economy, which allows for significant financial resources to be directed towards the modernization of the industry and the comprehensive development of rural areas; the presence of significant potential for agricultural science. Products of traditional industries are

competitive not only in the regional, but also in the national and international food markets. Let us consider the trends in the development of agriculture in the pre-reform and market periods. In the history of agricultural development in the Arctic territories, the most favorable were the 1970s–1980s. The conducted analysis of the dynamics of livestock production indicators in the subjects whose territories are entirely within the Arctic zone showed that the average annual volume of meat in 1986–1990 compared to 1971–1975, increased by 2.2 times, milk – by 1.9 times, eggs – by 3.9 times. The change in production volumes in the pre-reform period is shown in Table 3 and Figure 2.

Table 3. Production of livestock products in farms of all categories in the subjects of the Federation, the territories of which are entirely included in the Arctic Zone of the Russian Federation

Region	On average per year				1986-1990 to 1971-1975, %
	1971-1975	1976-1980	1981-1985	1986-1990	
Meat of cattle and poultry in slaughter weight, thousand tons					
Murmansk region	5.3	8.1	14.4	24.1	454.7
Nenets Autonomous Okrug	2.7	3.3	3.7	4.2	155.6
Yamalo-Nenets Autonomous Okrug	4.6	4.2	4.3	5.6	121.7
Chukotka Autonomous Okrug	6.3	5.7	6.0	7.0	111.1
Milk, thousand tons					

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Murmansk region	38.6	48.0	57.3	76.7	198.7
Nenets Autonomous Okrug	9.6	10.1	9.9	11.9	124.0
Yamalo-Nenets Autonomous Okrug	4.0	4.5	5.0	7.4	185.0
Chukotka Autonomous Okrug	2.8	4.1	5.4	6.7	239.3
Egg, million pieces					
Murmansk region	78.7	167.5	243.0	30,6,0	388.8
Yamalo-Nenets Autonomous Okrug	0.6	3.8	4.1	11.7	1950,0
Chukotka Autonomous Okrug	4.1	6.7	9.7	9.7	236.0

Market reforms had an extremely negative impact on agriculture. Moreover, the rate of reduction in the volume of vegetables, livestock and poultry products in the Arctic zone was higher than in the Northern zone. In the Arctic Zone of the Russian Federation, vegetable production

decreased by 15 times, meat - by 3.7, milk - by 4.5, eggs - by 34 times in 1990-2015. In the Northern zone, meat production during this period decreased by 3 times, milk - by 2.7, eggs - by 3.8 times. Since 2005, there has been a slight increase in meat production due to an increase in venison.

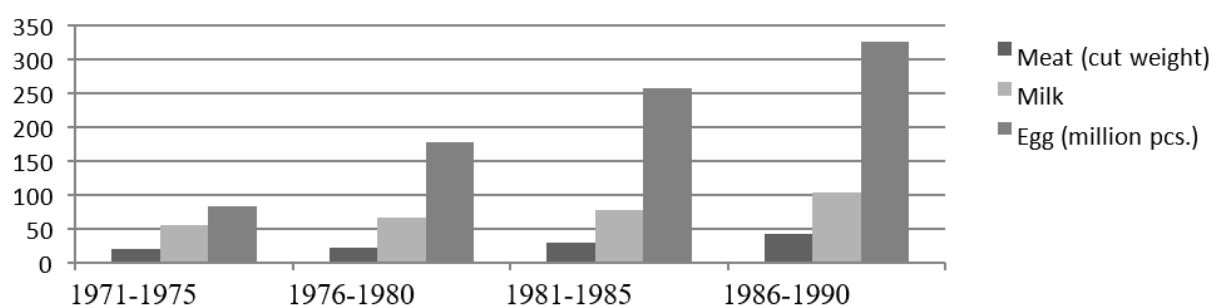


Figure 2. Production of livestock products in farms of all categories in the subjects whose territories are entirely within the Arctic zone, thousand tons

Changes in agricultural production in the Northern and Arctic Zones of the Russian Federation are shown in Table 4 and Figure 3.

Table 4. Agricultural production in farms of all categories in the subjects whose territories are entirely within the Northern and Arctic Zones of the Russian Federation for 1990-2023, thousand tons

Region	1990	1995	2000	2005	2010	2020	2021	2023
Potato								
Northern Zone	755.1	1227.6	1067.8	849,0	614.4	705.2	689.5	668.1
Arctic zone	5.0	39.5	25.9	12.8	11.8	11.8	10.9	10.3
Vegetables								
Northern Zone	186.1	257.9	260.8	218.0	189.7	196.4	195.8	188.0
Arctic zone	8.7	5.7	5.0	2,2	1,1	0.7	0.6	0.6
Meat of cattle and poultry in slaughter weight								
Northern Zone	306.8	169.3	90.1	91.4	108.0	122.9	112.4	102.5
Arctic zone	42.1	18.6	11.6	8.5	15.3	13.7	13.9	11.5
Milk								

Impact Factor:

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GIF (Australia)	= 0.564	ESJI (KZ)	= 8.100	IBI (India)	= 4.260
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Northern Zone	1547.1	882.6	694.9	635.1	604.4	573.9	573.2	573.3
Arctic zone	109.0	42.2	35.7	32.6	33.5	32.3	27.3	24.0
Eggs, million pcs.								
Northern Zone	2208.7	1153.9	891.9	853.2	945.5	606.1	663.8	574.0
Arctic zone	300.8	158.2	172.9	152.6	148.4	25.9	11.4	8.8

Compiled from: Russian statistical yearbook for the relevant years.

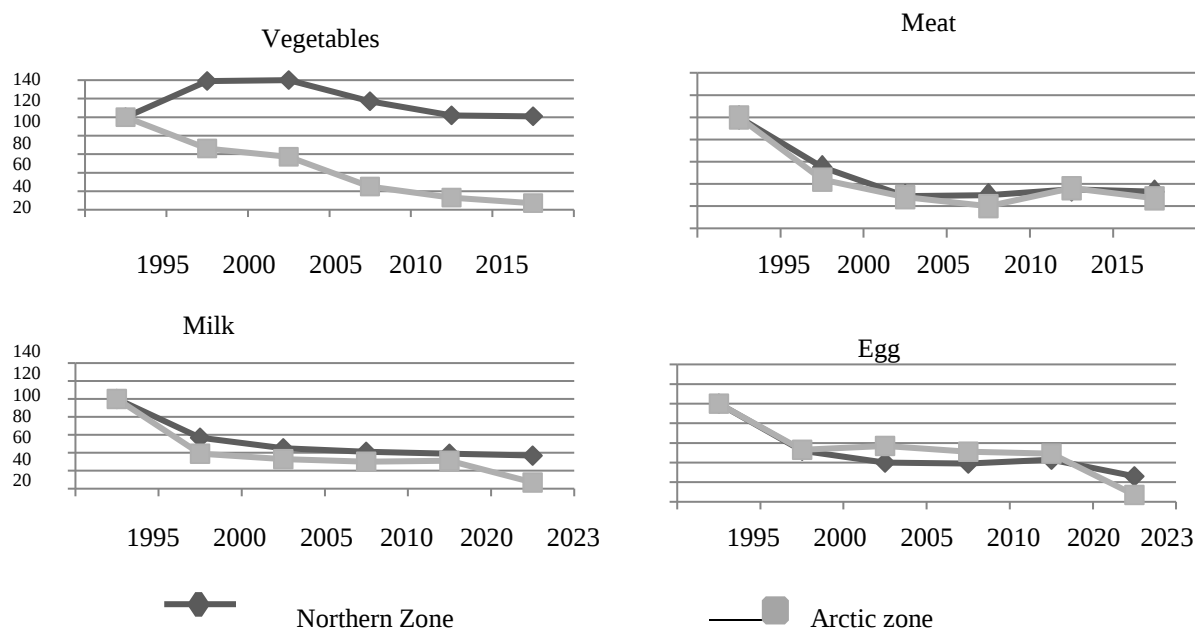


Figure 3. Dynamics of agricultural production in farms of all categories in the subjects whose territories are entirely within the Northern and Arctic Zones of the Russian Federation for 1990-2023 (1990 = 100)

The decline in crop and livestock production is due to a reduction in sown areas and livestock numbers. In the North and Arctic zone, vegetable sown areas decreased by 2.7 times, potatoes by 1.7 times, and the livestock numbers decreased by 1.2 times in 2000–2023.

In 1990–2023, the number of reindeer in all categories of farms in the North and the Arctic decreased by 41%. The number of domestic reindeer

fell especially sharply in the Chukotka Autonomous Okrug (by 3.2 times). The reindeer population increased in the Yamalo-Nenets Okrug during the years of reforms (by 50%). Since the beginning of 2018*89*, the reindeer population has been growing in all subjects of the Northern zone and the Arctic Zone of the Russian Federation, with the exception of the Murmansk, Magadan and Sakhalin regions (Table 5).

