

The Food (In)Security Issue Across Indigenous Communities in the Russian Arctic: Economic, Social, and Environmental Aspects

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The livelihoods and prosperity of Indigenous Peoples substantially depend on the quality of local ecosystems and biodiversity. Indigenous communities are particularly vulnerable to the detrimental effects of climate change. At the same time, Indigenous Peoples have extensive historical knowledge about the possibilities of responsible and environmentally friendly use of local resources, which allows them not only live in severe conditions, but also adapt to climate change. However, as the changes in the way of living have accelerated under the influence of progressing economic exploration and development of the Arctic, the adaptation is becoming increasingly harder. Establishing food security is exacerbated by the cross-influence of climatic, environmental, economic, social, and cultural transformations that Indigenous communities are experiencing. In the cases of nine territories in the Russian Arctic, the chapter conceptualizes an approach to assessing the level of food and nutritional security with the differentiation of environmental, economic, and social factors that affect the security-related parameters in Indigenous communities. The authors make recommendations on how to improve food security of Indigenous Peoples, mitigate adverse effects of food insecurity on public health, boost self-sufficiency in food, and promote the use of traditional foods and related products in diets.

Introduction

Food security is an important component of the national economic security of both a country as a whole and a particular territory. In accordance with the policy documents of the Food and Agriculture Organization of the United Nations (FAO) (FAO, 1996, 2009, 2015, 2023), this concept is used to characterize the state of the national and global food market and it is interpreted as conditions under which people at any time have physical, social, and economic access to sufficient, safe, and nutritious food that meets the needs and preferences of their diets for an active and healthy life (FAO, 2009). Food Security Doctrine of the Russian Federation (President of the Russian Federation, 2010, 2020a) recognizes food independence, physical availability, economic

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accessibility, and safety of food among integral elements of food security. Achieving the food security status of a particular community implies ensuring the following conditions:

- providing people with food and agricultural products according to scientifically based standards without prejudice to the competitiveness of the domestic food market and the economic security issues;
- protection of people from low-quality food products (both domestic and imported), provided on the basis of quality control on the set of parameters;
- continuous improvement of nutrition standards, especially in ecologically unfavorable regions, and promotion of healthy food and agricultural products;
- establishment of food banks and reserves of food and agricultural products for their use in case of extreme situations (natural disasters, lean years, civil tensions, or any other emergencies that disrupt food supply chains).

A set of policy documents declares the priority status of the food security agenda in Russia (President of the Russian Federation, 2020a; Government of the Russian Federation, 2020b). Nevertheless, certain aspects of the food insecurity problem are becoming increasingly acute for Russia, especially in the context of recent COVID-19 outbreak and the international sanctions regime. Russia is self-sufficient in most of the staples, including wheat, poultry, beef, fish, vegetable oil, and sugar (Wegren & Elvestad, 2018; Ahrens & Galiev, 2021; Götz et al., 2022). Meeting Russia's national food self-sufficiency targets in quantitative terms, domestic agricultural sector fails to secure supply of sufficient volume of qualitative foods in accordance with international standards of adequate and healthy nutrition - a situation of food insecurity (Ivanov, 2015; Erokhin, 2017; Ivanov & Ivanova, 2017).

The unevenness of the sufficiency-insecurity dilemma across Russia highlights the relevance of addressing food security dimensions not only at the federal level, but also in individual entities and territories. The going regional approach is particularly vital in the Arctic zone of Russia due to the substantial gaps in the standards of living between urban and rural dwellers and Indigenous peoples (especially, nomadic communities) (Andronov et al., 2020). The significance of this distinction is consistent with the FAO Policy on Indigenous and Tribal Peoples (FAO, 2015), which reports that about 15% of Indigenous Peoples worldwide live below the poverty line. It postulates that the protection of life support systems and specialized knowledge possessed by Indigenous Peoples may both reverse the erosion of Indigenous cultures and offer new solutions to the food insecurity and malnutrition problems, as well as contribute to global efforts on fighting poverty and environmental degradation (FAO, 2015). However, the issues of the quality of life and food security across Indigenous communities in the Russian Arctic remain underexplored (Poppel, 2014).

Food security and sovereignty of Indigenous Peoples are based on the preservation of traditional types of nutrition. It is a key element of the culture and economy of Indigenous communities in the Arctic, as well as an effective means of preventing health issues and adapting to the Arctic environment (healthy benefits specific to the Arctic climate). According to Andronov et al. (2018), a traditional diet is one in which the portion of traditional foods (venison, local fresh river fish, etc.) exceeds 60%. Under-consumption of traditional animal and fish products may result in an increase in a number of health-related risks, such as the increased incidence rates of cardiovascular

diseases, chronic bronchitis, and metabolic disorders; decrease in adaptive body functions; transformation and erosion of traditional lifestyle; increased dependence on imported food (marketed products, junk food); decrease in quality of life and related demographic issues in the Arctic. As evidenced by FAO (2015), the food insecurity threat to Indigenous communities could be more severe than that to non-Indigenous ones due to the lower standards of living and higher dependence of Indigenous Peoples living in remote territories on a narrower assortment of imported marketed products. Progressing climate change and related environmental transformations in the Arctic, economic and industrial development of traditional Indigenous habitats, and radical shifts in food consumption patterns and the entire way of life of Indigenous Peoples are becoming decisive factors of food insecurity (Dudarev et al., 2013; Erokhin, 2019a, 2019b; Shishaev et al., 2020; Ruiga et al., 2021). Combating the problem requires the development of a methodological approach to improving the sustainability of the traditional economy of Indigenous Peoples, its adaptation to the changing conditions of the Arctic environment, and ensuring an adequate response to the major challenges to social and economic development of the Arctic.

When developing specific approaches to addressing the food security issues across Indigenous communities in the Arctic, one should take into account its specific features, including low self-sufficiency in staples due to limited capacities of domestic agricultural production in the Arctic climate and the dependence of food supply on imports from outside (inner territories or other countries); small number of rural population and poor provision of agricultural resources; poor development of local agricultural facilities and rural infrastructure; lack of stable links with the areas of food production outside the Arctic zone; focal settlements and seasonal food delivery to remote territories (Ivanov & Ivanova, 2017).

The FAO's data on food security issues in the Russian Arctic are based mainly on the data collected at the regional level, not individual territories included in the Arctic zone of the country. Therefore, the data may not adequately reflect the real differentiation and degree of food security problems in urban and rural areas and in nomadic Indigenous communities. Regardless of particular location or way of life, diverse communities of Indigenous Peoples inhabiting the Russian Arctic region substantially depend on traditional food in their diets. Therefore, the issues of their food security and food sovereignty should be studied at the territorial level, taking into account not only economic factors of food supply, but also social, cultural, and environmental dimensions of food security. In this chapter, the authors make an attempt to systematize Russia's approach to ensuring food security of the Indigenous Peoples at the national level, as well as to explore regional specifics of the food security agenda across nine territories of the Russian Arctic. The study conceptualizes an approach to assessing the level of food and nutritional security with the differentiation of environmental, economic, and social factors that affect the security-related parameters in Indigenous communities.

Food Security of Arctic Indigenous Communities: Background and Narratives

Reindeer herding, hunting, and fishing have historically been considered crucial activities for the survival of Indigenous Peoples in the Russian Arctic. The intensification of exploration of natural resources in the Arctic zone of Russia along with the industrial exploration of vast territories in the Yamal Peninsula, Republic of Sakha (Yakutia), and Chukotka and Nenets autonomous districts

(including traditional Indigenous habitats) have triggered a significant increase in the population, mainly urban, aggravated anthropogenic pressure on the environment, and compromised food and nutrition security status of Indigenous communities (Gao & Erokhin, 2020a). The above narratives are addressed in the literature in four main directions: degradation of traditional habitats (not only those of animals, birds, and fish, but also people), contamination of food sources (pastures, water), climate change, and food-borne diseases and related public health issues in Indigenous communities (Gladun et al., 2021; Andronov et al., 2021; Stimmelmayer & Sheffield, 2022).

