Agroindustrial Clustering as a Driver of the Activization of Breeding Work in Animal Husbandry

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Abstract. The current condition of breeding in animal farming in Russia and on the regional example the Saratov area was researched. The indicators of the development of pig breeding, meat and dairy cattle breeding are analyzed. Data on livestock scoring and the specific share of various breeds of pigs and cattle in households of all categories are presented. The main problems of the development of stock breeding were identified, among which: the destruction of a unified system of breeding work, the lack of specialized education in the regions, reduction of specialized research institutions, reduction in the number of breeding enterprises, etc. The organizational and economic structure of the livestock cluster, consisting of a production core (agricultural, processing and marketing enterprises) and serving satellites (supplying organizations of scientific, technical, educational, financial and credit and insurance sectors) is proposed. The need for the creation of regional reception centers for primary meat processing and the Center for Cluster Development was also identified. And the creation of a single Selection and Hybrid Center in the regions will allow to restore and systematize the breeding work in the agricultural enterprises participating in the cluster. The implementation of proposals for the organization of breeding in the regions on the basis of livestock clusters will solve a number of organizational and economic problems of increasing the competitiveness of the main animal breeds and the efficiency of livestock production.

1. Introduction

The breeding work in animal farming in Russia over the past three decades has existed thanks to the accumulated base from the time of the Soviet Union, but continued to gradually decline. In the 21st century, foreign companies and research organizations were called upon to compensate for the lack of domestic breeds. And this is in a country where many foundations of animal breeding were laid by such world-famous scientists as: M.F. Ivanov, P. N.Kuleshov, M. I. Pridorogin, E. A. Bogdanov, E. F. Liskun, D. A. Kislovsky, S. I. Shteyman, S. I. Smetnev, A. A. Maligonov, A. S. Serebrovsky, L. K. Ernst [9].

Of course, this state of affairs in the country of worthy followers of Robert Bakewell and Charles Robert Darwin could not last forever. If in the days of the Russian Empire and later in the USSR, own breeds were bred and then regionalized, and a well-functioning breeding system was destroyed, which was destroyed during the time of new Russia. Now, animals brought from abroad do not quite correspond to the local climatic conditions and conditions of detention. And if the last factor can still be rebuilt for the sake of more productive breeds of animals, then the first is not possible to change. Today
this creates new challenges for Russian livestock. But over the years, the world science of breeding in livestock has gone far ahead in almost all areas.

Currently, in order to implement the state policy in the field of import substitution for breeding products and ensuring epizootic well-being, an in-depth breeding and breeding work with specialized animal lines is required, which ensures the production of highly productive domestic hybrids. Today, there is an objective need for a radical technological reform of livestock breeding, the platform for which should be the latest industry innovations, in particular reproductive, information and genomic technologies, which are of great importance for the reproduction of competitive breeding resources of their own reproduction. To solve this problem, the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food Markets for 2013–2020 provides for support in the form of subsidies from the federal budget to reimburse part of the direct costs incurred related to the creation of new and modernization of existing selection genetic centers.

2. Relevance, scientific significance of the issue with a brief review of literature

The experience of issues of integration and cooperation development has been accumulated by many scientists of the world. At the same time, insufficient attention is paid to the study of issues of the interconnected transition from the processes of integration and cooperation to the wide clustering of all areas of the agro-industrial complex, as well as their development and functioning in the system of a single mechanism at the regional level, organizational and economic features and the methodology for the formation of specific elements and objects. In addition, despite the sufficient study of the features of the formation of cluster activity in individual industries, questions remain open related to the transfer of this positive experience to the sphere of agricultural production. The problems of interaction of agricultural, processing and marketing enterprises with research, educational and financial-credit institutions are required to be disclosed. A lot of problems lie in the plane of creating a favorable external environment for the operation of agro-clusters, including increasing their investment attractiveness and innovative activity (information and analytical support, simplifying and accelerating project registration procedures, eliminating administrative barriers, training qualified specialists, etc.). At the same time, there is practically no work to improve the organization of the breeding system, both at the state or regional levels, and at the level of enterprises or holding structures. At the same time, the lack of targeted state regulation of cluster activities within the framework of a single federal agency on the basis of a single mechanism is still being traced, which forces research to be focused on the development of regional projects for their implementation at the enterprise level, which predetermined direction of research.