Table 5. The number of domestic reindeer in the Northern and Arctic zones in all categories of farms at the end of the year, thousand heads

Subject of the Federation	1990	1995	2000	2005	2010	2020	2021	2023
Komi Republic	123.6	122.8	110.1	89.5	83.8	89.9	85.3	85.8
Arkhangelsk region	4.4	4.4	2.9	2.92	1.8	1.9	1.9	1.8
Nenets Autonomous Okrug	186.3	167.2	122.1	147.9	172.9	186.6	171.5	177.5
Murmansk region	77.3	71.4	61.3	59.8	58.9	54.9	54.4	56.1

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Khanty-Mansiysk Autonomous Okrug	47.1	33.8	26.5	28.3	35.5	38.1	38.5	40.6
Yamalo-Nenets Autonomous Okrug	490.5	539.7	504.7	537.2	665.2	739.9	671.5	733.5
Republic of Tuva	8.1	3.4	1,2	1.7	2.1	2.5	3.3	7.1
Krasnoyarsk region	107.1	50.3	46.2	54.9	77.6	99.0	107.1	116.3
Republic of Sakha (Yakutia)	361.5	196.4	156.2	153.6	200.3	177.1	165.3	156.0
Chukotka Autonomous Okrug	491,0	156.8	92.5	154.3	195.4	172.5	158.2	152.3
Kamchatka region	16.8	8.7	-	-	-	-	-	-
Kamchatka Krai	150.3	63.6	35.9	35.4	38.6	42.3	44.8	46.8
Magadan region	121.5	33.4	17.7	18.2	21.6	21.2	12.8	14.4
Sakhalin region	4.0	2.9	3.3	0.2	0.2	0.2	0,1	0,1
Republic of Buryatia	2.0	0.7	0.5	1.0	1.0	0.5	0.6	0.6
Irkutsk region	1.7	0.5	0.7	0.2	0.3	0.3	0.5	0.5
Transbaikal Territory	9.2	1.3	0.7	1,1	2,3	2.6	2.9	3.1
Khabarovsk Krai	42.7	17.1	7.7	6.1	6.4	6.0	5.8	6.1
Amur region	12.9	9.3	6.2	6.5	6.9	6.5	6.7	6.7
Total for the Northern zone	2258,0	1483.7	1196.4	1298.1	1570.6	1642,0	1531.2	1605.3

The rapid growth of the reindeer population in the Yamalo-Nenets Autonomous Okrug in the late 1990s and early 2000s led to the degradation of the vegetation cover of reindeer pastures. According to environmentalists, the reindeer capacity of pastures in the district is 386 thousand heads, and at the beginning of 2016 there were 733.5 thousand. Currently, 300 thousand reindeer graze on the Yamal Peninsula, but there may be less than 100 thousand heads. This factor, as well as the abnormally hot summer of 2016, caused an outbreak of anthrax in Yamal. To stop the degradation of tundra ecosystems in Yamal, the reindeer population will have to be reduced by at least 200 thousand heads.

The development of reindeer herding in the northern taiga will help to protect depleted tundra pastures from irreversible degradation in a number of northern and Arctic regions. Currently, positive

experience in forest reindeer herding is available in the Khanty-Mansiysk Autonomous Okrug, Zabaikalsky Krai and Yakutia. Forest reindeer herding was widely used in Komi in the 1920s and 1930s. Then, before the start of market reforms, it was successfully developed in the Pomozdinsky state farm. The reduction in agricultural production has led to a constant decrease in the provision of the population with local food products. An assessment of the ratio of the level of per capita consumption of own food products to rational consumption standards in the Arctic zone shows a decrease in this indicator for meat, milk, eggs and vegetables during the reform period. A particularly significant decrease in indicators was observed in the Murmansk Region and the Chukotka Autonomous Okrug (Table 6).

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Table 6. The share of local products in rational consumption standards per capita in the Arctic territories, %

Region	Year	Potato	Vegetables	Meat	Milk	Egg
Arctic zone	1990	1,1	3.3	30.5	15.2	55.0
	2023	3.2	0.4	18.1	4.6	1.4
Murmansk region	1990	1,2	4.4	28.4	18.2	82.6
	2023	4.3	0.4	8.5	6.5	3.0
Nenets Autonomous Okrug	1990	2.4	1.4	105	58.3	-
	2023	12.4	1.3	45.8	19.5	0.3
Yamalo-Nenets Autonomous Okrug	1990	0.6	1.4	16.8	4.7	6.8
	2023	0.6	0,1	11.2	1.0	0,1
Chukotka Autonomous Okrug	1990	-	1.4	65.1	11.3	14.5
	2023	0.3	1.3	24.4	0,1	1.4

The priorities for the development of domestic agricultural production are: innovative modernization of food production; improvement of specialization, cooperation and integration; ensuring sustainable sales of products; transition to targeted management of each municipality's own food sector; formation of an effective organizational and economic mechanism.

The use of selection-genetic, technical-technological, organizational-economic and socio-ecological innovations will allow the formation of the fifth and sixth technological modes in the agricultural sector. Innovations should be implemented not only in collective and peasant farms, but also in rural households, whose role in the conditions of cyclical economic crises is great. Small forms of management may be more receptive (compared to large enterprises) to the use of innovations.

To implement technical, technological and socio-economic development of the agricultural sector, significant financial resources will be required, including government investment. Since private investors in the Arctic conditions, due to the low profitability of agriculture and long payback periods for invested funds, are not interested in investing capital in its development, in this case the role of the state is especially great.

It is proposed to provide financial support to the agricultural sector of the Arctic territories in the following areas:

1. Increasing the volume of financial resources for agricultural development in rural areas through the redistribution of subsidies from agricultural organizations that are self-sufficient and self-financing.

2. State support for economic entities implementing investment projects in the form of providing state property as collateral to ensure the fulfillment of credit obligations.

3. State support in the form of targeted grants to peasant farms.

4. Support for small businesses that ensure employment growth in remote rural areas (development of private farms, organization of collection and processing of wild plants).

5. Provision of subsidies for the development of fish farming.

6. Reimbursement of part of the costs of loans.

7. Exemption of peasants from taxes for 5 years.

8. Provision of a preferential loan for the construction of livestock facilities for a period of up to 20–25 years, and the purchase of machinery and equipment for 6–8 years.

9. Removal of restrictions on state support for agriculture under the “yellow basket”.

Thus, unfavorable natural conditions for agriculture, low availability of biological resources, underdevelopment of agriculture from financial support hinder food self-sufficiency of the population of the Arctic territories. The basis of food supply is formed by the import of food products from other regions of the country and from abroad. During the period of market reforms, the share of imported food has increased significantly. Increasing self-sufficiency in food will require accelerating the modernization of the agricultural sector, improving the living conditions and quality of life of peasants, activating and stimulating the sale of products, forming an effective organizational and economic mechanism, creating rear food bases located in adjacent, favorable agricultural zones. The system and structure of human nutrition is determined by the availability of food resources (products), which depends on the natural and geographical environment, socio-economic living conditions, the availability of food processing technologies and policy. Natural and climatic conditions determine the diversity of different types of animal resources and species of wild plants used as food. This is especially important for indigenous peoples (with hunting and gathering traditions), who have been forming their

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balanced nutrition system for centuries. In the modern world, it is quite difficult for indigenous peoples to maintain a certain dietary structure, which threatens the traditional knowledge necessary for its preservation. On the Kola Peninsula, traditional economic activity is represented by two main types of households that had developed by the end of the 19th century: indigenous peoples (the Sami) and the newcomers (the Pomors and the Komi-Izhemtsy). Despite the fact that both types are based on a natural resource base, the models of economic activity and food traditions are different. Let us dwell on one of the main food resources of the region - fish. Fishing was one of the main means of subsistence for the Sami. Fish was divided into three categories: salmon; lake and river fish; sea fish: salmon, brown trout, char, char, trout, grayling, whitefish, pike, etc. The fishing season, according to the Sami way of life, mainly lasted from spring to autumn, during which time fish stocks were prepared for both personal consumption and sale. The diet structure corresponded to the seasonal availability of food resources and the adaptation of the people to the local characteristics of the territory. This also determined the technologies for processing food, both for long-term storage and for current consumption. The technologies for harvesting and storing fish were quite simple. Two methods were used to prepare fish for long-term storage: salting or drying in the sun without salt, for which the fish was cut along the back, gutted and hung on poles. Supplies were stored in barrels buried in the ground. Former residents of the village of Varzino (north-east coast of the Barents Sea, in the 70s the village was resettled) recall how their parents buried barrels of fish, placing roofing felt, insulation and boards on top to make it easy to open in winter. This is how they stored herring and salmon. In summer they ate only fresh fish, in winter they ate salted and dried fish. The peculiarities of cooking fish, associated with constant seasonal movements, are described in his book "Three Years Beyond the Arctic Circle" by A.E. Fersman: "The Lapps fry fish in a very clever way, first cleaning it, sprinkling it with salt and sticking it through the tail onto a stick. In this case, the fish is cut crosswise, and its sides are cut with a sharp knife in several places. The stick is stuck into the ground at an angle near the fire so that the fish is fried on the fire. The Lapp sitting by the fire changes the position of the stick several times, turning one side and then the other towards the fire; after 20–30 minutes the fish is ready, having been fried in its own fat." It should also be noted that along with the general trends in the nature of the people's diet, there are also local differences in nutrition associated with the peculiarities of the people's settlement. Depending on the location of the traditional household (pogost), the diet also differed. The coastal Sami treat the inhabitants of the central part of the peninsula with a

certain degree of irony. "If you get married in Lovozero, you will eat wet fish (whitefish). But we cannot live without our "vitamin" (that is, without salmon). Eating fish with berries was also one of the features of the traditional Sami diet. In the book "Lapponia" of 1674, I. Schaefer describes the fish dish of the Swedish Sami as follows: "They like to eat fish with fresh cloudberry and from this mixture they prepare another very strange dish. The fish, soaked in water, is cleaned of bones and mixed with cloudberry, then ground with a wooden pestle to form a sort of soup, which is then eaten with spoons." And we cannot live without our "vitamin" (that is, without salmon). Eating fish with berries was also one of the features of the traditional Sami diet. In the book "Lapponia" of 1674, I. Schaefer describes the fish dish of the Swedish Sami as follows: "They like to eat fish with fresh cloudberry and from this mixture they prepare another very strange dish. The fish is boiled in water, cleaned of bones and, mixed with cloudberry, ground with a wooden pestle so that something like a soup is obtained, which is then slurped with spoons." And we cannot live without our "vitamin" (that is, without salmon). Eating fish with berries was also one of the features of the traditional Sami diet. In the book "Lapponia" of 1674, I. Schaefer describes the fish dish of the Swedish Sami as follows: "They like to eat fish with fresh cloudberry and from this mixture they prepare another very strange dish. The fish is boiled in water, cleaned of bones and, mixed with cloudberry, ground with a wooden pestle so that something like a soup is obtained, which is then slurped with spoons."

