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Prospects for livestock farming in Siberia and Far East of Russia

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Abstract:
This article describes the current state and prospects of cattle farming in remote areas of Russia with a focus on the role of the Siberian Research Institute of Animal Husbandry in developing the dairy and beef cattle breeding industries between 1930 and 2025. It highlights new approaches to cattle breeding that adapt conventional breeds to extreme environment, and lists local R&D projects aimed at increasing meat and dairy productivity.
By outlining the faults and errors of animal husbandry in northern latitudes, we define the current priorities in agricultural science and practice that could improve forage production, thus leading to high-quality organic livestock products in the risk farming areas of Siberia and the Far East.
We propose to develop a net of independent food supply areas that would provide the local population with essential foods and create jobs for new rural settlers.

Keywords: Food independence, animal selection, breeds, extreme conditions, organic food production

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The rapidly changing geopolitical situation affects the economy of nations and entire continents [1]. National independence relies on certain economic sectors, and countries can reach economic sovereignty only by boosting their development.

Russian agriculture still depends on imports in such spheres as seed production, monogerm beet seeds, vegetable and fruit storage technologies, breeding and hybridization in broiler poultry farming, meat and dairy cattle breeding, etc. High-quality animal feeds and livestock processing lag behind the global standards. The domestic pedigree livestock farming has lost its scientific, experimental, material, and technical foundations. While struggling to regain quantity indicators in milk, meat, wool, and eggs, the agricultural science has abandoned its previous research achievements in primary agricultural aspects (food quality, fertility, productive longevity, economically valuable breeds, etc.) and secondary products. As a result, the contemporary R&D budget distribution relies on the wrong priorities, state funds being directed to projects of doubtful demand. The market is saturated with low-quality livestock foods while what Russian scientific agriculture really needs is to focus on improving the quality of bread, milk, meat, and eggs. And to do that, Russia has all necessary resources, i.e., land, energy, water, equipment, and scientific knowledge.

The underdeveloped remote regions beyond the Urals occupy more than 60% of Russia. Their agricultural development depends on a number of important conditions that are hard to meet. The exploration of Siberia and the Far East was a long and complex process; today, the colossal resources of the Russian Antarctic are on the real-time national agenda. Historically, only a few major attempts to develop the Russian frontier proved successful. Here, we could mention Stolypin's project of reclaiming Siberia and the Baikal-Amur Mainline, but the efficiency of the latter remains biased.

When it comes to developing remote territories with harsh climate, the strategizing depends not so much on the income of extractive industries and raw material sale options as on the geopolitics, i.e., population density, sedentary lifestyle vs. nomadism, local production of essential foods, footwear, and clothing, etc. The bioclimatic parameters of the Russian North and Far East are incomparable with the black earth belt of its European part, which means a total absence of any competitiveness between them.

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In 2023, the domestic milk production was at its lowest while beef farming demonstrated zero profit [2]. The government did its best to support beef breeding by issuing various decrees in 2009–2012, but the industry keeps shrinking, the only exception being the Miratorg Holding that receives considerable financial injections from the government. However, the company's price policy fails to recognize the needs of the lower middle class, retirees, and other financially-challenged social strata.

The development of livestock farming in remote areas remains as challenging as any attempts to encourage the working migration to the underpopulated North. Fur, wool, skins, feed grain, meat, timber, and other industries are seldom profitable if they are provincial. The only way out seems to be a closed production cycle that ends with high-quality primary and secondary goods with high added value. For example, coats, hats, and mantles from high-quality pelts could bring more profit than the sheer breeding of minks, nutria, foxes, or sables. Wood processed into luxury furniture, finishing materials, environmentally friendly tableware, and other green utensils is a huge market that generates high profit from renewable raw materials. Processed wool, fleece, and skins of horses, deer, yaks, and other small and large cattle are a source of a wide range of goods, from clothes and footwear to carpets, and they are in high demand on domestic and foreign markets.

If combined with hi-tech processing facilities, livestock farms provide new year-round jobs. However, such full-circle enterprises require a stable cooperation of proactive entrepreneurs with the state. In the Russian North and Far East, it is the bioclimatic potential and the geopolitical situation that dictate the business conditions. The only profitable variant seems to be small and medium-sized livestock family farms of 10–100 cattle heads that are serviced by local feed and fattening cooperatives. These small businesses are then linked by strict contractual terms with processing enterprises and regional retail chains.