Until recently, most studies in the sphere of food security in the Russian Arctic focused mainly on small and geographically remote Indigenous communities, such as Nenets in the Nenets Autonomous District and Arkhangelsk Oblast (Murashko & Dallmann, 2011; Lobanova et al., 2013; Andronov et al., 2021), Selkup in Krasnoyarsk Krai (Stepanova, 2020), Khant and Mansi in the Yamal-Nenets Autonomous District and the Komi Republic (Ivanov & Ivanova, 2017; Bogdanova et al., 2020), Evenk and Even in the Republic of Sakha (Yakutia) (Robbek et al., 2015; Petrova, 2018), and Chukchi and Yupik in the Chukotka Autonomous District (Kozlov et al., 2007; Vate & Davydova, 2018; Davydova, 2019). However, approaches to assessing the level of security varied significantly due to different interpretations of food security parameters (Trotsuk et al., 2018). Thus, Gao (2017) and Ivolga (2014) focused on the sustainable development of rural areas in the High North as one of the solutions to the food insecurity problem. Ilinova and Dmitrieva (2016) and Savenkov (2018) considered environmental aspects of sustainable development of Indigenous communities and traditional economic activities. Rodnina (2022) and Ruiga et al. (2021) investigated perspectives of agricultural production across sectors and areas. Among major threats to security, Ivanov and Ivanova (2017) and Hiyama and Takakura (2018) highlighted the declining self-sufficiency of small settlements in food, growing dependence on food supplies from outside (in many cases, junk food of poor quality and nutritional value, but at high prices), as well as the degradation of water and biological resources in most of the territories within the Arctic zone of Russia. Against the background of aggravating food insecurity problems, Kondrashev et al. (2016) and Zimmermann et al. (2023) noted the urgent need to considerably improve self-sufficiency of Indigenous communities with food, preferably traditional foods (food availability and food safety parameters of food security).

Ragulina (2018) developed the concept of food deserts through the lens of the food security narrative in Indigenous communities in the Arctic. The concept emerged in the 1990s to reflect significant violations of key parameters of food security (physical availability, economic affordability, and quality of food) and correlate them with specific territorial issues (Cummins, 2014; Battersby, 2019; Jin & Lu, 2021; Sisk et al., 2023). In general, those communities that inhabit food deserts are characterized by social disadvantages manifested in underemployment and critical role of state support and food aid programs in supporting the food security status of the population (Alviola et al., 2013). Access to food (adequate volume and quality) in such territories is complicated by macroeconomic and social factors, as well as cultural patterns of traditional way of life of Indigenous communities (Lebel et al., 2016; Davies et al., 2017). Initially, food deserts were seen as inherent in urban communities across developed and developing countries, since it was assumed that the products of rural households could compensate for the lack of access to food in cities (Beulac et al., 2009). According to Lebel et al. (2016) and Ragulina (2018), peculiarities of economic transformations in the Russian Arctic along with territorial imbalances of the current economic landscape make it possible to apply the concept of a food desert to Arctic Indigenous communities.

Economic, social, and environmental parameters of food security vary significantly across Indigenous communities in the Arctic (Russian Arctic, Alaska, Arctic Canada, Northern Europe) (Plisetskii & Plisetskii, 2019). Nevertheless, the latter have at least one thing in common, which is a lack of domestic supply of food (physical availability) and over-dependence on food supply from outside. Consequently, two categories of food sources are distinguished: traditional food (domestic) and marketed food (imported). Traditional and non-traditional foods complement each other in diets: when one category decreases, the other increases. Cyclical fluctuations in diets are adaptive, since traditional nutrition is associated with the use of local habitats (herding, hunting, fishing, gathering) and seasonal fluctuations of particular foods in diets. The products of hunting, fishing, gathering, and reindeer husbandry come as a result of the exploitation of functionally different lands within the economic area of a community. The seizure of lands in traditional Indigenous habitats or deterioration of quality of lands due to industrial development act in two ways. First, a gap that emerges in the annual food cycle is to be compensated by an increase in the portion of marketed foods in diets. Changing diets due to an increase in the proportion of non-traditional foods causes metabolic disorders and a variety of public health issues in Indigenous communities (Kuhnlein et al., 2004; Young et al., 2000). Second, not only the lands of certain categories (associated with certain types of traditional economic activities), but also management practices with utilitarian and cultural-symbolic content are withdrawn from the turnover. According to Willows (2005), preference for traditional foods is not only the receipt of food, but also a method of production that supports social relations and distinctive cultural characteristics. This vision corresponds with the FAO's interpretation of sustainable food systems as those ensuring the availability and equitable access to safe and nutritious foods and providing access to diverse, culturally appropriate, and sustainably produced foods on a consistent basis (High Level Panel of Experts on Food Security and Nutrition, 2020). The consumption of traditional foods is the end point of a number of culturally significant processes involved in the collection, processing, distribution, and preparation of food products. Food aid networks, food sharing practices, and distribution of commercial food products merge into a single complex of economic adaptation to the natural environment and contemporary economic and social circumstances. At the same time, the distance from the transport networks and the high cost of transport services compromise physical availability and economic affordability of food across remote territories in the Russian Arctic.

Indigenous Peoples in the Russian Arctic

Russia's legislation defines Indigenous Peoples of the Arctic, Siberia, and the Far East as those living in the territories of the traditional residence of their ancestors, preserving the traditional way of life, economic activities, and crafts, numbering less than fifty-thousand people, and identifying themselves as independent ethnic communities (President of the Russian Federation, 2000). The approved lists of places of traditional residence and types of traditional economic activities of Indigenous Peoples include 28 administrative entities - many more than territories of nine regions that make up the Arctic zone of Russia (Government of the Russian Federation, 2009). Thus, the territories of ancestral residence (places of traditional residence and traditional economic activity) of Indigenous Peoples go far beyond the Arctic zone of the country. The list of Indigenous Peoples of the North, Siberia and the Far East of Russia includes forty positions (Government of the Russian Federation, 2006), the largest being Nenets, Evenk, and Khant (Table 1).

Some Indigenous Peoples lead a nomadic or semi-nomadic life associated with traditional types of nature management, such as reindeer husbandry, hunting, fishing, marine hunting, and gathering. The majority are settled residents living in urban areas or rural settlements. According to Tishkov et al. (2016) and Hossain et al. (2021), about twenty thousand people roam year-round or seasonally (about a quarter of the total number of Indigenous Peoples in the Russian Arctic). About 60% of the nomadic population in the Russian Arctic is concentrated in the Yamal-Nenets Autonomous District.

Table 1. Largest Indigenous communities in the Russian Arctic: territories and population, descending order

Indigenous Peoples	Territories	Population, 2021 Census, people
Nenets	Arkhangelsk Oblast, Komi Republic, Krasnoyarsk Krai, Nenets Autonomous District, Yamal-Nenets Autonomous District	49,787
Evenk	Republic of Sakha (Yakutia)	39,420
Khant	Komi Republic, Yamal-Nenets Autonomous District	31,600
Even	Chukotka Autonomous District, Republic of Sakha (Yakutia)	19,975
Chukchi	Chukotka Autonomous District, Republic of Sakha (Yakutia)	16,228
Mansi	Komi Republic	12,308
Dolgan	Krasnoyarsk Krai, Republic of Sakha (Yakutia)	8,182
Koryak	Chukotka Autonomous District	7,498
Vepsians	Republic of Karelia	4,687
Selkup	Krasnoyarsk Krai, Yamal-Nenets Autonomous District	3,491
Itelmen	Chukotka Autonomous District	2,622
Eskimo	Chukotka Autonomous District	1,659
Saami	Murmansk Oblast	1,550
Yukagir	Chukotka Autonomous District, Republic of Sakha (Yakutia)	1,183
Ket	Krasnoyarsk Krai	1,096
Chuvan	Chukotka Autonomous District	903
Nganasan	Krasnoyarsk Krai	693
Chulym	Krasnoyarsk Krai	382
Enets	Krasnoyarsk Krai	203
Kerek	Chukotka Autonomous District	23

Source: Authors' development

Legal Framework

Federal Level

Contemporary food security policies in Russia were formed in the 2000s. In 2010, Russia released its Food Security Doctrine (President of the Russian Federation, 2010). It defined food security as the state of the economy, which ensures the country's food independence, guarantees physical and economic accessibility for all of food products that meet the requirements of Russia's legislation on technical regulation, in volumes not less than the rational norms of food intake required for an active and healthy lifestyle. Food security was differentiated from food independence, a stable domestic production of food and agricultural products in volumes not less than the established threshold shares of domestic production in the supply of corresponding food products on the domestic market.

