Current state and development trends of the Foodnet market in Russia

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Abstract. The article considers the prerequisites for creating a new high – tech market for food production and consumption-FoodNet; examines the possibilities of intellectualization, automation and robotics of technological processes of food production and delivery (FoodTech), and also identifies the main objectives of the roadmap – systematization of Russian business projects, implementation of measures to create conditions for rapid growth and scaling of such projects.

Keywords: agriculture, market, production, consumption, products, food, nutrition, technology, economy.

1. Introduction
Science and industry by their very nature strive for constant development. This is not always a uniform process, but it can be synchronized and managed depending on the goals. In Russia, the "National Technology Initiative" has been created for this purpose: a platform that unites industry leaders for the development of production and marketing practices and technologies with the support of the state. NTI 20.35 focuses on 10 promising markets, one of which is FoodNet. In fact, this is a "road map" for the development of food production, starting from breeding and agrochemistry and ending with the delivery of finished products to the buyer [4].

2. Informal interpretation of the problem
Middle class growth and rising incomes in developing countries are increasing the demand for personalized nutrition as a way to improve health and quality of life. The concept of organic food is becoming very popular.

The dynamics of the Foodnet market growth is geographically diverse: lack of resources, lack of arable land, the stagnation of the efficiency of animal husbandry in the current stage of development, significant production and logistic losses in product manufacturing, shipping and trading.

During the first 9 months of 2020, agricultural production of the Russian Federation increased by more than 3%, compared to 2019 [6].

The production of agricultural products increased by almost 1.5% over the month. The total increase was 1 trillion 327.4 billion rubles. In August 2020, the increase was at 4.1%. In the first 9 months of 2020, the production of agricultural goods reached 4.2 trillion rubles. The grain market demonstrated impressive results – 121.9 million tons, which is more than 12.1% from prior year [9]. However, the harvest of beets and many other vegetables went down due to the drought and early frosts in 2020.

The number of livestock, in particular, pigs and cows, as well as poultry, increased slightly in 2020. On the contrary, the number of sheep and goats decreased by 1.1%. Milk production in Russia in 2020...
increased by 2.7%, totaling 24.9 million tons. At the end of 2019, the total growth was 4.0-4.5% or 650-700 thousand tons.

State support in the form of concessional loans and subsidies contributed to the growth of agriculture. In 2020, Russia increased exports of agricultural products by almost 14% totaling $20 billion in just 9 months. China, Turkey, Korea, Kazakhstan and many other countries are the main purchasers of Russian merchandize. Despite the success in the agricultural sector and the growth of exports of Russian products abroad, there is an increase in prices for many raw food products (sunflower oil, cabbage, sugar, and much more).

Market participants are constantly looking for ways to make the production less risky, more efficient, flexible and marginal. The research is focused not only on new technologies, but also on new production patterns, new markets and new methods for consumer relations.

3. Formalization and analysis of the market

One way to solve the problems of improving the quality and quantity of agricultural products is the use of smart technologies that can make farms more "intelligent" and more connected through so-called "Smart Farming". Agricultural institutions collect a huge amount of information: on yields, soils, as well as data on fertilizer application, meteorological data, equipment, and animal health. Smart sensors are already being used for monitoring and early detection of animal health problems. Typical monitoring data are the body temperature, activity and pulse of a farm animal, its GPS location. Alerts can be sent to the breeder based on the pre-defined factors.

The goal of the agricultural sector is the process optimization and efficient use of existing resources. The Internet of Things can improve all of this: increase production and improve the quality of agriculture.

The Foodnet market is a personalized food market based on advanced developments in food production and marketing technologies. A significant part of it is the market of products produced on the basis of organic farming and related services (this includes the production of biohumus, including at the Factory of commercial biohumus in the Suzdal district, built on public funds). Products should be produced without the use of synthetic fertilizers, pesticides, food additives and GMOs, taking into account the local characteristics of ecosystems (with the concept of permaculture and agrolandscape farming factored in).

FoodNet – a new high-tech market for food production and consumption. It will not replace the existent agricultural and food markets as a whole, but will become their most advanced and highly efficient segment, closely integrated with other hi-tech markets, and above all with the IT industry. An integral part of FoodNet will be FoodTech ("Fudtech") – technologies integrated with IT solutions in the food market [1].

FoodNet together with other nine markets-AeroNet, AutoNet, MariNet, NeuroNet, HelsNet, EnergyNet, TechNet, SafeNet, FinNet will make up the main directions of NTI. 10 NTI working groups, which involve 451 companies and 869 experts, are working on the development of roadmaps for these areas [3].

FoodNet is tasked with the creation of ecosystem for food market, and personalized nutrition-backed intellectualization, automation and automation of technological processes throughout the life cycle of products.