Traditional Sami cuisine was often perceived negatively by the resettled majority, although Sami food is very balanced. It takes into account everything, including the method of extracting substances useful during the polar night, fat-soluble vitamins, as well as caloric content and other nutritional properties necessary for life in these latitudes. Politics occupies an important place in the issue of preserving traditional knowledge about food products and the use of traditional feeding systems by indigenous peoples. The colonization of the Kola Peninsula affected the preservation of the cultural traditions of the indigenous people. In the 20th century, with the change in the way of life, much in cooking also changed. A variety of kitchen utensils appeared. Previously, the basis of kitchen utensils was a copper or cast-iron cauldron, cooking on a fire or a butt. The mass distribution of vegetables, in particular potatoes, occurs in Soviet times. A Pomor remains a Pomor only when he lives by the sea and is engaged in fishing - this is the self-determination of the Pomors. Historically, the Pomors of the Kola Peninsula are settlers from Novgorod. Over the course of almost 800 years of their stay in this region, they have adapted to the natural environment. This applies to nutrition to a high degree: "Adaptation of

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traditional nutrition is a close connection of this element of folk culture to the possibilities of the natural environment in the habitat. Adaptation means human action to change the conditions of food supply in accordance with their needs and demands, as well as adjusting newly introduced products and dishes to national tastes.” The first settlers brought the rudiments of agriculture to the region. Before their arrival, bread was not at all in the culture of the indigenous population. The Pomors also grew turnips, which gave a bountiful harvest, and cabbage. Sea fish and fish dishes form the basis of Pomor cuisine. On the Kola coast of the White Sea, there is still a saying: “If you don’t eat a rattle, don’t drink tea, and you won’t work.”

Consequences of the loss of traditional food systems. When people remain close to their traditional environment, the decline in their use of traditional foods is a gradual process. People displaced from their home areas have little opportunity to retain traditional knowledge of available resources and technologies for processing and use. They are forced to adapt to new food patterns and are unlikely to pass on traditional food knowledge to the next generation. Overall, the loss of traditional food systems will result in a decline in culturally specific foods and a decrease in dietary diversity for rural residents, especially if hunting, gathering and other traditional activities are discontinued and foods are purchased from stores. There may be health consequences for indigenous peoples as they change their lifestyles. With a decrease in the use of marine mammals, fish and fish oils, indigenous peoples who have these items in their traditional food systems will experience a decrease in the amount of omega fatty acids in their regular diets, which may impact the occurrence of various chronic diseases. Maintaining the integrity of knowledge about traditional cultural food systems is essential to ensuring sustainable development.

The Arctic zone of Western Siberia is the homeland of indigenous peoples engaged in traditional reindeer herding and fishing. The life of a reindeer herder is harsh. In the structure of morbidity of the adult indigenous population, respiratory diseases are in first place. According to some authors, the consumption of vitamins and ω -3 fatty acids with food prevents the development of chronic bronchopulmonary diseases. The main source of these protective food components for the indigenous population is traditional nutrition (venison and local fish). The aim of our study was to study the effect of traditional nutrition on the most important mechanisms for preventing respiratory and circulatory diseases in reindeer herders of the Yamal Peninsula. 1015 people were examined, including 796 indigenous villagers and 219 indigenous tundra residents. Diet analysis was carried out using questionnaires developed at the Federal Research

Center of Nutrition and Biotechnology. All patients underwent the following: anamnesis collection, examination by a therapist and pulmonologist. An analysis of the dynamics and monitoring of consumption of venison and local fish for the period 2013–2018 was carried out.

Among the indigenous inhabitants of the tundra and national villages, over the course of 5 years, the following has been observed: a decrease in the consumption of local fish by 50.0%, and venison by 40.0%.

The highest incidence of hypertension is observed in the Tazovsky District, chronic non-obstructive bronchitis and overweight in the Nadym District. A tendency toward a decrease in the prevalence of chronic non-obstructive bronchitis and an increase in hypertension and overweight is noted. Depending on the routes of contact, an increase in the prevalence of chronic non-obstructive bronchitis was found due to the severity of the climate (an increase in the north-east direction), and overweight - depending on the availability of imported products (an increase near large settlements). Thus, the health of the indigenous population is most affected by the provision of traditional foods and the impact of weather and climate factors.

The use of animal and plant raw materials from the Arctic zone is not only a contribution to the health of the Arctic inhabitants, but also an important social project that allows the indigenous population to be provided with work and, at the same time, to preserve the traditional way of life.

In the food supply of the population of the Arctic and the Far North, a significant place is occupied by traditional industries - reindeer herding, fishing, hunting, procurement of wild products, etc. Of these, the most important industry in economic and social terms is reindeer herding, since today in the Arctic there is no other type of domestic animal that could convert the phytoresources of many millions of hectares of tundra and forest-tundra into meat, antlers, EFS, leather and fur raw materials and other products useful for humans. Just as there is no other similar branch of animal husbandry with which the fate of the indigenous peoples of the North would be inextricably linked. The sale of products from this industry is the main and often the only source of cash income for reindeer herders. In Russia, which ranks first in the world in terms of the number of domestic reindeer, until recently reindeer herding was a branch of production specialization in more than 260 large collective and state farms. In the structure of commercial output of specialized farms, revenues from the sale of reindeer herding products before the beginning of perestroika amounted to an average of 16-19% in the North. The denationalization of large reindeer herding farms, their transformation into privatized small collective, peasant, clan forms of management coincided with a period of general

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economic crisis in the country as a whole. Those regions that did not break up and privatize existing reindeer herding farms turned out to be relatively viable - these are the Nenets and Yamalo-Nenets Autonomous Okrugs, the Komi Republic and the Murmansk Region. In all other Arctic regions, after the breakup of reindeer herding farms, there was a sharp decline in commercial production. Over the period from 1991 to 2023, the number of northern domestic reindeer in the Russian Federation decreased by 22.4%. At the beginning of the new millennium, reindeer herding as a commercial industry survived only in four regions of Russia: Murmansk Oblast, the Komi Republic, and the Nenets and Yamalo-Nenets Autonomous Okrugs. Due to the general economic situation in the country during the global crisis, state support for reindeer herding in 2009–2018 was slightly lower than in the previous period, but increased slightly in 2018–2023, contributing to a slight increase in the domestic reindeer population. In 2023, the Federal Targeted Program “Sustainable Development of Rural Areas for 2023–2025 and for the Period up to 2035” and the industry program “Development of Reindeer Herding in the Russian Federation for 2023–2025” were approved, with a total funding of RUB 5.9 billion, which was to be implemented within the framework of the State Program for the Development of Agriculture for 2018–2035.

This was the first program of this kind to be developed. It took into account not only the factors that would strengthen reindeer herding in the regions, but also focused on preserving the traditional way of life and employment of the peoples of certain territories of the Far North, Siberia and the Far East, on the efficient use of vast pasture feed resources unsuitable for other types of farm animals, and on increasing the production of reindeer products. The need to improve the model of reindeer herding farms with the development of pastures in the taiga zone was emphasized. To achieve these goals, it was planned to increase the number of reindeer in farms of all categories by 2025 (compared to 2018 figures) by 33 thousand heads - up to 1.624 million heads, and to increase meat production by 6.7 thousand tons. In areas where large-scale commercial reindeer herding is concentrated, it was planned to create modern technological complexes (workshops) for primary and deep processing of meat and related products with refrigerated storage facilities. It was supposed to expand transport and logistics services and promote the formation of markets for the sale of products of traditional farming. Analysis of the dynamics of the domestic reindeer population in the Russian Federation showed that over the years of the program's implementation, 7 reindeer herding regions allowed this indicator to decrease (Table 7).