A decade later, certain provisions of the Doctrine 2010 were revised and formalized in the Food Security Doctrine of the Russian Federation 2020 (President of the Russian Federation, 2020a). Four principal novelties apply:

- Food security is defined as a condition in which food independence is ensured and physical and economic availability of products for all is guaranteed in the amounts required for an active and healthy lifestyle.
- Food independence is defined as the self-sufficiency threshold calculated as the ratio of domestic production to domestic consumption. Thus, the self-sufficiency thresholds for meat and meat products and fish and fish products are established at above 85%. The Doctrine 2010 assessed food security through the criterion of the specific weight of products in the total volume of commodity resources of the domestic market, taking into account rolling stocks.
- The list of potential risks and threats to food security has been expanded. There are risks of reducing the fertility of agricultural lands due to their irrational use, veterinary, phytosanitary, and epidemiological risks. Social threats have also been considered, such as a falling attractiveness of the rural lifestyle.
- Achieving self-sufficiency is postulated as a priority goal of the development of the entire food security system.

Neither the Food Security Doctrine 2020, nor the Action Plan (Government of the Russian Federation, 2020b) sufficiently reflect the territorial specifics of the food security agenda. Both documents describe the general principles of achieving food self-sufficiency, food independence, and food security at the national level, without delving into the differences in approaches to ensuring FAO's four dimensions of food security across the country's macro-regions. Similarly, national strategies for the development of the Arctic and programs to ensure economic development and security of the Arctic zone of Russia fail to pay adequate attention to food security issues in circumpolar communities, not to mention the food security specifics in Indigenous communities. The State Policy of the Russian Federation in the Arctic till 2035 (President of the Russian Federation, 2020b) emphasizes the following tasks in the sphere of development of agricultural activities in the Arctic zone of Russia:

- stimulating local production of agricultural raw materials and food;
- preservation and development of traditional economic activities and crafts that contribute to improving the employment opportunities (including self-employment) in Indigenous communities;
- ensuring access of Indigenous Peoples to natural resources required for pursuing their traditional way of life and carrying out traditional economic activities;
- creating conditions for increasing the efficiency of the development and exploitation of aquatic biological resources, stimulating the production of value-added fish products and the development of aquaculture.

The mechanisms for implementing the above tasks remain unclear. Strategy for the Development of the Arctic Zone of the Russian Federation and Endurance of National Security till 2035 (President of the Russian Federation, 2020c) only mentions the need to develop and implement a program of state support for traditional economic activities of Indigenous Peoples. It also notes the creation of a network of trade and logistics centers to facilitate supplies of staples and essential goods to remote settlements. State Program of Social and Economic Development of the Arctic Zone of the Russian Federation (Government of the Russian Federation, 2021) does not refer to food security. It only designates goals of state policy in the Arctic, among which is improving the quality of life of Arctic residents, including Indigenous Peoples. But the State Program 2021 highlights the role of individual territories included in the Arctic zone of Russia in achieving the goals of the program and ensuring the development of a system of benefits for regional and local taxes and non-tax preferences for Arctic residents. Thus, additional powers and additional responsibilities emerge for regional administrations in the sphere of ensuring food security in local communities.

Regional Level

The Arctic Zone of Russia includes nine territories (President of the Russian Federation, 2014). Four of them are located within the zone (Murmansk Oblast and Chukotka, Nenets, and Yamal-Nenets autonomous districts), while the remaining five are partially included in it. They are Arkhangelsk Oblast (Arctic territories include Arkhangelsk, Mezensky, Novaya Zemlya, Novodvinsk, Onezhsky, Primorsky, and Severodvinsk municipal districts), the Komi Republic (Vorkuta municipal district), Krasnoyarsk Krai (Norilsk city, Taymyr Dolgan-Nenets municipal district, and Turukhansky district), the Republic of Karelia (Belomorsky, Loukhsky, and Kemsy municipal districts), and the Republic of Sakha (Yakutia) (Abyisky, Allaikhovsky, Anabarsky, Bulunsky, Eveno-Bytantaisky, Momsky, Nizhnekolymsky, Olenesky, Srednekolymsky, Ust-Yansky, Verkhnekolymsky, Verkhoyansky, and Zhigansky districts). The total area of the Russian Arctic is 4.8 million km² (28% of the country's territory).

Arkhangelsk Oblast

The system of legislation of Arkhangelsk Oblast pays little attention to the food supply and nutrition issues in Indigenous communities. Regional Strategy of State National Policy in Arkhangelsk Oblast till 2025 addresses general aspects of the development of the public administration system in the sphere of interethnic relations without specifying the Indigenous issues (Government of Arkhangelsk Oblast, 2014). Among directions of the Regional Assistance

Project, Strategy of Social and Economic Development of Arkhangelsk Oblast till 2035 provides for the promotion of the development of folk crafts, increasing the level of adaptation of traditional economic activities of Indigenous Peoples to contemporary economic environment, and ensuring the protection of habitat and traditional way of life in Indigenous communities (Assembly of Deputies of Arkhangelsk Oblast, 2019). Due to the high level of urbanization and the density of settlements and transport infrastructure in Arkhangelsk Oblast, the vast majority of Indigenous Peoples are deeply integrated into the regular economic system of the region. Therefore, the government sees no rationale in highlighting the Indigenous-related narratives in the economic and social development agenda.

Chukotka Autonomous District

In Chukotka, the development of traditional economic activities of Indigenous Peoples is considered a strategic line of economic development (Government of Chukotka Autonomous District, 2014). The traditional branches are reindeer husbandry, which provides up to 50% of the needs of Chukotka residents in meat products, and sea hunting, which provides the needs of Indigenous Peoples in coastal territories in meat of marine animals. The development of other types of agricultural activities is restricted by climate conditions of the region. That means that apart from traditional foods, all other food and agricultural products are supplied from outside. The Northern Delivery is a set of measures and financial mechanisms for the regular and uninterrupted supply of remote territories in the Russian Arctic with essential goods (primarily, food and petroleum products). Since the supply of local communities with food critically relies on imports, physical availability of staples and their economic accessibility are vital components of the food security status of Indigenous Peoples. According to the Strategy of Social and Economic Development of Chukotka Autonomous District till 2030 (Government of Chukotka Autonomous District, 2014), the first component of food security (physical availability) is to be improved by increasing the volume of domestic production of local foods. The district government aims to increase reindeer livestock to 153.2 thousand head of cattle by 2030, which will ensure the gain in output of meat in slaughter weight up to 411.2 tons. In the sea-hunting sector, the government prioritizes the development of processing facilities to add value to processed fish products and meat of marine animals. In terms of economic availability of staples, the Concept of Sustainable Development of Indigenous Peoples 2009-2025 (Government of Chukotka Autonomous District, 2009) provides for the expansion of transport and logistics services and assistance in the development of markets for traditional foods and related products; support for small and medium-sized businesses of Indigenous Peoples aimed at improving the efficiency of traditional economic activities, including financial support of entrepreneurs; establishment of portable transshipment bases for storing and distributing of food products; simplified procedure for obtaining licenses for hunting by Indigenous Peoples in places of traditional habitat and traditional economic activity; creation of workshops for primary and deep processing of reindeer meat and related products.

Komi Republic

According to the Strategy of Social and Economic Development of the Komi Republic till 2035, the development of the region in the long term is considered in several contexts, including through economic development of rural areas and traditional forms of environmental management of Indigenous Peoples (Government of the Komi Republic, 2019). The Republic largely depends on food supplies from outside (the food self-insufficiency status). The share of the domestic

production in food supply on the domestic market is 54.5% for eggs, 36.2% for meat and meat products, 25.5% for milk and dairy products, and only 19.6% for vegetables. To improve the food security status of the territory, the Strategy prioritises the increase in output in the local agricultural sector, increase in the competitiveness of domestic farmers, and ensuring the financial stability of agricultural producers. Measures to improve the level of food security of Indigenous Peoples include the preservation of reindeer husbandry as a traditional economic activity and an integral element of lifestyle and culture of Indigenous Peoples. The Plan on Implementation of the Concept of Sustainable Development of Indigenous Peoples 2017-2025 implies the establishment and development of intermediate bases (storage and distribution points) along the routes of reindeer herders' nomads, provision of social guarantees and compensations to reindeer herders, and provision of land plots from state or municipal ownership for free use to Indigenous Peoples for carrying out their economic activities (Government of the Komi Republic, 2017). The Strategy of Social and Economic Development specifically encourages the development of livestock breeding and commercial aquaculture. It is expected that by 2035, the level of self-sufficiency of the Komi Republic will improve up to 35.3% for milk and dairy products, 38.0% for vegetables, 47.7% for meat and meat products, 61.4% for eggs, and 100.0% for potatoes (Government of the Komi Republic, 2019).