Russian North and Far East are huge territories with a remarkable diversity of agricultural production. Such far-sighted scientists and statesmen of the Russian Empire as Dmitry Mendeleyev and Pyotr Stolypin [3] believed that agriculture needed much more capital than other production sectors. Prime Ministers of the Russian Federation Valentin Pavlov and Egor Gaidar, on the contrary, proved short-sighted in their conviction that Russia's abundant resources could buy us everything we need. They reduced the domestic agriculture to a "bottomless barrel" and a "black hole" that would swallow any serious investments. As a result, Russia started to lag behind the global standards in plant and animal breeding, feed production, agricultural engineering, farm and storage design, etc. What is even more important, this attitude did enormous harm to agricultural science. However, when the foreign sanctions turned Russia's food independence into a national economic priority, domestic agricultural scientists and managers made invaluable contributions to the national poultry and pig breeding. Thanks to their efforts, these areas of animal husbandry started to receive state loans to purchase highly productive animals, quality feeds, and hi-tech farm equipment. Thanks to them, Russian consumers can now buy high-quality livestock products instead of unhealthy, fatty pork. However, these achievements became feasible only due to some R&D developed by foreign scientists, who, unlike their Russian colleagues, received much better funding from their national state budgets.

Yet, this approach has also brought about some major failures. For instance, we built 61 no-grass fattening cattle complexes for 10,000 heads each using Italian G&G technology, but they all closed down as a result of poor product quality. The monotonous feeds, aggravated by the lack of sunlight and active exercise, degraded the sensory profile of commercial-scale beef.

Although the R&D work goes on, the quality of products yielded by large industrial complexes remains below the standard level, especially their taste properties. As the country abandoned the system of state standards (GOST) and all-union standards (OST) in favor of technical specifications (TU), the quality of foods and feeds fell victims to all sorts of additives, fillers, and leavening agents. In such conditions, consumers of meat and dairy products turn to private farms, and this trend indicates the low quality of products obtained by large-scale industrial technologies.

Microorganisms that come with feed and environment play a crucial role in animal metabolism, thus affecting the quality of meat products [4, 5, 6]. Since foreign consultants encouraged stagnation in the chemical and microbiological industries, biologically active feed additives have become scarce in the domestic cattle farming. Combined with long-term stall keeping, the poor diet ignores the typical needs of farm ruminants. The weak microbiome literally raises the demand for animal products of satisfactory quality and lowers the profitability of industrial cattle farming.

Considering that Russian North and Far East are risk farming areas, foreign plant cultivars, animal breeds, technologies, and projects have to be subjected to profound testing in local conditions before being introduces on industrial scale. Moreover, different regions of Russian North, Siberia, and the Far East have different climates and thus require different agricultural strategies.

The current geopolitical situation demands independent agriculture, textile and footwear industry, pharmacy, construction materials, etc. Undoubtedly, Russia has enough resources to gain sovereignty in all these areas. The Siberian Research Institute of Animal Husbandry (1930) is the oldest agricultural institute in Siberia. Its teams assess the current trends in agriculture, trying to adjust the research to actual consumer demands. However, state support for regional agricultural science is limited mainly to covering salaries. As a result, agricultural engineering, seed selection, animal breeding, and farming technology lag behind the global standards with no coordination of science and management

to boost cattle and crop farming. Agricultural producers have to spend their income on import products. Their expectations of robust extra-budgetary financing of agricultural production and science have failed. For instance, the mass Holsteinization of dairy cattle requires a radical revision of the structure and technology of forage production.

Cow breeds with high milk and meat yield need a lot of energy and essential nutrients, i.e., protein and fast-digesting carbohydrates. As a result, the proportion of grain feed in their diet has reached 45–60%. However, a long-term diet like that is bad for ruminants since it fails to provide optimal conditions for symbiotic microflora and microfauna in the forestomach, thus preventing absorption of essential nutrients. The resulting epidemic of metabolic disorders in purebred Holstein dairy cattle caused a sharp decrease in productive longevity and calf yield. Obviously, this inevitably affects milk composition [7].

The most urgent task of modern agricultural science is to monitor not only the state of the improved dairy cattle but also livestock products and production economy. Siberia and the Far East possess much poorer bioclimatic resources than the European part of Russia, and it would be impractical to develop here large dairy complexes because they would demand large volumes of transported roughage and succulent feed. These territories are more appropriate for small farms of gourmet marbled beef, young lamb, horsemeat, yakmeat, and venison. With sustainable processing of main and by-products, such small businesses could facilitate the development of remote territories and resolve a lot of social and political issues in the area.