Table 7. The population of domestic reindeer in the Russian Federation for 2018–2023

Name of the region		2018	2021	2023	2018 in % to 2023
Item No.	Russian Federation	1642.2	1531.6	1602.3	97.5
1	Komi Republic	89.9	85.31	85.8	95.4
2	Arkhangelsk region	188.5	173.4	179.3	95.1
3	including Nenets Autonomous Okrug	186.6	171.5	177.5	95.1
4	Murmansk region	54.9	54.4	56.2	102.3
5	Khanty-Mansiysk Autonomous Okrug	38.1	38.5	40.6	106.5
6	Yamalo-Nenets Autonomous Okrug	739.9	671.4	733.5	99.1
7	Republic of Buryatia	0.5	0.6	0.6	120,0
8	Republic of Tuva	2.5	3.3	3.5	140.0
9	Transbaikal Territory	2.6	2.9	3.1	119.2
10	Krasnoyarsk region	99.0	107.1	116.3	117.5
11	Irkutsk region	0.5	0.7	0.9	180,0
12	Republic of Sakha (Yakutia)	177.1	165.3	156.0	88.1
13	Kamchatka Krai	42.3	44.8	48.8	115.3
14	Khabarovsk Krai	6.0	5.8	6.1	102.0
15	Amur region	6.5	6.7	6.7	103.1
16	Magadan region	21.2	12.8	14.4	67.9
17	Sakhalin region	0,1	0,1	0,1	100,0
18	Chukotka Autonomous Okrug	172.5	158.2	152.3	88.3

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The decline in the number of animals was especially noticeable in such subjects as the Sakha Republic (Yakutia) - by 11.9%, Magadan Region - by 32.1%, Chukotka Autonomous Okrug - by 11.7%. In the Northwestern Federal District, a slight decrease in the number of livestock was recorded in the Arkhangelsk Region (Nenets Autonomous Okrug) and the Komi Republic, in the Ural Federal District - in the Yamalo-Nenets Autonomous Okrug due to an environmental disaster on pastures in 2023. At the same time, albeit small, but positive dynamics were shown by the regions of forest reindeer herding: Khanty-Mansiysk Autonomous Okrug - 106.5%, the Republic of Buryatia - 120.0%, the Tyva Republic - 140.0%, Irkutsk Region - 180.0%, Zabaykalsky Krai - 119.2%. The Khabarovsk Territory, Amur and Sakhalin Regions demonstrate stability in the population. Such an important reindeer herding region as Krasnoyarsk Territory demonstrates good growth rates of the population - 117.5%. Unfortunately, in the Russian Federation as a whole, the planned figure of the program - 1.624 million heads - in 2024 was not achieved. At the same time, the selective agricultural census of 2018 showed the number of domestic reindeer at 1.906 million heads, which indicates the inaccuracy of the survey of this type of animal.

In the natural-geographical format, reindeer herding can be divided into two large types: tundra and taiga. At the same time, the majority of reindeer herding farms can use both tundra and taiga zones during the annual cycle of migration, i.e., it is actually interzonal reindeer herding. Of the 1,600 thousand domestic reindeer, only 120 thousand, or less than eight percent, graze in the forest zone all year round, the rest of the reindeer herding is tundra or interzonal.

Tundra interzonal reindeer herding in the northwestern part of the Arctic zone of the Russian Federation can be a profitable industry even at the current level of prices for reindeer meat. In addition to increasing meat prices, the profitability of reindeer herding can be increased by approximately 1.5-2 times due to the sale of EFS, blood, skins, heads, dry antlers, antlers, camus, etc. In this case, reindeer herding can successfully develop even in the taiga zone. With the use of new technologies that make it possible to obtain medical products from reindeer blood and endocrine glands, even higher incomes can be obtained. However, the introduction of such technologies is effective only when slaughtering a large number of reindeer, that is, only in tundra large-herd reindeer herding. According to the review "Analysis of the Venison Market in Russia", prepared by BusinesStat magazine in 2023, the Russian market's demand for venison in 2018-2023 was almost completely satisfied by domestic production. Over the five-year period, venison production decreased by 34.3% - from 9.9 thousand tons to 6.5 thousand tons. The dynamics of the indicator were multidirectional. Its growth was recorded in 2013 and 2018. In 2018 and 2023, venison production demonstrated a decrease of 14.2% and 32.3% compared to the levels of previous years, respectively. During these years, the main efforts of reindeer herders were aimed at increasing the number of animals. This was especially relevant in 2023 due to the need to eliminate the consequences of local reindeer mortality as a result of fodder shortage in 2018-2023. In 2023 and 2024, there was a significant increase in venison production - by 12.3% and 16.4%, respectively. This became possible due to the ongoing restoration of the livestock. In 2023, the production of reindeer for slaughter in live weight in farms of all categories was estimated at 16.9 thousand tons, which is 62.5% or 6.5 thousand tons more than in 2018. In 2018-2023, production grew at a more moderate pace - by 2.2-4.7% per year. Supplies of Russian reindeer meat abroad are developing. They are mainly carried out by agro-industrial enterprises located in Yamal. The volume of exports largely depends on the volume of meat production. Reindeer herding makes a significant contribution to providing the Yamalo-Nenets Autonomous Okrug with meat, and the region's leadership is trying to maintain a balance between meeting domestic needs and receiving export revenue. In 2021-2023, when meat production was at a high level, export volumes amounted to 420-456 tons per year. On the contrary, in 2023 and 2024, when venison production was declining, the volume of deliveries abroad fell to 335 tons and 336 tons, respectively. According to the results of the five-year period, the volume of venison exports from Russia decreased by 26.4% - from 456 tons to 336 tons. Currently, the restoration of the Yamal reindeer population is proceeding at a fairly steady pace, and the regional leadership is making optimistic plans for the development of exports. It is expected that in 2025 the volume of Russian venison exports will reach 600 tons. An important source of commercial products, including export, are reindeer antlers and horns. However, this type of production is still opaque and difficult to account for and regulate. Assessing the potential of pastures for grazing domestic reindeer in the Far North, taking into account their reindeer capacity, it should be noted that the possibility of increasing the number of animals is more than 360 thousand heads. Particularly great prospects for increasing the number of domestic reindeer are in the Republic of Sakha (Yakutia), Chukotka Autonomous Okrug, Magadan Region, Kamchatka Krai, and Evenki Municipal District (Table 8).

Forest pastures are practically not developed today due to the lack of shepherds who have the skills and technologies for year-round grazing of domestic reindeer in the taiga zone.

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Table 8. Potential of Far North pastures for grazing domestic reindeer

Name of the region	Total area of reindeer pastures, thousand hectares	Design capacity of pastures for reindeer, thousand heads	Actual population as of 01.01.2025, thousand heads
Komi Republic	6342,0	110,0	85,8
Nenets Autonomous Okrug	12375,0	180,0	177,5
Murmansk region	7127,1	63,7	56,2
Khanty-Mansiysk Autonomous Okrug	6086,5	48,0	40,6
Yamalo-Nenets Autonomous Okrug	48551,6	452,0	733,5
Taimyr (Dolgano-Nenets) MR	33194,7	91,6	112,0
Evenki MR	12150,8	65,0	7,2
Republic of Sakha (Yakutia)	92453,7	406,2	156,0
Kamchatka Krai	16506,2	135,0	48,8
Magadan region	18475,9	122,0	14,4
Chukotka Autonomous Okrug	42597,8	410,6	152,3
By regions of the Far North	295861,3	1962,1	1602,3

Over the years of reforms, reindeer herding in the Russian Federation has largely lost its commercial significance, primarily in the northeastern tundra and taiga parts of the Arctic zone. At the same time, it retains its socio-economic and ethnocultural significance for the indigenous peoples of the North. Federal target programs for the development of reindeer herding were fully funded, but the effectiveness of their implementation turned out to be low: for example, the reindeer population in 7 regions did not reach the planned level. Commercial reindeer herding is preserved only in 4 regions, and venison production in the Arctic zone is gaining momentum again after a slight decline. This became possible due to the ongoing restoration of the herd. In 2024, reindeer production for slaughter in live weight in farms of all categories was estimated at 16.9 thousand tons, which is 62.5% or 6.5 thousand tons more than the 2018 level. In 2018-2023. Production grew at a more moderate rate of 2.2-4.7% per year. Russian venison exports are growing and are expected to reach 600 tons in 2025. Reindeer antlers and antlers are an important source of commercial products, including export products. The potential for increasing the domestic reindeer population in the Russian Federation is more than 360 thousand individuals. There are particularly great prospects for increasing the population in the Sakha Republic (Yakutia), the Chukotka Autonomous Okrug, the Magadan Region, the Kamchatka Territory, and the Evenki Municipal District. Commercial forest reindeer herding is virtually non-existent today due to the lack of shepherds with the skills and technologies for year-round grazing of domestic reindeer in the taiga zone. The habitat of the reindeer species (*Rangifer tarandus*) is located in

areas with a harsh Arctic climate. The reindeer is an exclusively grazing animal, its diet does not include stimulating additives and industrial feed, with a variety of green vegetation in the summer and lichen (lichen) in the winter. According to the international classification, such meat is grass fed - grown on pasture. As a result of such nutrition, unique dietary characteristics of venison are formed: a relatively low fat content, the predominance of biologically active microelements - copper, zinc, iron. It contains virtually no hormones, pesticides and antibiotics. In terms of the content of toxic substances: dioxins, chlorine, lead, cadmium, nitrates and nitrites, venison is the most favorable type of meat. Scientific research data allow us to confidently recommend venison for regular, preventive, therapeutic, special, rehabilitation and baby food. According to the general chemical composition, venison contains protein - 21-23%, fat 3.3-4.8%. This ratio makes venison an important product for dietary and gerontological nutrition, especially for people suffering from excess weight, cholesterolemia, and metabolic disorders. In the Arctic zone, about half of the venison is obtained from the slaughter of six-month-old animals. There is an opinion that at this age their meat is less valuable in its biochemical, nutritional and taste qualities compared to meat from animals of older age groups. In 2018, GOST 32227-2018 "Deer for slaughter. Venison in carcasses and half-carcasses. Technical conditions" came into force, according to which young deer were animals from 4 months to 2 years of age, regardless of gender, and accordingly, the meat from their processing was called "venison from young animals". Previous studies have shown that when slaughtering adult males, a carcass weighing 52-66 kg is obtained, adult

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females - 36-53 kg, the slaughter yield is 50.3 and 49.2%, respectively. When studying the morphological composition of carcasses of 6-month-old young animals, it was found that they contain an average of 70% muscle tissue, 4.4% fat, 8.3% connective tissue, and 17.3% bone, while in adult

carcasses the corresponding figures are 70.9; 6; 7.1; 16%. The area of the "muscle eye" studied in domestic deer is 12-15 cm² in 6-month-old young animals and 18-22 cm² in adults (Figure 4). The diameter of the muscle fiber is 33-37 and 42-60 μk, respectively.