Krasnoyarsk Krai

The number of Indigenous Peoples in Krasnoyarsk Krai exceeds 16,000 people, of which about 3.5 thousand people are engaged in traditional economic activities, such as reindeer husbandry, fishing, commercial hunting, and gathering. Monitoring and recording of the reindeer livestock, pastures, and reindeer farms are conducted in order to preserve and further develop reindeer husbandry in the conditions of intensive industrial development in the North of Krasnoyarsk Krai (Government of Krasnoyarsk Krai, 2017). Commercial hunting is typical for the Taimyr Dolgan-Nenets municipal district, which is home to the world's largest population of wild reindeer (over 400,000 head of cattle). In Turukhansk district and the Evenki municipal district, Indigenous Peoples are engaged in hunting fur animals. A distinctive feature of the legislation of Krasnoyarsk Krai is a merge of the territorial, economic, and social development agendas of Indigenous communities. In February 2023, the regional government released the revised Strategy of Social and Economic Development of Northern and Arctic Territories and Support of Indigenous Peoples in Krasnoyarsk Krai till 2030 (Government of Krasnoyarsk Krai, 2023). Among priorities of agricultural development of the region are greenhouse farming, cattle breeding, reindeer husbandry, and processing of local natural and wildlife resources (fish, game, venison, wild plants) and imported raw materials (bread and bakery). Innovative approaches to increasing the volume of agricultural production include the development of infrastructure for the primary processing of agricultural products, hunting, and fishing (including the use of mobile processing complexes and mobile slaughter complexes in the reindeer sector), as well as the development of deep processing of venison and wild plants to obtain medicinal raw materials and biologically active additives. Special attention is paid to ensuring healthy nutrition of people of all age groups, education and training of people on healthy nutrition, development and implementation of the Arctic Diet that compensates for the adverse factors of extreme climate and landscape of the Far North.

Murmansk Oblast

Among the priorities of the state agrarian policy of Murmansk Oblast, the Strategy of Social and Economic Development of Murmansk Oblast till 2020 and for the Period until 2025 highlights the supply of high-quality agricultural products and locally produced food to the market, including through the development of the reindeer sector (the self-sufficiency approach to ensuring food security) (Government of Murmansk Oblast, 2013). To improve the well-being of Indigenous communities, the Strategy provides for stimulating the production of premium products from venison. According to the Regional Program of Social and Economic Development of Murmansk Oblast, low level of development of traditional economic activities and underemployment of Indigenous Peoples hinder the prospects for economic and social development of the region (Governor of Murmansk Oblast, 2014). The Program emphasizes the necessity of creating conditions for ensuring economic accessibility and physical availability of essential food products based on rational norms of food intake for vulnerable populations. One of the measures for the development of the fisheries sector is the improvement of the organization of traditional fishing of Indigenous Peoples. The Action Plan for the Implementation of the Concept of Sustainable Development of Indigenous Peoples in Murmansk Oblast in 2016-2025 (Government of Murmansk Oblast, 2017) includes such measures as the provision of aquatic biological resources for fishing to Indigenous Peoples (Saami), the implementation of state support for the domestic reindeer husbandry, and the provision of subsidies to improve the material and technical base of Indigenous communities.

Nenets Autonomous District

The share of agriculture in the gross regional product of the Nenets Autonomous District is only 0.5%, but the sector provides employment for 4% of population. For Indigenous Peoples, agricultural activities are currently the main source of life support. According to the Strategy of Social and Economic Development of Nenets Autonomous District till 2030, agriculture and processing of agricultural products are included in the list of priority sectors of the regional development (Assembly of Deputies of Nenets Autonomous District, 2019). Reindeer husbandry is the main economic activity across Indigenous communities, the vital source of livelihood, and the basis of food security. The development of the reindeer sector aims at the formation and maintenance of expanded reproduction of domestic reindeer, the development of a system of harvesting, processing, and sale of related products to preserve the ancestral habitat and traditional way of life of Indigenous Peoples. Such a goal is achieved by improving the quality of domestic reindeer livestock, increasing the productivity of the sector, developing deep processing of reindeer products, organizing training and retraining of specialists for reindeer husbandry, as well as providing targeted assistance aimed at developing and modernizing the infrastructure of reindeer herders, harvesters, processors, and distribution networks. Fishing is much less developed than reindeer husbandry. In this sector, the government strives to increase fishing of aquatic biological resources and the degree of processing of fishery products. Harvesting and processing of berries, mushrooms, and medicinal plants has a significant potential for generating additional income for Indigenous Peoples. Hundreds of species of edible berries, medicinal herbs, and mushrooms grow in the Nenets District. However, neither the regional government nor the municipal administrations have elaborated any mechanisms of state support for Indigenous Peoples in those sectors.

Republic of Karelia

The climate of Karelia is relatively mild compared to other territories of the Arctic zone of Russia, which makes it possible to cultivate certain crops native to the non-chernozem zone. However, since the region is located in a zone of risky agriculture, the dairy sector, meat farming, and fishing are more developed compared to crop production. Similar to the system of legislation of the neighboring Arkhangelsk Oblast, neither the Strategy of Social and Economic Development of the Republic of Karelia till 2030 (Government of the Republic of Karelia, 2018) nor the Individual Program of Social and Economic Development of the Republic of Karelia for 2020-2024 (Government of the Russian Federation, 2020a) focus on the role of Indigenous communities and traditional agricultural activities in the development of the agricultural complex and the achievement of food security. Only the Action Plan for the Implementation of the Concept of Sustainable Development of Indigenous Peoples in the Republic of Karelia in 2021-2025 (Government of the Republic of Karelia, 2021) details the measures in the sphere of development of Indigenous communities. Among them are the development of territories of traditional use of natural resources of local significance in Vepsian communities (Prionezhsk municipal district), enforcing the exercise of rights of Indigenous Peoples to fishing and hunting in order to ensure the conduct of a traditional lifestyle and the carrying out of traditional economic activities, as well as the provision of federal budget funds to support economic and social development of Indigenous communities.

Republic of Sakha (Yakutia)

In the Arctic zone of Yakutia, 49 settlements (70% of the total number of settlements in the Republic) are classified as places of residence of Indigenous Peoples, including Evenk, Even, Dolgan, Yukagir, and Chukchi. As stated in the Strategy of Social and Economic Development of the Arctic Zone of the Republic of Sakha (Yakutia) till 2035 (Head of the Republic of Sakha (Yakutia), 2020), the ensurance of food and nutrition security of Indigenous communities is severely challenged by harsh climate conditions (the physical availability component) and lower standards of living in rural areas compared to urban territories (the economic accessibility component). Centralized food delivery (the Northern Delivery system) plays a critical role in supporting the food security status of Indigenous communities. According to the updated State Program “Development of the Arctic Zone of the Republic of Sakha (Yakutia) and Indigenous Peoples in the Republic of Sakha (Yakutia)” (Government of the Republic of Sakha (Yakutia), 2022), to facilitate food supplies, the government provides subsidies for the transportation of agricultural and commercial products, raw materials, feed, and seeds. Subsidies are also provided for the delivery of essential food products by air and water. The development of the reindeer sector includes the introduction of advanced technologies for grazing; optimization of herd sizes with due account for reindeer capacity and pasture turnover; modernization of the material and technical base of reindeer husbandry (construction of corrals, fences, purchase of all-terrain and snowmobile vehicles); transition to industrial reindeer husbandry; provision of comprehensive protection in reindeer husbandry (introduction of electronic certification of reindeer herds, herd guarding and grazing monitoring in order to minimize losses of animals from predators and exclude grazing in contaminated areas, carrying out systematic health checks and veterinary support). In the fishing sector, the main tasks are to increase the volume of catch of low-value fish species and to involve remote lake areas of the Yana, Indigirka, and Kolyma river basins in economic development, as

well as carrying out measures for the artificial reproduction of aquatic biological resources in order to restore fish stocks of the main commercial fish species. The development and implementation of state and municipal programs in the sphere of sustainable development of Indigenous Peoples is facilitated by the Concept of Sustainable Development of Indigenous Peoples in the Republic of Sakha (Yakutia) till 2035 (Government of the Republic of Sakha (Yakutia), 2021).