The late XX century saw the development of a complex net of central and regional research institutions, breeding enterprises, multiplying farms, experimental production farms, and test facilities. Working together as a system, they created improved stock breeds adapted to local conditions: one breed and four new types of dairy cattle, three types and five specialized ecotypes of the Hereford meat cows, two types of the Simmental meat breed, one type of the Kazakh white-headed breed, two new breeds of herd horses, one new type of yaks, one new type of meat sheep, two breeds of wool-producing goats, two breeds and four types of pigs, as well as two breeds of fish. By organizing a large Siberian bank of semen and embryos of wild, endemic, and experimental breeds, the government could ensure the continuity of breeding work and improve the arrays of domestic animals in the Regional Center for Breeding and Genetics, which is part of the Siberian R&D and Technological Institute of Animal Husbandry with its 95 years of coordinating breeding work across Siberia and the Far East.

Unfortunately, all new centers for breeding and genetics are located in the European part of Russia, including two in the Moscow Region. Moreover, they belong to agricultural organizations with poor results in dairy cattle breeding. It would be much more expedient to scatter new selection centers across the Russian Federation, preferably in the regions with research laboratories that have successful breeding experience. For instance, the breeding center in Novosibirsk has good results in dairy cattle and pig breeding; Barnaul is famous for beef cattle and maral breeding; Yakutia successfully deals with herd horse and reindeer; Transbaikalia is known for its yaks and sheep, etc. A wide all-Russian net of experimental production centers would support the principle of regional specialization in animal husbandry, preserve achievements of local scientific schools, provide the regions with domestic breeding material, maintain coordinated breeding work, and develop a continuous system of personnel training.

The industrial curse of Russian cattle farming is that the improvements in the feed sphere never catch up with those in the animal breeding, both in terms of quantity and quality. As a result of this gap, inappropriate diet degenerates highly productive cattle breeds, even those purchased abroad, and it does so in several generations. Across Siberia, the feed stock could vary from 4 centners of feed units per head in Tuva and Buryatia to 40–45 in Tomsk, Kemerovo, Omsk, Novosibirsk, Krasnoyarsk, and Altai regions. With an average milk yield of over 6,000 kg per cow, one Russian cow needs at least 50–55 feed units.

Most bulk feeds belong to grades 2 and 3 while the specific weight of rough and succulent silage feeds of grade 1 rarely rises above 10%. As a result, farmers turn to concentrates (45–50%), which are bad for digestion: such a diet cannot be routine since it prevents nutrient absorption. A long-term lack of high-quality hay, straw, and fast-digesting carbohydrates inhibits the upper-rumen microbiome that destroys fiber and forms microbial protein.

We need a new generation of feed additives to normalize the digestion of cattle, which, in its turn, will improve the taste of milk and meat. These new additives improve the microbiome and facilitate the digestion of low-quality feed, e.g., straw, crop waste, overripe natural grass during long-term grazing of beef cattle, herd horses, sheep, yaks, etc. Given the national priority of food independence, these R&D projects are conducted by several institutes powered by the Siberian Branch of the Russian Academy of Sciences, i.e., Institutes of Solid-State Chemistry, Organic Chemistry, Cytology and Genetics, as well as by the Sibbiopharm Production Association. Their combined efforts provide mutual theoretical, financial, and production support. The pilot samples of new feed additives contain enzyme compositions, rumen microbial complexes, sets of cheap fast-digesting carbohydrates, capsuled urea, immune system stimulants, etc. However, most experimental facilities located in pilot production farms have gone bankrupt, which complicates the R&D work. These facilities provided equipped experimental base where experiments could be conducted together with students' field practice and personnel retraining. No breakthroughs in animal husbandry are possible without such facilities, which makes their financial maintenance a state priority. New experi-

mental facilities will provide for the much-needed creativity in fundamental and applied science to boost the domestic feed production, without which all other agricultural work is futile.

We need a new, more effective forage production system to yield high-quality artificially dried forage based on the regional long-term green conveyor principle. We need a comprehensive study that would compare – both biologically and economically – the standard diets oversaturated with forage grain and silage forages with alternative diets based on granules or briquettes of artificially dried alfalfa, rye, triticale, goat's rue, mallow, rape, and other promising plant species. These raw materials can fortify the deficient cattle diets with vitamins, fast-digesting carbohydrates, and valuable proteins preserved by special drying modes. Such additives normalize metabolic processes and improve the quality of final meat and dairy products.