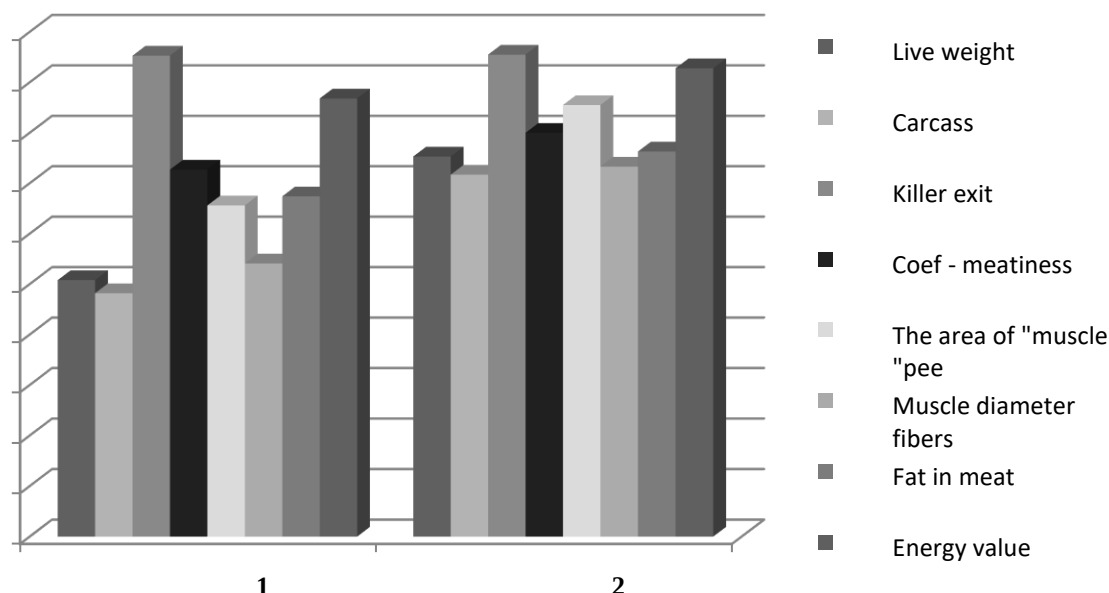


Figure 4. Quality indicators of reindeer meat at 6 months (1) and 18 months (2) of age (indicators of adults – 100%)

Given the low cost of meat products, slaughtering young animals at an early age makes their raising more economically profitable than keeping deer until older ages. Early slaughter has been practiced in industrial reindeer herding since the 1960s; to increase the yield of marketable young animals in herds, it is recommended to increase the proportion of females to 60-65%. In traditional ethnic reindeer herding, early slaughter of young animals is usually done to obtain high-quality skins for further sewing of national clothing. Reindeer are usually slaughtered for meat at the age of 1.5 years. The issue of the quality and taste of meat when slaughtering young animals at the age of 4-6 months is still debatable. Opponents of early slaughter of deer point to the wateriness and low nutritional value of veal, while its supporters attribute these qualities to positive ones, determining the dietary properties of young venison.

Live weight, carcass weight and internal organs of reindeer were determined by the weight method directly at the slaughter sites of reindeer herding farms in the Yamalo-Nenets Autonomous Okrug during autumn slaughter. Animals aged 6 and 18 months, typical in development and live weight, were selected for slaughter. Slaughter, deboning, sampling, biochemical and organoleptic analysis of meat were carried out according to the methods of

VNIIMP and VIZh. A total of 40 carcasses of males of each age were examined. The longissimus dorsi muscle was taken from 3 males and 3 females from each age group on the cross section between the 9th and 12th ribs. The samples were cleaned of surface fat and fascia and placed in a double polyethylene bag. Samples of minced meat and the longissimus dorsi muscle were stored frozen at a t° not exceeding 18°C before the study. The contours of the longest back muscle were drawn on tracing paper, then the area of the "muscle eye" was determined using a planimeter. In the longest back muscle, the amino acids tryptophan (according to Graham and Smith), oxyproline (according to Neumann and Logen, modified by Verbitsky and Deterage) were additionally determined. The protein quality indicator was determined by the tryptophan to oxyproline ratio, the content of other amino acids - on an ND-1200 amino acid analyzer. The diameter of the muscle fiber was determined on the longest back muscle, after dissection, using an MBI-1 microscope (8x objective), equipped with an AM-9-2 screw eyepiece micrometer (15x eyepiece), which contained a microscopic ruler. In each sample, the thickness of 100 fibers was determined. The organoleptic evaluation of boiled meat and broth was carried out on a 5-point scale, the longest back muscle from 3 males from each age group was

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examined. The cost of venison was calculated using the generally accepted method in reindeer farms. Our studies have shown that the carcass weight of 6-

month-old deer is inferior to adult males by 51.8%, i.e. almost 2 times, at the age of 18 months this difference is reduced to 28.3% (table 9).

Table 9. Changes in meat quality indicators depending on the age of reindeer

Indicator	6 months	18 months	Adults	Young animals in relation to adults, %	
				6 months	18 months
Live weight, kg	55.6	82.4	109.4	50.8	75.3
Carcass weight, kg	27.3	40.6	56.6	48.2	71.7
Slaughter yield, %	49.1	49.2	51.5	95.3	95.5
Meatiness coefficient	4.0	4.4	5.5	72.7	80.0
Area of the "muscular eye", cm ²	16.5	21.4	25.1	65.6	85.5
Muscle fiber diameter, mm	33.7	45.7	62.3	54.1	73.3
Fat in meat, %	4.5	5.1	6.7	67.4	76.3
Energy value, MJ/1 kg (kcal) OE	5.2 (1246)	5.6 (1332)	6.0 (1428)	86.8	92.8

The difference in slaughter yield between the studied groups is insignificant, it increases with age by 0.1-2.4%. In morphological terms, meat has a complex tissue complex, and the most valuable part of the meat is skeletal muscles. The color of the muscle tissue in the studied samples was dark red, and it was darker in adult individuals than in young animals. The dark color of reindeer meat is due to a higher content of myoglobin, the hemes of which contain a lot of iron. With age, the meatiness coefficient (the yield of meat and fat per 1 kg of bones) increases in reindeer, as in other farm animals. In our experiment, this increase was 20-27%. Another quality indicator of meat - the area of the "muscle eye" - increases in adults by 34% compared to 6-month-old animals and by 14% - compared to 18-month-old animals (Figure 5). The diameter of the muscle fiber - by 46% and 17%, respectively. An important indicator determining the dietary properties of any meat is the relative fat

content. Venison obtained from the slaughter of 6-month-old calves has 33% less fat than adult males, when slaughtered at 18 months of age, this difference decreases to 24%. Accordingly, with age, the energy value of venison increases by 13 and 8%. In almost all studied indicators, except for slaughter yield, adult deer had a significant advantage over young animals.

One of the main characteristics of the value of proteins of any food raw material of animal and plant origin is the ratio of replaceable and essential amino acids or the amino acid index. A comparative assessment of the amino acid composition of meat from animals of different ages (Table 10) showed that 6-month-old animals are inferior to 18-month-old animals in terms of the content of lysine (42.0%), histidine (25.0%), arginine (34.0%), methionine (50.0%), isoleucine (36.0%) with a reliable degree of difference (p 0.001).