In preparing the article, data from the Federal State Statistics Service of the Russian Federation (Rosstat), scientific works of Russian and foreign scientists on the organization of breed work in agriculture, materials of research organizations from different countries of the world were used. In the study of theoretical and methodological aspects of various organizational-economic aspects of the development of breeding in animal husbandry, monographic and logical methods were used. In the research of theoretical and methodological aspects of various organizational-economic aspects of the development of breeding in animal husbandry, monographic and logical methods were used. The study of the current state of breeding work in animal husbandry of the Russian Federation was carried out on the basis of comparative statistical and economic analysis. In studying the practical work experience of industrial enterprises, pedigree organizations, educational and scientific institutions of animal husbandry, methods of sociological research of expert opinion were used: interviewing and interviewing. The determination of the directions of development of animal husbandry and proposals for the formation of a breeding system are based on abstract-logical and computational-constructive methods.

Currently, many scientists of the world continue to work on the study and improvement of various livestock breeds: Holstein (Aebi A. [1], Brotherstones S. [5], Freeman A.E. [12]), Simmental (Fonge J. [11]), Hereford and Angus (Marschal D.M. [17]). New methods are being created and well-known methods for the study of the characteristics and productive qualities of livestock, as well as selection, including molecular genetic using telemetry methods and modern equipment, are being developed (Wim-
mers K. [29], Morlein D. [19], Steinhardt M. [26], Eichinger H.M. [7], Ahlbom-Brier G. [2]). Work is conducting on zoning livestock, both in tropics of Latin America (Hagnauer W. [13]) and in the southern (Purroy A. [21]) and continental countries of Europe (Spindler F. [25]). Some scientists (Buchholz C. [6], Roos L.P. [23]) publish works on improving livestock production methods. Livestock regulation legislation is also being developed (Rappen W. [22]) and measures of its state support (Van Vleck L.D. [28]). In recent years, organic animal husbandry is gaining popularity (Bhandari D.P.) [3].

3. Formulation of the problem
The objective of the study is to analyze the state of the livestock industry and find relevant directions for the development of breeding work through the integration and cooperation of enterprises based on agro-industrial clustering, which can improve the organization and efficiency of production and distribution of products. For this purpose, it is required to develop models of a regional livestock cluster and a selection-hybrid center in its structure, which will contribute to solving the problem.

4. Theoretical part
Obviously, at the present stage of development of the industry, whose products (food) are very perishable and require special conditions of delivery and storage, the supply and service sectors play an important role, the optimization of which is ensured by marketing distribution and logistics. When independent participants in distribution channels individually act on the market, they have to independently conduct sales, pricing, other policies and plan marketing events separately at each level. The participants of the integrated and cooperative structure function as a single organism, coordinating their activities in all areas of production, marketing, etc., which eliminates duplication of functions. Nowadays, various theories and methods of integration and cooperation of economic entities have been widely developed in terms of ensuring the organization and effectiveness of industrial and economic interaction. The basis of the research is: the theory of comparative advantages, economies of scale, industry life cycles, the concept of transaction costs and strategic advantages. Among these works, one can note the direction of regional economic growth, which includes sections: neoclassical (D. Bort's model, etc.), cumulative (center-periphery theory by J. Friedman, etc.), new theories (the “market potential” model by J. Harris, etc.), other theories (the theory of sectors by A. Fischer, C. Clark, J. Furastier, etc.) [16]. Moreover, in the framework of this research, the section of new forms of territorial organization of production in the part devoted to clusters, and conditionally divided into 3 scientific schools: American (M. Porter and others), British (D. Dunning, etc.) is of particular importance. and Scandinavian (B.-O. Lundval and others). Particular emphasis should be placed on the influence of clusters on increasing the competitiveness of participating enterprises. This research is based on the works of representatives of the American school, in particular M. E. Porter [20], M. Enright [8], P. Maskell, M. Lorenzen [18], S. Rosenfeld [24], M. Storper [27]. At the same time, one of the main prospects for the development of livestock breeding is the formation of agro-industrial clusters that bring together not only manufacturers, processors and marketers (core), but also scientific, educational, supplying and servicing organizations (cluster satellites).