Yamal-Nenets Autonomous District

The district is home to over 49,000 Indigenous Peoples, including Nenets (72% of the total number of Indigenous Peoples), Khant (24%), and Selkup (4%). More than 18,000 people (5,420 families) pursue a traditional way of life. Traditional economic activities are reindeer herding, fishing, and caged-animal farming. The depletion of reindeer pastures, climate change, and industrial exploration of traditional habitats distort traditional life patterns of Indigenous communities. There emerge families with few reindeer cattle or without reindeer cattle at all. The transition to a settled lifestyle is hampered by a poor integration of Indigenous Peoples into the economic, cultural, and social environment of the district. According to the Strategy of Social and Economic Development of Yamal-Nenets Autonomous District till 2035 (Legislative Assembly of the Yamal-Nenets Autonomous District, 2021), the preservation and development of the traditional way of life and economic activities and crafts of Indigenous Peoples represent "an absolute priority" of the development policy in the region. At the same time, the Strategy does not detail the specifics of improving the food security status of Indigenous communities. Instead, it emphasizes the need to develop dairy and meat cattle breeding, poultry farming, and crop production by providing support to farmers (dairy, meat (cattle, pigs, horses, poultry), vegetables (open ground and greenhouses), wild plants, herbs). Thus, the Strategy is too attentive to the physical availability component of food security, while the economic accessibility of adequate diets remains undervalued. The increase in domestic agricultural output is to be achieved by the development of the reindeer sector (optimization of structure of herds in reindeer enterprises, processing of reindeer products, modernization of slaughter and refrigeration complexes and their certification) and fishing (development of new fishing areas, new tools and methods of fishing, organization and modernization of processing plants in the East of the district, releases of fish of valuable species, such as whitefish, to the Ob and Taz rivers). Indirectly, economic aspects of food security are addressed in the State Program on Preservation and Sustainable Development of Indigenous Peoples in the Yamal-Nenets Autonomous District through improving the level of economic and social well-being of Indigenous Peoples (support for the minimum material security of families according to the regional standard, at least 4,500 families annually) (Government of the Yamal-Nenets Autonomous District, 2021).

Food Security Dimensions

In most of the interpretations, measuring food security involves employing quantitative methods of assessment and modeling. The issues related to assessing the food security and nutrition statuses of Arctic Indigenous communities can hardly be addressed without using qualitative methods. Food sharing, food intake, procurement of traditional foods and agricultural products cover FAO's four dimensions of food security, namely: availability, accessibility, utilization, and stability of food supply. However, in relation to Arctic Indigenous communities, the commonly applied interpretations of food security parameters need certain adjustments. As evidenced by the Inuit Circumpolar Council (2012), Duhaime and Bernard (2008), and Nuttall and Callaghan (2019),

critical food security issues across Indigenous communities in the Arctic include high prices of food products, economic vulnerability of Indigenous Peoples, falling consumption of products derived from local Arctic flora and fauna, spiking energy prices, and the adverse effects of climate change on traditional habitats. Along with all those threats to the food security status of Indigenous Peoples, promoting traditional activities in the reindeer sector, fishing, hunting, and gathering is fundamentally important for both the livelihood of Indigenous communities and the preservation of their culture. According to the concept of food sovereignty, traditional food is interpreted as sacred thing and an element of connection with the nature. Thus, the system of food supply and nutrition based on local foods not only provides people with necessary nutrients, but also ensures the preservation of ecosystems and traditions of Indigenous Peoples. Such an interpretation of food security is significantly broader than the mere availability of food in a certain amount or the economic accessibility of basic foodstuffs.

This study pursues FAO's approach to interpreting food security as physical, social, and economic access to food (FAO, 2009). Consequently, the food security parameters are divided into three groups to reflect the three dimensions, i.e., the availability of food, its economic accessibility to all Arctic residents, and the stability of food supplies (Table 2). Due to the lack of reliable data on the nutrition components of food security across Indigenous communities in the Russian Arctic, the authors omitted the FAO's utilization pillar of food security. In country-level studies, national average data or territory-average data could be used to reflect the ability to utilize food to support human health. For the community-level studies in the Russian Arctic, however, the data on food safety and the occurrence of food-borne diseases is fragmented and inhomogeneous. This limitation of the study is further addressed in the Conclusion.

Table 2. Parameters of food security in the Russian Arctic

Dimensions	Parameters	Units	Scale		
			0	1	2
Availability	Intake of meat products, per capita	kg/year	<63	63-77	>77
	Intake of dairy products, per capita	kg/year	<324	324-396	>396
	Intake of vegetables, per capita	kg/year	<133	133-147	>147
	Intake of bread, per capita	kg/year	<114	114-126	>126
	Intake of fish and marine mammals, per capita	kg/year	<7.5	7.5-9.2	>9.2
	Share of traditional food in diets	%	<50	-	>50
Access	Share of food expenditures in total household's expenditures	%	>34	28-34	<28
	Share of population living below a minimum subsistence level	%	>13	11-13	<11
	Share of households with a hunter, a herder, or a fisherman in a family	%	<50	-	>50
Stability	Number of days in a year when food delivery is disrupted due to weather conditions	days/year	>60	30-60	<30
	Number of safety net programs	number	0	-	≥1
	Number of food aid programs	number	0	-	≥1

Source: Authors' development based on Erokhin (2019a, 2019b) and Gao and Erokhin (2020a)

The scale for assessing the food security status of individual territories is based on the standards of healthy nutrition of the World Health Organization and the relevant international and national thresholds for each indicator (World Health Organization, 2023; Ministry of Health of the Russian Federation, 2016; Eganyan, 2013; Dudarev et al., 2013). The achievement of the food security threshold scores 1 (100% of the standard). A value below 90% of the threshold may signal a threat to security (0 points), while that above 110% of the threshold is considered a high level of security (2 points). The final score for each of the measurements is defined as the sum of the scores of individual parameters. In accordance with the obtained values, the food security status of a territory is determined (by food security dimension and the total) (Table 3).

Table 3. Food security scores

Dimensions	Food security thresholds			
	Extreme insecurity	Insecurity	Security	Reliable security
Availability	0.0 – 2.9	3.0 – 5.9	6.0 – 9.9	10.0 – 12.0
Access	0.0 – 0.9	1.0 – 2.9	3.0 – 4.9	5.0 – 6.0
Stability	0.0 – 1.9	2.0 – 3.9	4.0 – 5.9	6.0
Total	0.0 – 5.9	6.0 – 12.9	13.0 – 20.9	21.0 – 24.0

Source: Authors' development based on Erokhin (2019a, 2019b) and Gao and Erokhin (2020a)

This scale is applied to the territories of the Arctic zone of Russia. In order to capture the diversity of food consumption patterns, the influence of anthropogenic factors on food systems, and the environmental parameters of food production, the territories are grouped into four categories:

- Type 1: predominantly urban agglomerations with a substantial share of imported marketed foods in diets (Arkhangelsk Oblast, Komi Republic, Murmansk Oblast, Republic of Karelia).
- Type 2: predominantly industrialized territories with high level of environmental pollution (Krasnoyarsk Krai, Yamal-Nenets Autonomous District).
- Type 3: territories with the developed reindeer sector and a substantial share of meat in traditional Indigenous diets (Republic of Sakha (Yakutia)).
- Type 4: territories with a substantial share of fish and fish products in traditional Indigenous diets (Chukotka Autonomous District, Nenets Autonomous District).

The study demonstrates that most of the Arctic territories of Russia fail to secure the credible levels of availability, accessibility, and stability of food supply (Table 4). Only the Yamal-Nenets Autonomous District demonstrates security on the accessibility and stability thresholds due to a high per capita income and a low proportion of population living below the poverty line.