Table 10. Changes in the amino acid composition of meat depending on the age of reindeer, g/100 g protein

Amino acid	6 months	18 months	Adults
Lysine	1.64 ± 0.05	2.33 ± 0.12	0.85 ± 0.10
Histidine	0.84 ± 0.01	1.05 ± 0.05	0.91 ± 0.13
Arginine	1.32 ± 0.06	1.77 ± 0.04	1.85 ± 0.44
Threonine	0.94 ± 0.01	0.91 ± 0.02	0.79 ± 0.26
Valin	0.93 ± 0.01	0.87 ± 0.05	0.48 ± 0.07
Methionine	0.14 ± 0.01	0.21 ± 0.02	0.18±0.10
Isoleucine	0.89 ± 0.02	1.21 ± 0.04	0, 93±0,22
Leucine	1.64 ± 0.03	1.67 ± 0.06	1.27 ± 0.19
Phenylalanine	0.87 ± 0.02	0.83 ± 0.03	0.76 ± 0.06
Total essential acids	9.21	10.85	8.02

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Aspartic acid	1.75 ± 0.03	1.79 ± 0.08	1.81 ± 0.51
Serene	0.81 ± 0.02	0.76 ± 0.02	0.42 ± 0.64
Glutamic acid	2.73 ± 0.05	3.81 ± 0.18	0.98 ± 0.17
Glycine	0.84 ± 0.01	0.78 ± 0.02	0.82 ± 0.95
Alanine	1.17 ± 0.02	1.12 ± 0.02	1.32 ± 0.25
Tyrosine	0.81 ± 0.02	0.72 ± 0.03	0.71 ± 0.11
Proline	0.83 ± 0.02	0.87 ± 0.02	0.67±0.14
Total replaceable acids	8.94	9.85	6.73
Amino acid index	1.03	1.10	1.19

In terms of the amount of essential amino acids (valine, leucine, threonine, phenylalanine), the difference does not exceed the limits of random values. Young venison surpasses the meat of adult deer in the content of almost all essential amino acids except arginine (the difference is unreliable). Thus, in terms of the sum of essential amino acids, the meat of 18-month-old deer surpasses the meat of adult and 6-month-old animals by 36.3% and 17.8%, respectively; in terms of the sum of replaceable amino acids, this superiority was 62.5% and 10.2%. The amino acid index changes insignificantly with age: at 6 months of age, its value is 1.03, at 18 months - 1.10, in adult deer - 1.19.

The results of the studies of the amino acid composition of the meat of Even reindeer in Sakha

(Yakutia) showed that the meat of calves is richer in methionine and lysine than that of adult animals. As is known, the proteins of the sarcoplasm and myofibrils of animal meat contain essential amino acids and do not contain the amino acid oxyproline. In connective tissue, proteins are incomplete in amino acid composition (collagen, elastin, reticulin) and do not contain the amino acid tryptophan. Consequently, the ratio of tryptophan and oxyproline can be used to judge the biological value of meat proteins, and this ratio of amino acids is called the protein quality indicator (PQI). In our study, in 6-month-old reindeer (Table 11), the tryptophan content is 40% higher in males and 44% higher in females than in 18-month-old animals.

Table 11. Protein quality index (PQI) of the longissimus dorsi muscle (m. Longissimus dorsi) of reindeer of different ages

Indicator	Age, months			
	6		1	8
	Males	Females	Males	Females
Tryptophan, mg%	247.7 - 11.47	273.7-7.12	146.8 - 2.64	155.2 - 3.02
Oxyproline, mg%	23.4 - 1.44	22.2 - 0.95	9.3 - 1.13	11.3 - 1.76
BKP	11.8 - 0.51	12.4 - 0.54	17.0 - 2.49	14.6 - 1.48

The oxyproline content in deer decreases more than twofold with age. As a result, the BCP of 18-month-old males exceeds the BCP of 6-month-olds by 41%, and by 18% in females, respectively. The absence of data in the literature on the ratio of tryptophan and oxyproline content in adult deer does not allow a comparative analysis between groups of animals of different ages. It was previously noted that the maximum BCP is observed in 1.5-year-old deer and is largely

associated with the fatness of the animals. The organoleptic indicators of meat and broth in 6-month-old calves were rated by experts as the lowest (Table 12). The taste of boiled meat from 18-month-old animals turned out to be the highest, and the quality of the broth is higher in adult deer. The total assessment of venison at slaughter at the age of 18 months was equal to adult animals.

Table 12. Organoleptic assessment of deer meat of different ages on a 5-point scale

The indicator under study	6 months	18 months	Adults
Boiled meat	4.2±0.22	4.8±0.19	4.5±0.33
Bouillon	3.9±0.36	4.4±0.25	4.7±0.41
Overall rating	8.1	9.2	9.2

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A comparative analysis of the cost price of deer meat of different ages shows that the economic efficiency of slaughtering deer at 6 months of age is twice as high as slaughtering adults (Table 13). This

is due to the low labor costs of raising deer up to 6 months of age with the same selling price of meat products.

Table 13. Cost price of venison obtained at different ages

Expense item	6 months	Adults
Costs per 1 centner of production, man/day,	2.7	5.2
including wages per 1 centner of output, RUB %	490	1250
	63.3	72.9
Indirect costs per 1 centner of production, RUB %	280	560
	36.7	31.0
Cost price of 1 centner of growth, rub.	780	1810

Thus, the comparative analysis showed that the meat of 18-month-old reindeer exceeds that obtained from the slaughter of 6-month-old calves in terms of fat content, amino acids, BCP and organoleptic indicators. The slaughter yield and amino acid index of reindeer change insignificantly with age. Due to the low content of metabolic energy, oxyproline and high amino acid index, venison can be used as a dietary product. To produce high-quality meat, reindeer should be slaughtered at the age of 16-18 months. Mass slaughter of young animals at the age of 6 months allows to significantly reduce the cost of venison production, and in case of a shortage of winter pastures, to reduce the load on them. The latter is especially important for the overloaded tundra pastures of the Yamalo-Nenets and Nenets Autonomous Okrugs. The geographical concept of the Arctic includes territories whose southern border is the southern border of the tundra. But, based on the Decree of the President of the Russian Federation of May 2, 2014, No. 296, the land territories of the Arctic zone of the Russian Federation include, in particular, the entire territory of the Yamalo-Nenets Autonomous Okrug, the southern border of which runs in the taiga zone. This allows us to use a larger number of historical examples, which we find it possible to comment on. In 1643, a petition was sent to the tsar from the Berezovsky district, which included the territory that now belongs to the Yamalo-Nenets Autonomous Okrug, speaking, among other things, firstly, about the impossibility of paying yasak due to the lack of furs. The petitioners explained this lack by "lean" years for squirrel, as well as for fish, which the petitioners had previously exchanged in dried form for "soft junk" from visiting "marine Kazym Samoyeds". This "Samoyed" probably refers to the Forest Nenets, who "in 1511 fought with the Karachay Samoyed // the Nenets of the Ob Bay coast // and did not go hunting for wood goblins." Secondly, there is information about

famine, including mass mortality ("And many Obdorsk Ostyaks with their wives and children died of hunger," "And many Ostyaks from the Kunovatsky volost with their wives and children died of hunger"). The events mentioned took place, in particular, in the territory that today belongs to the Shuryshkarsky District of the Yamal-Nenets Autonomous Okrug, i.e. to the southwestern, taiga part of the autonomous okrug. G.F. In the 18th century, Miller in his "Description of the Lower Ob River and the Rivers Flowing into the Ob: from the Place of Its Division into the Bolshaya Ob and Malaya Ob" reported the death of the population of a small town in the lower reaches of the Nadym River in 1730. The historian's report is confirmed by the legend of local indigenous residents. We are talking about a case of famine among a relatively small group of people, caused by completely exceptional circumstances. Obdorsk assessor Yu.I.Kushelevsky, who in the 19th century, on the instructions of the Krasnoyarsk entrepreneur M.K. Sidorov, carried out research into promising summer and winter routes between the Yenisei River and the village of Obdorskoye, testified to the famine among the "Turukhansk foreigners" in the spring of 1863. At the same time, Yu.I.Kushelevsky noted: "The fishing industries along the river." "The Taz and especially the mouth of this river are so rich that I have never seen anything like them anywhere. So my workers would cast their small net and pull out 90 nelma with roe at a time, each weighing no less than 15 pounds (more than 6 kg). There is nothing to say about the moksun, chir and pike of amazing size."

Trying to resolve the observed contradiction between the abundance of local natural resources and the poverty of the ethnic group, the traveler writes: "Meanwhile, the local aliens are unable to get themselves a seine. Need forces them to make seines from willow bast and, despite this inconvenient and impractical means, they catch fish both for daily food

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and for storage. Only the long cold spring makes them starve and even often die of hunger.” On another page of his notes, Yu. I. Kushelevsky reported a typical example of seasonal malnutrition in the family of a priest of the Tazovskaya Church. Pictures reflecting the problematic food existence of the aborigines of the taiga and forest-tundra, whose reservoirs, according to the testimony of travelers, were extremely rich in fish, make us assume that one of the reasons for the hunger strikes of the indigenous groups of the region is the difference in the mentality of reindeer herders-hunters, on the one hand, and fishermen, on the other. Fishermen were never forced to work as continuously as reindeer herders. In addition, with the availability of alcohol imported by merchants, fishermen could even afford long group drinking bouts, as described by many contemporaries, which was unthinkable for the owners of reindeer herds. As a result, periodically, under unfavorable climatic conditions, abnormally prolonged springs, the results of the fishermen's labor were sometimes not enough. Famine began among them. Vasily Ivanovich Nemirovich-Danchenko (the elder brother of the reformer of the Russian theater Vladimir Ivanovich Nemirovich-Danchenko), widely known in the late 19th - early 20th centuries as a writer, traveler and describer of the northern outskirts of the Russian Empire, in particular, visited the Turukhansk region, the territory of the western part of which falls on the current Tazovsky and Krasnoselkupsky districts of the Yamal-Nenets Autonomous Okrug. In the essay "Yuraks" we find the following: "The main occupation of the Yuraks is reindeer herding. "The deer gives them material for housing, fur, and skins for clothing, and means of transportation. The Yuraks value it to such an extent that sometimes they do not dare to slaughter a domestic deer, whereas, having killed a wild one, they greedily pounce on its meat, and eat it at 14 pounds per person. They are ready to endure hunger rather than sacrifice one of these gentle and useful animals from their herd. Fishing and hunting for birds provide them with abundant food, which is why in the summer they migrate to the river and lake shores. Their herds reach 1000 heads, and in any case they are richer than the Samoyeds and Ostyaks, whose trades, already described by us, are completely similar to those of the Yuraks."