5. Practical importance, offers and results of introductions, results of experimental studies
The livestock industry in Russia, due to extremely difficult internal economic conditions and the external economic situation, demonstrates multidirectional dynamics. Over 5 years, the number of cattle decreased by 6.1%, including cows by 7.0%, while the number of pigs, on the contrary, added 17.1%. Meat sales increased by more than a fifth, and milk production fell 3.4% (table 1).

The most common breed of beef cattle is Aberdeen Angus (53.3 %) in second place, Kalmyk (21.1 %), and 3rd and 4th places – Hereford (13.3 %) and Kazakh white-headed (9.3 %), respectively. The number of representatives of the remaining breeds is less than 6 thousand heads [10].

In pig breeding in Russia, the largest share among pig breeds was occupied by large white (67.9 %), landrace in second place (14.1), Yorkshire in third (10.9 %) and Duroc in fourth (4.9 %). And the remaining breeds of bred pigs together account for 2.2 % (table 2).
Table 1. The main indicators of livestock development in farms of all categories of Russia in 2012–2016.

| Indicators                          | Years     | 2012 | 2013 | 2014 | 2015 | 2016 | 2016 r., % to 2012 | 2015 |
|------------------------------------|-----------|------|------|------|------|------|-------------------|------|
| Cattle stock, thousands heads      |           | 19981| 19564| 19263| 18992| 18752| 93,9             | 98,7 |
| Cows stocks, thousands heads       |           | 8883 | 8661 | 8530 | 8408 | 8263 | 93,0             | 98,3 |
| The number of pigs, thousands heads|           | 18816| 19081| 19546| 21506| 22027| 117, 102         |      |
| Implemented for slaught of livestock and poultry (in slaughter weight), thousand tons | | 8090 | 8544 | 9070 | 9565 | 9899 | 122, 103         | 4    |
| Milk production, thousand tons     |           | 31830| 30528| 30790| 30796| 30758| 96,6             | 99,9 |

Source: ASRIbreed (VNIIplem) [10]

Table 2. Breed composition of the scoring number of pigs in the Saratov region, heads.

| Breed             | Scoring, at all | Including boars | sows | repair boars | repair sows |
|-------------------|-----------------|-----------------|------|--------------|-------------|
| Large White       | 1015            | 7               | 374  | 112          | 522         |
| Landras           | 549             | 24              | 240  | 55           | 230         |
| Purebred hogs     | 1564            | 31              | 614  | 167          | 752         |
| At all            | 1564            | 31              | 614  | 167          | 752         |

Source: ASRIbreed (VNIIplem) [10]

The dairy herd is represented by 24 breeds and 21 types of cattle, with more than half of the number being black and motley animals. On the 2nd place, occupying about 10%, is the Holstein breed of black-and-white suit, and in the 3rd, 4th and 5th places (each less than 10%) are Simmental, Kholmogorsk and red-motley breeds, respectively [10]. These breeds are well adapted to local agro-climatic conditions, but at the same time they do not have competitive productivity in comparison with foreign breeds. Table 3 provides data on the abundance and productivity of some breeds of cattle in the dairy direction using the example of the Saratov Region as one of the representative regions of Russia.

For the development of the most productive breeds and their adaptation to local economic conditions, the development of breeding at the federal and regional levels is required. Such work is possible only with a systematic approach that existed in the Soviet period.