Table 4. Food security scores per territories

Type	Territory	Food security scores /thresholds						Overall food security status	
		Availability		Accessibility		Stability		Score	Threshold
		Score	Threshold	Score	Threshold	Score	Threshold		
1	Arkhangelsk Oblast	2.6	Extreme insecurity	0.8	Extreme insecurity	4.0	Security	7.4	Insecurity
	Komi Republic	2.4	Extreme insecurity	0.9	Extreme insecurity	2.6	Insecurity	5.9	Extreme insecurity
	Murmansk Oblast	3.1	Insecurity	1.7	Insecurity	4.0	Security	8.8	Insecurity
	Republic of Karelia	3.4	Insecurity	1.1	Insecurity	4.2	Security	8.7	Insecurity
2	Krasnoyarsk Krai	4.9	Insecurity	2.2	Insecurity	3.6	Insecurity	10.7	Insecurity
	Yamal-Nenets Autonomous District	3.7	Insecurity	3.8	Security	5.8	Security	13.3	Security
3	Republic of Sakha (Yakutia)	6.0	Security	2.2	Insecurity	2.0	Insecurity	10.2	Insecurity
4	Chukotka Autonomous District	4.0	Insecurity	3.5	Security	2.0	Insecurity	9.5	Insecurity
	Nenets Autonomous District	3.0	Insecurity	5.3	Reliable security	4.0	Security	12.3	Insecurity

Source: Authors' development based on Erokhin (2019a, 2019b) and Gao and Erokhin (2020a)

In Type 1 territories, diet is predominantly based on marketed foods (under-consumption of meat, dairy products, and vegetables compared to the national standards of adequate nutrition). The share of traditional foods in diet is rather low. In type 2 territories, higher pollution levels due to the industrial development of natural resources on the Yamal Peninsula and the north of Krasnoyarsk Krai exert a negative impact on the quality of traditional food sources – reindeer pastures, soil, and water resources. In such territories, improving the safety parameters of diets is inseparable from importing food products from outside. However, the economic accessibility of marketed products would be lower compared to domestic foods. With a decrease in economic accessibility of foods, diets become less diversified. Dietary patterns change by shifting from higher-nutrient products to lower-quality substances and carbohydrates (Kuhnlein et al., 2004; Lambden et al., 2006; Gao & Erokhin, 2020a). Therefore, balancing the safety and accessibility parameters of food security is of particular importance for local administrations.

In Type 3 and Type 4 territories, diets contain a large portion of traditional foods, such as venison, fish, and seafood. For the Republic of Sakha (Yakutia), the intake of meat and meat products per capita is the highest among Arctic territories of Russia. The food security status of Indigenous

communities, however, is threatened by the remoteness and low transport accessibility of the Arctic territories of the Republic. Diets are poorly diversified (under-consumption of vegetables, bread, dairy products). Like Yakutia, Chukotka and the Nenets District demonstrate high levels of consumption of traditional foods. In more than 80% of households in Chukotka and in 65% of households in the Nenets Autonomous District, people are engaged in hunting and fishing. Still, the problems of non-diversified diets and under-consumption of vegetables and other products are acute, especially in Chukotka. Due to the high cost of delivery, the economic availability of foods in the Chukotka Autonomous District is significantly lower compared to that in other territories of the Russian Arctic. Imported products are commonly of low quality, frozen, with a high content of preservatives and food additives to increase their shelf life.

Physical Availability

Apart from the climatic conditions and low diversification of the agricultural sector (over-reliance on reindeer husbandry, fishing, and hunting), immediate threats to ensuring the resilient availability of essential foods in the Russian Arctic include the irreplaceable retirement of production funds, declining performance of agricultural and processing enterprises, degradation of soils and pastures, stagnation of the seed and breeding systems, and the low level of innovative development of the agricultural sector. The above factors radically degrade the foundations of the availability pillar of food security in Ingenious communities.

Russia's Food Security Doctrine (President of the Russian Federation, 2020a) defines physical availability of food as the level of development of the distribution infrastructure, in which residents in all territories of the country are able to purchase food products or get meals in volumes and assortment that meet the recommended rational consumption threshold. In relation to this study, the key aspect in the above definition is that physical availability of food should not vary considerably between territories (Ivolga, 2014). Nevertheless, the inequality in the level of physical availability of essential foods between territories of the Russian Arctic is quite notable. The establishment of a reliable food supply system in the Arctic zone of Russia requires addressing a set of technical, technological, organizational, social, and economic issues, such as the optimization of locations and specializations of the agricultural sector in particular territories and rational combination of domestic production with import of food products, seeds, and feed. The State Policy of the Russian Federation in the Arctic till 2035 emphasizes a need to create a system of state support for the delivery of food products and essential goods across the Arctic zone in order to ensure their physical accessibility for Arctic residents (President of the Russian Federation, 2020b). The development of the Northern Delivery system should be accompanied by the establishment of a system of food bases. As far as possible, they should be located near large settlements and be connected with other territories of the Arctic zone and the rest of the country by land, water, and air. Such bases would not be able to fully meet the population's need for food on a regular basis, but they can serve as temporary insurance in case of a break in supply chains due to climatic or other force majeure circumstances. Also, by linking food bases with agricultural enterprises and farms, local administrations would be able to form stocks of not only imported staples, but also vegetables, meat, and dairy products. However, stable provision of high-quality foods to Indigenous communities is impossible without developing food market infrastructure and coordinating activities of various economic entities in regional, sectoral, and institutional aspects. The participation of the state is necessary, since the development of market infrastructure requires

substantial investment with an exceptionally long period of return (transport infrastructure of the Northern Delivery, construction of the branch railway to Yakutsk, development of the Northern Sea Route) (Erokhin et al., 2022).

The stability of food supply chains can also be improved by establishing foreign economic and trade links (Erokhin et al., 2019). For the Republic of Sakha (Yakutia) and the Chukotka Autonomous District, imports from markets in Asia could be less expensive compared to supplies from Central Russia (especially in the format of special zones of border trade in Magadan and Nakhodka). Cooperation with Northeastern provinces of China (Heilongjiang, Jilin, Liaoning) is promising in not only physical supply of food, but also breeding of new varieties of crops, livestock, poultry, and fish and joint development of natural resources and lands (Gao, 2017). As China's Arctic Policy 2018 states, "China takes part in the development and utilization of Arctic resources on the condition of respecting the traditions and cultures of the Arctic residents including Indigenous peoples, preserving their unique lifestyles and values, and respecting the efforts made by the Arctic States to empower the local citizens, foster their social and economic progress, and improve education and medical services, so that the Arctic residents, including Indigenous Peoples, will truly benefit from the development of Arctic resources" (State Council of the People's Republic of China, 2018).

Economic Accessibility

According to the Russia's Food Security Doctrine 2020 (President of the Russian Federation, 2020a), economic accessibility of food is the capacity of purchasing food products of adequate quality at current prices in volumes and assortment that meet the recommended rational consumption threshold. Logistics costs increase prices of imported foods, such as potatoes, vegetables, canned foods, cheese, sausages, confectionery, etc. by at least 2.5-3 times compared to the average price level in non-Arctic territories of the country. The demand for locally produced meat and dairy products, dietary eggs, vegetables, potatoes, and other foods demonstrates the rationale for the development of local agricultural production. In terms of their nutritional parameters, local products, including traditional foods, are more suitable for Arctic residents. Consequently, the production of food locally (with the exception of territories where it is impossible due to the climate) is a more appropriate way of improving the economic accessibility of at least certain categories of essential foods in the High North compared to importing of a wide range of food and agricultural products.

The food supply system of the Russian Arctic territories should proceed from the emerging new concept of regulating the number and structure of the population of the Far North. Along with preserving the traditional way of life and economic activities of Indigenous Peoples, it involves alleviating pressure on the domestic food market and food prices by controlling immigration to the region (particularly, workers employed in industrial projects). A law providing for an increase in the living standards, guaranteeing minimum subsistence, and providing supply of essential foods to Indigenous Peoples across territories of the Russian Arctic is particularly needed. Since the 1990s, many of traditional industries have been declining. The reindeer livestock has more than halved, while the production of fish and furs has dropped even more radically. Given the critical importance of reindeer herding and fishing for the preservation of the Indigenous way of life, developing the system of targeted state support of these sectors at both the federal level and the

regional level in the Russian Arctic is imperative for improving economic accessibility of essential foods in Indigenous communities.