Russian and Soviet archaeologist, enographer and hydrologist S.I. Rudenko in his work "Aliens of the Lower Ob. Ethnographic Essay" outlined his observations and the following point of view on the issue of northerners' nutrition: "As for what animals, birds and fish are used for food, it must be said that everything is eaten: seagulls, owls, squirrels, bears, wolverines and other predators, and all kinds of fish. They do not eat animals that are taboo for a given tribe – be it the Ostyaks or Voguls. It can be safely stated that nature provides the population of

northwestern Siberia with enough food, and with its rather limited needs, there can be no talk of hunger; however, it must be noted that the food is exclusively animal – there is absolutely no plant food." B.M. Zhitkov, describing the diet of the Nenets in the book "The Yamal Peninsula", written based on the results of his expedition in 1908, reported: "Their diet is abundant and varied. In addition to reindeer meat and fresh fish, they also stock up on dried fish, varka (fish oil), dried goose meat. In Obdorsk they buy flour, rye crackers, baked rye and white bread, pretzels, butter, brick tea (which everyone drinks and loves) and tobacco, and the richer ones also sugar and coarse flour." To the surprise of Russian researchers, the Khanty (with the exception of the Kazym Khanty) and the Nenets, despite the abundance of berries, did not pick them, just as they did not pick or eat mushrooms at all. Culinary art did not play any significant role (as, incidentally, it does not play to this day). Meat was consumed in large quantities raw (as well as fish) in the summer - fresh, in the winter - frozen. In the spring, the inhabitants of the region collected goose eggs for food. The Nenets ate all birds, not excluding loons, skuas and birds of prey. The onset of the Bolshevik era brought completely new realities to the far north of Western Siberia, as well as throughout the country. Already in the very first years, the state's pressure on the population of the northern outskirts of the country grew incomparably with previous times. As a result of the civil war, its manifestations in the form of anti-Bolshevik rebellions of 1921, as well as as a result of economic collapse, crop failure and the state's obstacles to self-organization of the population to overcome the food deficit (bagmen), 1921 and 1922 became famine years for Russia. In many areas of the middle and lower Volga region and other southern territories, this led to mass mortality, newspapers reported numerous cases of suicide and cannibalism. Mass mortality was also observed in the southern regions of Western Siberia, for example in the Tyumen district the number of officially registered deaths from starvation on May 20, 1922 was 573 people. In the far north of Western Siberia the famine did not acquire its full form, however, the collapse of the fishing industry and the trade that accompanied it created significant problems, expressed at least in the depletion of both the diet and the volume of food. In addition to these destructive factors, after the suppression of the Siberian peasant rebellion of 1921, firearms were taken away from the native and non-native local residents, which, as reported by the press organ of the Tobolsk Military Revolutionary Committee, "Soviet North", "were partly stolen, partly stored and perished in some primitive warehouses." As a result, as one of the archival documents from 1922 testifies, a situation arose in which hunters were forced to hunt as in ancient times with bows and even simple sticks. Despite these

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collisions, part of the population of the territories adjacent to the north of Western Siberia tried to flee here, saving themselves from severe hunger. As a result, for example, the number of residents of the largest village on the shore of the Ob Bay, He, increased by 73% from 1921 to 1923. The northerners, despite all sorts of regulations and prohibitions that had come into force, were, as always, saved, first of all, by the fish wealth of the local reservoirs. The assumption made before the revolution by individual officials, scientists and ordinary people about the long-standing process of extinction of the local "foreigners", which had been going on since the tsarist times, turned into an official statement in the first years of the new government. In materials prepared in 1922 for the leadership of the Main Directorate of the Northern Sea Route, a certain Berezyanin asserted: "Our northern foreigners were once a numerous population of a free and rich country that knew its heroes, its bogatyr, and had its own laws and customs. Now these foreigners are only the pitiful remnants of dying tribes that have stopped at one of the lowest stages of cultural development and are gradually losing even that which once provided them with at least their material well-being: reindeer herding has fallen into decline, the fur trade has greatly diminished, even fishing poorly provides for the foreigners - these natural hunters." Some dissonance to the above was followed by the admission of the same author that he personally "... managed to collect statistical material on the birth and death rates of the Ostyaks - Samoyeds of the Ob River delta in the summer of 1914. It should be noted that the foreigners covered by the survey were in the most unfavorable conditions of existence. Despite this, out of 48 registered families, only one turned out to be childless, 2 families gave unclear testimony, 45 mothers had 223 children, or an average of 5 children per mother. Thus, on the basis of the obtained material, the childlessness of foreigners is not confirmed. But be that as it may, the general extinction of foreigners remains a fact that must be seriously taken into account." The history of the Arctic zone of Western Siberia knows examples of famine that arose among the "dekulakized" and deported to the far north of Western Siberia special settlers. This famine led to mass mortality. Including on the island of Puiko, in the middle reaches of the Nadym River, on the eastern coast of the Yamal Peninsula. The Nenets reindeer herders were strictly forbidden to treat the settlers with any food. And the surrounding nomads could do this only in those rare cases when the authorities could not see it. As the old-timer A.G. Kotlyarchuk said about the years of the Great Patriotic War: "We lived here at the expense of the Nenets. If it weren't for them, we would have died of hunger here, like there, in Nadym." In 1947, there was a famine among the reindeer herders of the northern Yamal Peninsula. The famine was a

consequence of the general, often repressive policy of the authorities towards the reindeer herders and a number of their specific short-sighted management decisions. As S.V. Lezova wrote, "Documentary evidence leads to the conclusion that the main goal of the actions of the Soviet authorities in Yamal during this period was the systematic destruction of the elite part of the native population and the destruction of the traditional life support system of the tundra reindeer herders. The administrative and economic policy of the Party and its local executors led to a catastrophic decline in the northern Yamal reindeer herding and brought the native population to the brink of extinction." A number of documents testify to the fact that the depletion of pastures was not the only reason for the starvation of the population. For example, in a report to the chairman of the executive committee of the Tyumen regional council Koshelev, the deputy chairman of the Yamalo-Nenets district executive committee Pogorelov reported on July 1, 1947: "At the same time, I inform you that in connection with the equally difficult situation of the national population in the Baydaratskaya tundra of the Priuralsky district and the Gydoyamskaya tundra of the Tazovsky district, a partial resettlement of collective farmers to collective farms located on the Ob River has been carried out: Priuralsky district 64 farms, Tazovsky district 25 farms". A secret telegram to the Tyumen regional party committee from the Yamalo-Nenets regional executive committee on June 30, 1947 reported: "... part of the population, especially reindeer herders, are in dire need of money to buy food, that is, systematic assistance. A set of products according to the established norm for a family of 4 people costs 500 rubles a month, or 6,000 per year. On 51 collective farms, the family income is below 3,500 rubles. Fishermen-collective farmers of the Shuryshkarsky district could not go on a fishing expedition without having the means to buy bread. Most of the collective farmers will not have any earnings in October-November, that is, between the fishing and fur seasons." In conclusion, we consider it appropriate to quote the researcher I.I. Krupnik, who wrote: "... there is every reason to consider the demographic history of the Siberian Nenets during the first three centuries of contacts to be quite successful. <...> the main factor that contributed to the numerical growth of the Nenets and some of their neighbors in the 18th-19th centuries was their transition to a large-herd reindeer herding economy. ... Thanks to the rapid growth of herds of domestic reindeer, increasingly frequent slaughter of animals for meat and skins for their own consumption, exchange, sale, etc., families of reindeer herders were able to switch to a more regular diet of meat from their domestic animals. Seasonal and annual fluctuations in food abundance, regular hunger strikes, so typical for hunting or small-scale reindeer economy, have sharply decreased. In the