Foodnet gross sales in the global market is estimated at about 3.5 trillion dollars by 2035. Smart, high-tech and highly productive agriculture, personalized nutrition, organic products, biotechnologies, smart supply chains, and robotics are the main trends in the qualitative development of the modern global food market.

There are already more than 120 companies listed with FoodNet in Russia, that have both their own and patent-based technologies in the field of creating artificial meat, innovative packaging, automation, robotics, etc.(these are organizations that do not work directly in the agricultural sector).
Industrialization has given rise to total standardization, and the digital age is giving rise to total individualization. In the FoodNet environment, the products and services will cater to the specific needs of the consumer. This is called personalized food [8].

An integral part of FoodNet will be FoodTech ("Fudtech") — technologies integrated with IT solutions in the food market. The range of their applications can be extremely wide. The end-to-end "Artificial Intelligence" (AI) technology is already being used to analyze the appearance of plants. Thousands of photos from satellites, UAVs, timelapse cameras, etc. are processed to detect diseases, pest infestations, crop forecasts, etc. In the future — drawing up a schedule for soil irrigation and fertilization, using AI for transport management (including calculating the optimal trajectories of movement in the field), etc. So, in 2019, Rostselmash, among other developments, introduced the RSM Router system. It allows you to use machine communication technologies to build an optimal interaction of machines in the field, taking into account the specifics of the plant culture and the specified parameters of harvesting. The RSM system Voice Access enables you to control appliances using voice commands and the system Agrotronic from Rostselmash may collect and transmit tens of options, from fixing the trajectory of the car to the speed of individual rotors, fans, the magnitude of the gap of the grate cleaning, etc. Mass production of sensors for studying the properties of soil and vegetation cover has been established in a number of European countries, as well as in the United States and China, the serial production of sensors for studying the properties of soil and vegetation cover has been established [10].

Considering breakthrough directions of the FoodNet market one can notice [2]:

- "Smart" (accurate) agriculture. Use of agricultural land monitoring, high-precision and digital technologies, drones and robots. Digitalization will increase the efficiency of farms and create opportunities for the use of optimal technologies in agrochemistry and plant protection.
- "New sources of raw materials". Production of food and feed protein based on alternative sources of raw materials (for example, insects, algae, pseudo-slag crops), the use of bioplastics, biomass and other materials from renewable resources. New food biotechnologies should solve the problem of reducing the cost of food while increasing its functionality.
- Accelerated breeding: creating varieties and breeds with specified requirements that will be able to provide multiple yields regardless of seasonality.
- Organic farming. The use of high-quality feed, biological preparations and organic fertilizers.
- Personalized food. Analysis of the food status of the consumer, the use of personalized logistics. Changing consumer behavior and the demand for healthy food creates challenges for the manufacturers.

The key segments of the FoodNet market are:
- Individually personalized meals. The segment is just emerging and has no clear leaders — and this is a great potential for the Russian Federation players, due to the relevant technological reserves (gene decoding, production based on ESL2), a personnel base (IT specialists, biotechnologists) and players already working within the segment (Elementaree, Just for you).
- Modern breeding. The Russian Federation has successful experience in creating niche varieties with an altered gene, extensive scientific and technical competencies (Skoltech, IOGen RAS, VNIIF) and a unique collection of biomaterials (more than 100 thousand varieties and strains). Companies from the Russian Federation with relevant experience: "Gavrish", Agroholding "Kuban", "Rusagro".
- Alternative sources of raw materials. A large domestic market, the presence of enterprises with experience in developing competitive products, a unique scientific base for the production of biological products based on research centers (VIZR, VNIIBZR, VNIIF, etc.), the availability of organic raw materials and extensive human resource potential will allow Russian companies to seize leadership in the segment.
- Precision farming. Russia has globally competitive technologies (satellite and navigation-for example, the GLONASS system), large human resource potential and players with significant
experience-JSC "RKS3", ITC "SCANEX", "Rusagro". Extensive arable land in Russia makes it possible to develop large domestic market.
- Organic farming. Russia has its own competitive varieties for organic agriculture. Russia has enormous natural resources for organic agriculture (20% of the world's fresh water reserves, 9% of the planet's arable land, 58% of the world's molisols reserves, 40 million hectares of fallow agricultural land that has not received fertilizers for a long time).