Environment and Public Health

Climate change is exerting a major impact on Arctic ecosystems (Hiyama & Takakura, 2018). The increase in the average annual temperature in the Arctic is nearly four times higher than the global average (Rantanen et al., 2022). Climate-related processes have both positive and negative effects on the livelihoods and health of Indigenous peoples in the Russian Arctic, primarily on the food security status of Indigenous communities (Gao & Erokhin, 2020b). An increase in water temperature in the rivers of the Arctic zone along with an increase in the length of the off-season period may result in higher frequency of episodes of mass death of fish due to a lack of oxygen in organic-enriched water (Gao et al., 2021). As evidenced by Mozaffarian and Rimm (2006), Tong et al. (2019), and United Nations Nutrition Secretariat. (2021), sufficient consumption of fish and marine fish species contributes to reducing blood pressure, lowering cholesterol levels, and improving cardiovascular function. Fish tissues are rich in the essential elements, such as Se, Cu, and Zn and may significantly improve the nutritional intake by Indigenous Arctic people (Sobolev et al., 2019), while a decrease in the proportion of fish in diets may trigger a number of health issues in Indigenous communities (Erokhin, 2019a, 2019b; Gao & Erokhin, 2020a). The lengthening of the off-season periods and higher summer temperatures contribute to the trampling and degradation of deer pastures. More frequent extreme weather events, such as winter thaws and rains, late spring with an icy infusion, strong and prolonged heat create the threat of mass deaths of reindeer and the related lack of venison in Indigenous diets. The latter increases incidence rates in respiratory diseases, overweight, and hypertension, because meat, blood, and liver of reindeer are all irreplaceable components of Indigenous diets and elements of adaptation of Indigenous Peoples to the Arctic climate and environment. Another damaging consequence of climate change is the accumulation of persistent toxic substances in Arctic ecosystems (Nuttall & Callaghan, 2019). Accumulation of organic toxic agents in food chains, slow destruction of toxic elements in cold Arctic climate, high concentrations of heavy metals in soil, lichens, fish, and animals lead to a high toxic load on ecosystems across the Russian Arctic.

Nutrition patterns shift to predominantly carbohydrate type of diet with a lack of animal proteins (Gao & Erokhin, 2020a). The intake of nutritionally valuable products, such as dairy products, vegetables, and fruits, has decreased across the Russian Arctic territories down to 50% of the national average (Andronov et al., 2021). A poor-quality diet has long been associated with increasing obesity, diabetes, and glucose intolerance in Indigenous communities (Murphy et al., 1995). Due to the shortages of milk and dairy products, vegetables, and fruits, there is a shift of macronutrients in diets towards carbohydrates (an abundance of sugar, confectioneries, bread, pasta, cereals) and, therefore, a lack of almost all types of vitamins, mineral nutrients, and contamination of food by pesticides, metals, antibiotics, nitrates, and biological agents.

Kuhnlein et al. (2004) and Lambden et al. (2006) considered traditional food as critical for providing essential nutrients in balanced diets in Indigenous communities. However, due to climate change and environmental pollution, traditional food is becoming a less obvious solution to public health issues in the Arctic. Concentrations of some chemicals of emerging concern are increasing in air and wildlife, indicating their potential for bioaccumulation and biomagnification, including in food webs (Inuit Circumpolar Council, 2012). Climate change acts through alteration of food

web pathways for contaminants (McKinney et al., 2013), while pollution increases the risk of disease transfer from animals to humans as marine and terrestrial wildlife is consumed in by Indigenous Peoples, often raw and inadequately frozen (Jenssen et al., 2015).

At the same time, climate change also brings new opportunities (Panait et al., 2019), such as the development of vegetable growing, greenhouse farming, and dairy farming in areas where those types of agricultural activities were unprofitable or impossible due to the climate conditions. Local crop production and animal husbandry may largely enrich diets and make a positive contribution to health. However, the influence of climate change on the change in the fodder base for reindeer husbandry may be ambiguous. On the one hand, longer seasons without snow and higher temperatures during the growing season increase productivity of plants and crops, which improves forage supply in the reindeer sector (Tømmervik & Forbes, 2020; Kelsey et al., 2021). On the other hand, the increasing drying of vegetation communities and ecosystems as a result of higher evaporation due to higher air temperature (Sandvik & Odland, 2014) result in dehydration and trampling loss of lichen (Heggenes et al., 2020) and more frequent tundra fires (Vachula et al., 2022).

Society and Culture

In addition to its availability, accessibility, and nutritional parameters, traditional food is a cultural symbol of ethnic and local identity. Social pressures from the outside, such as the Westernization of traditional diets and lifestyle and growing proportion of marketed food in Indigenous diets are factors contributing to changes in diet patterns, the transition from traditional foods to unbalanced Westernized diets (Gao & Erokhin, 2020a; Gilbert et al., 2021), and the related adverse effects on the public health and adaptive capabilities in Indigenous communities (Andronov et al., 2021). In recent decades, the cultural context of supporting the food security status of Indigenous peoples in the Russian Arctic has been deteriorating due to the degradation of channels for the transfer of traditional knowledge and skills to younger generations. Outmigration, transition to a settled lifestyle, and cultural diffusion have all resulted in loss of traditional knowledge and food production practices. Therefore, it is necessary to pay attention to the analysis and study of knowledge transfer channels, traditional knowledge centers, networks, programs, community centers, northern research centers, as well as organizations capable of integrating traditional and modern scientific knowledge in the sphere of food production and food security. Food security strategies should integrate short-term measures, such as the creation of food supply bases, food sharing networks, and production and purchasing cooperatives, with long-term solutions of the food insecurity problem (legislation and the federal and regional level, standards of adequate and healthy nutrition, economic and social well-being, and protection of rights of Indigenous people). Both multilevel and interdisciplinary approaches are needed (Andronov et al., 2021). Since no single program can entirely eliminate a complexity of food insecurity issues, implementing a set of interrelated measures is required (Zimmermann et al., 2023). For example, educational programs on rational nutrition cannot compensate for the poor availability or accessibility of food.

Duhaime and Bernard (2008), Ragulina (2018), and Hossain et al. (2021), among others, suggest that the Westernization of traditional diets in Indigenous communities could be mitigated by promoting the “cultural food security” approach. This implies the ability of Indigenous Peoples to provide reliable access to food through traditional agricultural (rather, lifestyle) practices. The parameters of cultural food security include knowledge on various aspects of food, nutrition, and

safety that have been established across Indigenous communities for centuries. The food security status of Indigenous communities in the Russian Arctic is threatened by a number of culture-related factors, including restricted access to traditional lands and habitats, disrupted intergenerational transfer of knowledge and values, settled way of life and regular employment instead of traditional economic activities, shift of food consumption patterns towards unified diets with low portion of traditional foods, and ageing of family members who can engage in traditional Indigenous activities, such as hunting and fishing (Power, 2008).

Measures to Narrow the Food Insecurity Gaps

The diversity of factors affecting the parameters of food security and adequate nutrition in the Russian Arctic should be considered when drawing up food security programs. Prospective measures should take into account radical differences between territories (types of the Russian Arctic territories emphasized above) in economic, social, environmental, and cultural specifics of food security. In addition to those, differences in diets, consumers, and food security dimensions should be considered (Table 5).