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conditions of a large-scale reindeer herding economy, reindeer meat has become an abundant and year-round resource. Even families with few reindeer now have the opportunity to eat reindeer meat due to mutual assistance between relatives, exchange, and unification with more prosperous ones." Just ten years ago, we had to observe widespread seasonal (winter) natural exchange between large-scale reindeer herders of Yamal on the one hand, and small-scale and non-reindeer aboriginal fishermen of the southern coast of the Gulf of Ob on the other. The reindeer herders offered reindeer meat and reindeer skins, and the fishermen offered frozen and salted fish, yurok (dried fish fillet), varka (a mixture of rendered fish oil with crushed fish meat and caviar), and wooden products (sledges and koldanki boats). Opposing the supporters of the ecological approach in anthropology, which explains the low population density in the Arctic by low "ecological capacity", I. I. Krupnik noted: "The land of Yamal accepted and provided the necessary resources for existence for several powerful waves of migrants - from the ancient hunters-reindeer herders of the Kharyuchi phratry to hundreds of families of Nenets and Khanty reindeer herders, fleeing collectivization and repression by the Soviet administration in the 1920s and 1930s. All of them found a place in Yamal along with the previous inhabitants of this territory; for all of them, as well as for their descendants, the harsh Arctic tundra of Yamal was a land of abundance, security and freedom." We find it very difficult to describe the famine in the Arctic zone of Western Siberia, if this zone is understood strictly from a physical-geographical point of view, for the reason that the available historical information, if it did reflect serious food problems in the history of the region, then these problems, as a rule, were caused either by very temporary natural conditions and did not last long, or by exceptional personal circumstances of the place and time of a small group of people or individuals, or by the actions of the state. In general, since the mass penetration of fishermen into the Arctic zone of Western Siberia, i.e. since the end of the 19th century, food problems reaching the level of real famine arose only in Soviet times and were not initially caused by natural factors, but were generated in this region by state policy aimed, first of all, at increasing the "socialist commodity production of the national economy." That is, at creating the possibility for the state to take from northerners any amount of the results of their labor in the form of reindeer, fish and furs, in exchange for maintaining only a minimum level of food well-being. And sometimes not maintaining it at all. V.I. Vernadsky wrote "the chemical composition of organisms is closely related to the composition of the earth's crust" (1922) and characterizes the exchange of chemical elements between organisms and the environment. Biogeochemical studies allow obtaining qualitative

and quantitative information about the state of the environment by nature and the level of its pollution.

Conclusion

The study of the content of chemical elements in biosubstrates of the population of the Yamal and Priuralsky districts of the Yamal-Nenets Autonomous Okrug was conducted in 2021 within the framework of the research topic "Comprehensive monitoring of the territory of the original habitat of the indigenous small-numbered population of the Yamalo-Nenets Autonomous Okrug", approved by the Decree of the Government of the Yamal-Nenets Autonomous Okrug dated January 19, 2021 No. 30-P "On approval of the scientific plan of the Yamal-Nenets Autonomous Okrug for 2018". The purpose of the study: to identify the geochemical features of the accumulation of elements in the hair of residents of the Yamal Peninsula and the Urals. Hair samples for analysis were collected in accordance with the IAEA recommendations. Quantitative determination of chemical elements was carried out at the Chemical-Analytical Center of the Institute of Water and Environmental Problems SB RAS. Comparative characteristics of the element content in the hair of residents of the Yamal region (Panayevsk, Se-Yakha and Yar-Sale) with reference values showed deviations from the upper limit of the standard range of Mn, Hg and Ti. All examined residents of the Yamal region showed low Zn content in their hair. Every third resident had insufficient Co content, every fifth - Cu. The maximum Ti content was shown in the hair of the examined residents of the villages of Panayevsk and Yar-Sale (8.51 mg / kg and 5.31 mg / kg, respectively), Mn was detected in high concentrations in the hair of residents of the village of Panayevsk (26.2 mg / kg). The Hg content in the hair of Yar-Sale residents reached 3.9 mg / kg. Mercury is a highly toxic substance. Mercury can enter the environment of the autonomous okrug through transboundary transfer with air and water flows, and from regional potential sources of pollutant (activity of fuel and energy complex enterprises, natural fires, activity of the housing and communal sector, migration of mercury-containing gases along deep fault zones). Mercury enters the human body mainly through the alimentary route. Correlation analysis showed a relationship between Ti and Mn accumulation in hair ($y=2.66x-0.97$; $R^2=0.6$). With an increase in Ti content in hair, the level of Mn accumulation increases. This fact may indicate one source of entry of elements from the environment into the human body. The mineral resource base of solid minerals is localized in the territory of the Priuralsky district (Aksarka settlement). Geological studies have established that the eastern part of the Orangskaya suite coincides with a strip of linear geochemical anomalies of manganese with a length of more than 20 km.

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Titanium-zirconium placers were discovered in the Salekhard area. The accumulation of Ti and Mn in the biomaterial is mainly associated with the geochemical features of the study area and natural anomalies. The level of Zn content in the hair of residents of the Yamal region is 55.75 ± 14.14 mg/kg and is 3.2 times lower than the regional background value (180.56 mg/kg). The content of V and Fe in the studied biological samples is also lower than the average regional values by 6.5 and 3.6 times, respectively (0.012 ± 0.0075 mg/kg versus 0.078 ± 0.056 mg/kg for V, $p < 0.001$ and 20.96 ± 6.90 mg/kg against 75.12 ± 143.09 mg/kg for Fe, $p < 0.01$). Assessment of regional specificity of chemical element accumulation in hair of Yamal region residents allows us to identify Cr, Sr, Sn and Ba elements, the content of which in biosubstrate samples was higher than regional background values. Thus, analysis of the obtained data indicates the presence of geochemical specific features of chemical element accumulation in hair of residents of different regions of the autonomous okrug. Bioconcentration of chemical elements in hair of Yamal Peninsula residents is characterized by accumulation of Cr, Sr, Sn and Ba. Element concentration coefficients in hair of surveyed residents relative to regional background are 3.1 (Cr), 2.7 (Ba), 2.4 (Sr) and 2.3 (Sn), respectively. Low concentration coefficients and insignificant average accumulation levels indicate a natural source of accumulation of these elements in hair. In Arctic residents, exacerbations of circulatory diseases, decreased performance, memory loss and sleep disorders are largely associated with disturbances in the nervous system during geomagnetic disturbances. The qualitative composition of fats in the diet increases the adaptive capacity of the nervous system to the geomagnetic factor, since lipids determine the functional state of the neurocyte membrane. An experimental study was conducted involving 105 sexually mature male Wistar rats divided into 7 equal groups of 15 animals each. The animals received standard diets enriched with olive, linseed, butter, schekur fat (*Coregonus nasus* Pallas), pork and deer fats. The behavioral activity of animals in the open field test was studied daily. Behavioral indicators were recorded automatically using the EtchoVisionXT9 device. The studies were conducted during magnetic disturbances (11 out of 15 days): K-index ($M \pm SD$) = 3.04 ± 1.3 and Z-component of the Earth's magnetic field ($M \pm SD$) = 76.1 ± 67.3 nT. It was found that behavioral activity in the group receiving a diet enriched with schekur fat: the distance traveled ($p = 0.001$) and movement speed ($p = 0.001$) were 2 times greater than in the control group. The horizontal activity indices were highest in the group receiving schekur fat and significantly differed from the control group: the latent time of reaching the arena center ($p = 0.003$) and search

activity ($p = 0.001$). The animals' stress level was the lowest in the group receiving schekur fat compared to the control group ($p = 0.001$). The obtained data can be used to develop diets that enhance adaptation to geomagnetic disturbances for large groups of people living and working in the Arctic. Traditional nutrition for the indigenous people of the Yamal-Nenets Autonomous Okrug is not only a set of certain food products, but also an integral element of the culture of nomadic peoples, a means of prevention and treatment, and the most important factor in increasing the level of adaptation to Arctic conditions. The study examined the consumption of traditional food products by indigenous people of the Yamal-Nenets Autonomous Okrug depending on age, gender, area of residence, nomadic or sedentary lifestyle, the dynamics and monitoring of local fish consumption for the period 2018–2023, and the impact of traditional nutrition on the most important mechanisms for preventing circulatory diseases. Residents of national villages and the tundra of the Tazovsky Peninsula took part in the study. A total of 1,382 people were examined, including 796 indigenous village residents, 219 indigenous tundra residents, and 367 respondents from outside the area. The diet was analyzed using frequency and questionnaire methods. The amount of food consumed was assessed using an album of portions of products and dishes. Blood pressure was measured using the Korotkov method; the presence of arterial hypertension was established in accordance with the recommendations of the All-Russian Society of Cardiologists 2010. Based on the calculated data obtained using logistic regression, we constructed a model of increasing the risk of developing hypertension in the studied population using such a factor as the consumption of local fish in the traditional diet. The prevalence of hypertension in the examined patients was 48.0%. During the observation period, negative dynamics were observed (from 26.6% to 48.0%) in the form of a reliable increase in the prevalence of hypertension ($\chi^2 = 34.1$; $p < 0.001$). In our opinion, the leading and modifiable risk factor for hypertension is a violation of alimentary behavior, namely a decrease in the consumption of local fish. We found a reliable effect of such a factor as the consumption of local fish on the development of hypertension ($\chi^2 = 6.3$; $p < 0.01$; OR = 2.1; 95% CI – 1.1–4.5). During the observation period, negative dynamics (from 26.6% to 48.0%) were observed in the form of a reliable increase in the prevalence of hypertension ($\chi^2 = 34.1$; $p < 0.001$). In our opinion, the leading and modifiable risk factor for the development of hypertension is a violation of alimentary behavior, namely, a decrease in the consumption of local fish. We found a reliable effect of such a factor as the consumption of local fish on the development of hypertension ($\chi^2 = 6.3$; $p < 0.01$; OR = 2.1; 95% CI – 1.1–4.5). During the observation

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The reduction in fish consumption in the traditional diet of the population of the Arctic zone naturally leads to an increase in carbohydrate consumption and the development of hypertension.

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