Within the framework of the Foodnet market in Russia, it is planned to develop alternative sources of raw materials and food, biologized and organic agriculture, smart supply chains, personalized and specialized food. In the fall of 2020, a squid printed on a 3D printer appeared on the menu of one of the Moscow restaurants. The raw material for it was ordinary beans. It took nine months to get the right texture, taste, and smell. The manufacturer is a Russian startup, which in the fall of 2019 was the first in the world to conduct an experiment on meat bioprinting on board the ISS. Now the technology of production of "substitutes" for chicken nuggets is being developed. Similar projects - for the production of alternative meat and seafood-exist in other regions. As raw materials, not only vegetable ingredients like beans, peas or soy are used. A more serious direction is the cultivation of meat from animal cells in the laboratory. The animal takes a piece of muscle, which is placed in a nutrient medium, where the cells begin to divide and grow. Thus, it is possible to get minced meat. Create a piece of meat, repeating its texture, until it turns out. Such startups are only part of the Foodnet. This concept includes all food created "from the microbe to the plate" with the help of the latest technologies. Following the appearance of food products based on plant analogues of animal raw materials on the market, the trend of products from microalgae will begin. Then the production of insect products for agricultural animals will be developed. Insects are a relatively cheap and affordable alternative to full-fledged animal protein. And closer to 2030, the appearance of products based on cellular meat is expected. The purpose of all these projects is to feed the growing world population and at the same time make the food more correct and personalized. The pandemic has partly accelerated the development of the smart food market. Digital technologies have penetrated into the sphere of food production, food delivery has received the most rapid growth, and the population has begun to pay more attention to the quality of food.

By 2022, Russian companies are planning mass and high-quality production of plant protein concentrates, smart devices for determining the micronutrient status of products (the content of bioelements, vitamins, amino acids, pigments and other bioactive substances), agroecological map services and new biological plant protection products. Solutions for supply chain transparency are expected in 2023, and "digital twins" of agricultural enterprises-from 2026. Products from the "test tube meat" can be tried approximately in 2028. In 2032, agronomists are expected to learn how to change the local microclimate, and by 2035, they will bring out crops and fast-growing forests that absorb carbon dioxide [7].

4. Modern technologies used in the FoodNet

The technology that farmers are increasingly using is Big Data, which is the processing of large amounts of information related to the entire segment of the "Smart Economy" and other areas of the market.

Based on the analysis of huge amount of information, "Big Data" develops yield improvement solutions for farmers by analyzing and predicting weather, soil conditions, and other factors.

Similar to other future markets, these technologies permeate the entire FoodNet future market. In our opinion, the fastest growing foodtech areas will be biotechnologies, innovative food products and the Internet of Things (IoT), and innovative food products, including artificial meat and fish, can become the leader among them.

As of 2020, the global market for seeds and planting materials (not including work in the field of animal husbandry) was estimated at $60 billion, with the prospect of growth to $117.5 billion by 2035. Most of the work of geneticists is aimed at increasing the plants' yield and resistance to stress, as well as resource efficiency.

Despite rather high price threshold for entering the market, almost all developed countries have their own players in the development and implementation of new methods of plant breeding (including
transgenesis, accelerated selection, etc.). For example, in Russia, these are such companies and organizations as "Agroholding Kuban", "Rusagro", the Federal Research Center for Biological Systems and Agricultural Technologies. Monsanto is a recognized leader in the global market: it accounts approximately for a quarter of the global market. Next in chain are DuPont Pioneer, BASF, Syngenta, Groupe Limagrain. If we talk about specific countries, the United States accounts for about 50% of the market. Next with a large margin are Switzerland (10% of the market), Germany, France, and Japan. It should be noted that the share of Russian developments in the world market, despite the rich scientific potential, is extremely small. This small share is due to the Federal Law No. 358-FZ adopted in 2016 on the actual prohibition of the cultivation and breeding of genetically engineered plants and animals on the territory of the Russian Federation. However, quite strict restrictions on this issue exist in other countries as well, such as Australia, Turkey, and most EU states.

There is also high concentration of developers and producers of genetically modified products in animal husbandry. The Dutch Hendrix Genetics B. V. and the German EW Group together provide 4/5 of the global demand for the genetic material of chicken eggs, simultaneously with the French Groupe Grimaud and the American Tyson, they control three quarters of the broiler genetics market. The same Groupe Grimaud accounts for about a third of the global market for pig genetics, another third - for the British Genus.

5. Conclusion

38 countries around the world, including 19 European countries and Russia, have banned the cultivation of genetically modified crops (although such a ban is absurd in itself — all agricultural plants and domesticated animals were de facto subjected to genetic modifications during breeding). In early 2020, a significant step towards the development of FoodNet in Russia was made as a result of the adoption of the law "About Organic Products". Not only it introduces organic farming into the regulatory framework, but also creates the opportunity for a deliberately and meticulously defined state policy in relation to this market segment [5].

It is more difficult to circumvent the legal restrictions associated with the use of unmanned vehicles (particularly in Russia), or the lack of pre-existing standards (for example, for the production of products from insects and algae).

A number of problems are structural in nature: decline in the quality of education, unpopularity of life in rural areas, competition from traditional industries, etc. The role of each country in the future FoodNet market will be determined by how efficient it solves these kind of problems. Global warming, with all its ambiguous impact on agriculture, will stimulate technologies that reduce the weather dependency of the agricultural sector [11].

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