The above-mentioned green crops are a much more favorable variant of agricultural land use than wheat, and they could be sold at higher prices than low-quality wheat grain. Should this approach prove feasible, it could change the structure of the national livestock feed production. Today, grain feed mixes consist of mostly poor-quality hay and soft wheat. Artificially dried green grass, harvested in the optimal vegetation phase, is more biologically valuable than silage, haylage, or moldy hay rolls. Structural fiber could be obtained from high-quality straw combined with the above-mentioned new-generation feed additives to reduce the rate of concentrate-related metabolic diseases.

According to foreign best practice, artificially dried granulated or briquetted green feed is good for highly productive cattle of all types. This product is in demand on the world market, e.g., China even has to import it from the USA. Some agricultural entrepreneurs from the Voronezh Region have been applying a new drying technology to green plants for several years, and now they sell their products to other Russian regions. Several Russian enterprises have learnt to manufacture equipment for green mass drying from domestic components. In terms of energy consumption and drying modes, this new technology is much better than the old one that relied on diesel fuel. Supported by the enormous land and energy resources, the combined efforts of fundamental and applied science to improve the drying technology for green plants may bring about a breakthrough in the domestic agricultural production. Even in the risky farming areas, Russia may become a leader in the novel feed that could boost the productivity of farm animals, thereby improving the quality of milk, meat, eggs, etc.

The recent rise in the productive potential of farm animals has led to predictable consequences worldwide: high productivity suppresses reproductive functions [4]. For the Holstein dairy cows with a milk yield of 7,000–8,000 kg per lactation, the calf output has plummeted to 76 per 100 cows while their productive age is as short as 2.67 calvings [7]. The negative changes presumably affect the milk quality and the development of young animals. We need comprehensive analytical report on the state of beef and dairy herds, with monitoring and forecasts of breed development. These projects should be given scientific priority, with the management and coordination organized by professionals.

Beef cattle breeding in risky farming areas, i.e., 50% of Russia, can become the beacon of economic recovery in remote and underpopulated regions. Eventually, it could catalyze the settlement of sparsely populated areas. The specialized beef cattle breeding industry first attracted the state attention and funds in the early 1970s. Since then, the Siberian Institute of Animal Husbandry, together with regional science and breeding enterprises, has created eight new types of the Hereford beef cows, one new type of the Simmental breed, and one new Kazakh white-headed cattle breed, by combining local cattle with foreign specimen. The most successful new ecotype was a combination of Siberian Simmentals with German meat Simmentals, crossed with improved Herefords (Figs. 1 and 2). They are highly adaptable to steppe, mountain-taiga, and forest-steppe environment,



Figure 1 A 18-month-old Simmental bull of Baganskiy type: 705 kg of post-fattening live weight



Figure 2 First generation crossbred calves (♀Simmental × ♂Hereford)

providing up to 1.5 kg of daily live weight gain during final fattening. The cows demonstrate good maternal qualities, and the bulls are quite placid. Their semen is available in many breeding enterprises across Siberia.

In addition to marbled beef, regions with intensive farming have good prospects for long-term storage feed production and elite livestock products from herd horses, yaks, deer, meat sheep, and pigs. Their semen and other bio-products should be stored in special storage banks as state property.

Siberia and the Far East need new breeding and genetic centers for new ecotypes and breeds. With academic and state support, they could develop environmentally friendly organic products to be exported to China, India, and Africa. This type of export is likely to turn out more profitable than grain trade. In addition, an agile meat livestock industry with vast grazing areas and pastures could fortify the national independence in the eastern regions, as well as stop the neighboring countries from "friendly" attempts to claim underdeveloped territories.

Most proposals listed in this article are being implemented right now in the Altai Region (AltaiMyas Association, KFK Nauka, OOO Pharm, OOO Lebyazhye), in the Omsk Region (Tyukalinsky Butter and Cheese Factory, OOO Osha Food Corporation), and in Yakutia (AO Tuimada, Verte Agricultural Production Cooperative) [8, 9]. These enterprises use new technologies that render their livestock products with unique sensory qualities and ensure a meat potential of 0.9–1.1 kg/day. However, their profitability remains below 18–20%, which indicates a gap between energy prices and the bioclimatic potential of the region. The profitability of agricultural enterprises should be high enough to guarantee a constant production improvement and high wages for all their employees.

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