Table 5. Measures to improve the food security status per types of Russian Arctic territories

Type	Dimension	Measure	Anticipated effect
1	Availability	Development of animal husbandry and fisheries	Increase in the proportion of meat and fish of domestic production in diets
	Access	Targeted food subsidies	Increase in real incomes, purchasing power, and effective demand for food
	Stability	Safety net programs	Higher quality of animal products and vegetables
2	Availability	Development of animal husbandry and vegetable production	Increase in the proportion of meat, dairy, and vegetables of domestic production in diets
	Access	Increasing employment	Increase in households' income and effective demand for food
	Stability	Food aid programs	Providing vulnerable populations with basic foodstuffs
3	Availability	Protected vegetable production	Increase in the proportion of vegetables of domestic production in diets
	Access	Targeted programs in reindeer herding, hunting, and fishery	Growing involvement of Indigenous Peoples living in settlements in traditional industries
	Stability	Establishment of reserves of basic foodstuffs	Uninterrupted operation of food aid programs at the time of disruption of food supply due to weather conditions
4	Availability	Protected vegetable production	Increase in the proportion of vegetables of domestic production in diets
	Access	Targeted food subsidies	Increase in real incomes, purchasing power, and effective demand for food
	Stability	Establishment of reserves of basic foodstuffs	Uninterrupted operation of food aid programs at the time of disruption of food supply due to weather conditions

Source: Authors' development

Since an increase in the intake of basic foodstuffs per capita has a positive impact on food security in all types of territories of the Russian Arctic, appropriate measures should be aimed at ensuring both the physical availability and economic accessibility of such products on the market. In most of the territories of the Arctic zone of Russia, the level of income is rather low. Therefore, promoting food supplies from other regions would only drive food prices up thus depressing the economic accessibility of staples. One of the solutions to the availability and accessibility issues is the development of local production facilities, mainly animal husbandry, aquaculture, and protected vegetable growing. Targeted food aid programs and the establishment of food reserves can contribute to increasing the economic accessibility of essential food and the stability of food supplies. The quality of food must be improved through safe nutrition programs to mitigate adverse effects of unhealthy foods on the public health status of Indigenous communities.

The COVID-19 outbreak has sharpened the urgent food insecurity issues and demonstrated the priority of solving food insecurity problems across Indigenous communities in the Russian Arctic (Bogdanova et al., 2020). Lockdowns and related quarantine measures complicated the access of Indigenous Peoples to food, energy resources (fuel), social infrastructure facilities, and slaughter complexes. The pandemic has almost completely restricted the access of Indigenous Peoples to traditional foods, such as reindeer products. Reindeer herders were unable to share foods between neighboring communities, as well as they were restricted to share reindeer products with their relatives living in other territories. The consequences of anti-pandemic measures were aggravated by the underdeveloped food logistics infrastructure in the Russian Arctic.

However, the development of logistics infrastructure and the provision of regular food supplies cannot completely solve the food insecurity problem. The food security status of Indigenous communities is to be ensured by the development of traditional formats of food production and consumption. The development and support of traditional economic activities, such as reindeer herding and fishing face the need to overcome a set of hurdles:

- Development of the biotechnologies sector could create the demand for raw reindeer products, as well as for herbs, berries, mushrooms, and other plant raw materials. Reindeer husbandry products include powder, extracts, hydrolysates and dry slides from antlers, blood products, tails, and tendons (Maximov, 2019). They are used as raw materials in the pharmaceutical and cosmetic industries, as well as in the production of certain food products. In addition to producing reindeer products, some of the Indigenous communities would receive an option to switch to gathering (i.e., to embed themselves in alternative value-added chains and diversify their sources of income), continuing to pursue a traditional lifestyle in the tundra.
- Support of the conventional reindeer husbandry (production of venison) and integration into interregional and international production and supply chains through the development of the velvet antler industry.
- Support of nomadic reindeer husbandry or transition to modern technologies of reindeer feeding and development of corral reindeer husbandry.

Short-term and long-term economic, administrative, and social measures are needed to maintain and improve the food security status of Indigenous peoples in the Arctic zone of Russia. Short-term ones include the following:

- Organization of a mobile economic and legal advisory service for nomadic reindeer herders in order to support this type of traditional economic activity.
- Encouraging cooperative forms of reindeer husbandry and introducing a new state program of subsidies to Indigenous households in order to purchase equipment for small slaughter complexes and mobile refrigerating facilities.
- Development of veterinary services and provision of reindeer herders with medicines and other treatment substances and materials for animal care.
- Facilitating the access of reindeer herders to energy resources and basic foodstuffs at subsidized prices.
- Establishment of mobile slaughterhouses and points of additional feeding of animals along major routes of reindeer migration in the tundra.
- Expanding the export potential of reindeer husbandry products such as antlers and reindeer skins, to support food sovereignty of Indigenous Peoples, while focusing public policy efforts on improving the access of Indigenous Peoples to venison as a critical source of valuable trace nutrients required for supporting healthy life in the Arctic environment.

Long-term measures in the sphere of improving the food security status of Indigenous communities in the Russian Arctic could include the following:

- Knowledge transfer and training of Indigenous Peoples in the advanced technologies of processing traditional products (venison, other reindeer products, fish, herbs, etc.) in accordance with bio-production standards and integration of Indigenous Peoples into value chains as producers, intermediaries, processors, and distributors of traditional products.
- Subsidizing reindeer herders to purchase energy resources and medicines.
- Development of a special preferential tax regime for Indigenous households in the reindeer sector.
- Comprehensive annual monitoring of the health status of Indigenous communities across the Russian Arctic (examination of major health parameters of Indigenous Peoples and habitats, nutrition of people and animals, conditions of reindeer pastures, environmental safety parameters of soils, water, air, and food chains).

Addressing contemporary challenges to food security in the Arctic is a prerequisite for improving the food security status of Indigenous Peoples across diverse dimensions of food security through the use of traditional knowledge about biological resources of the Arctic. Exploring innovative ways of using biological resources may provide new income opportunities for Indigenous Peoples, create new jobs, and introduce innovations into traditional economics sectors and traditional lifestyles. A comprehensive solution to the food insecurity and nutrition issues in the Russian Arctic requires combining modern technologies and traditional practices of Indigenous Peoples, i.e., complementing gains in economic performance of traditional industries with improvements in their sustainability. Interdisciplinary studies would link adaptation mechanisms (climate,

environment), development of functional nutrition products and biologically active additives for all Arctic residents, methods to increase the profitability of using local plant and animal raw materials, methods for obtaining products from previously unused raw materials to expand the range of raw materials procurement and providing year-round employment for Indigenous Peoples.

Conclusion

In the Arctic, the food security status of Indigenous communities cannot be administered from the outside as a set of standard solutions since economic, social, ethnic, and cultural specifics of food production and food consumption vary widely across territories (even within territories). Many issues remain underexplored, such as, for example, compensatory mechanisms that help Indigenous communities mitigate the adverse impacts of disrupted availability of staples or inadequate nutritional parameters of marketed foods. A comprehensive approach focused on the convergence of the food security narratives (agricultural production, economic and social access to food, stability of supplies, safety of traditional and marketed foods, environmental parameters of food chains) that will contribute to the development of a more precise regional policy in the sphere of food security of Indigenous Peoples. Food supply of Arctic territories is an important part of the overall strategy of economic and social development of Russia. The specific features of the food security agenda in the Arctic include climatic and environmental conditions that determine a need for increased intake of high-calorie foods, restricted use of huge natural resources of the region in domestic agricultural production, and a reliance of local food chains on supplies of essential food products from other regions of Russia.

The nutrition components of food security across Indigenous communities are to be measured by the food utilization parameters omitted in this study due to the lack of data. The poor nutritional quality of many retail foods that are available in the North increases the risk of nutritional deficiencies (Little et al., 2021). Furthermore, the high cost of these foods and the breakdowns of food supply chains can impact households' food security status, particularly when local foods are not readily available (Kenny et al., 2018). Consequently, the utilization pillar should be assessed with the implementation of food safety indicators which allow measuring the occurrence of food-borne diseases, such as nutritional and metabolic disorders and diseases of the digestive system. In the Arctic, the utilization pillar should capture not only nutrition parameters of food intake, but also a healthy physical environment, including safe drinking water and adequate sanitary facilities. For example, the safety of water resources is a critical component of the aggregated food security score in the Arctic, since waterborne infectious diseases have been reported among Indigenous communities (Nilsson et al., 2013; Daley et al., 2018; Wright et al., 2018).

Prospective venues of the food security policy in the Russian Arctic should capture four blocks: food production in traditional sectors (reindeer husbandry, fishing, hunting); farming and animal husbandry based on the use of traditional knowledge and practices adapted to local conditions; industrialized agricultural production where possible due to the climate and the availability of lands (meat and dairy animal husbandry, protected agriculture); and the delivery of food from non-Arctic territories of Russia and from abroad.

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