Unfortunately, in the last decade, breeding in Russian animal husbandry, without which the revival and subsequent effective development of this vital industry is impossible, was in a state of anabiosis. The structure of the breed network was disrupted, a huge number of breed enterprises were eliminated, almost no selection work was carried out to improve the existing and create new breeds. At the moment, Kurganinsky, Yuriinsky cattle breeds, Siberian northern and Kemerovo pig breeds, Gorky and Kuchugurovsky sheep breeds are out of breeding registration [14]. All this together led to the destruction of the
livestock gene pool, the destruction of the complex biogenetic process of breed formation, formed through the long and painstaking work of breeders.

Table 3. The number and productivity of dairy herd cows in the Saratov region.

| Breeds              | All categories of farms | Quantity of farms | Cows at all, thousands heads | Milk yield, cg | Fat, % | Protein, % | Live weight, cg |
|---------------------|-------------------------|-------------------|-----------------------------|----------------|--------|------------|----------------|
| All breeds          | 9                       | 6.56              | 7129                        | 3.87           | 3.25   | 537        |
| Holstein            | 1                       | 2.68              | 9497                        | 3.82           | 3.24   | 538        |
| Red-motley          | 1                       | 1.24              | 5773                        | 4.01           | 3.26   | 545        |
| Simmental           | 6                       | 2.38              | 5336                        | 3.87           | 3.23   | 531        |
| Black-and-white suit| 1                       | 0.26              | 5540                        | 3.81           | 3.40   | 535        |

Source: ASRIbreed (VNIIplem) [10]

As a result, today the parent flocks of new and modernized commodity complexes are almost 100% equipped with foreign animals of high genetic potential. The destruction of the Russian highly productive breeding base forces these enterprises to permanently acquire foreign livestock to repair their parent flocks, thereby falling into the technological dependance and the zone of high risks of veterinary problems that exclude the import of breeding material. So, in 2016, the dependence of the pig industry on the share of parent and grandparent forms used in imported crosses was fixed at the level of 80–90% [15]. Such scales of animal imports are not found in any other country in the world. This is due, firstly, to the desire of states to preserve their own breeding and genetic resources as the main means of production for increasing the number of pedigree livestock and producing livestock products; secondly, the focus on the acquisition of not the animals themselves, but their biomaterial in accordance with the requirements of veterinary safety, the interests of breeding and economics.

At the XVI All-Russian meeting on the development of animal husbandry, which took place in March 2018, Director of the All-Russian Scientific Research Institute of Breeding, Academician I.M. Dunin noted that the modern market of competitive breeding resources, breeding and genetic services is tightly monopolized by the largest genetic companies and is formed by a limited number of countries with developed animal husbandry. Their influence is quite noticeable on the Russian market of breeding products and genomic technologies [4].

At the same time, practice shows that imported livestock of pigs under the conditions of technology of industrial complexes in Russia (insufficient feed supply, technological violations of maintenance and operation, etc.) undergo a difficult process of adaptation and acclimatization, as a result there is a large waste of livestock and a decline in productivity.

In addition, the fashion for meat pork has led to a significant decrease in livestock viability, increased sensitivity of animals to stress and, as a result, deterioration of meat quality. Thus, one-sided selection for the production of lean meat pork has shown spectacularly that the selection of animals based on only one specific attribute of productivity, as a rule, improves this attribute, but at the same time, others worsen, and, first of all, viability. In this case, accumulation in the population of undesirable recessive genes occurs. However, the main problem requiring urgent solution is the destruction of the unique gene pool of Russian pig populations, in particular, the irreplaceable loss of sebaceous breeds, well adapted to the special natural-climatic, ecological-geographical and economic conditions of our country, with good taste qualities of meat. The most important argument in favor of the need to inhibit unsystematic import of livestock of pigs, speed up the transition to the use of foreign technological solutions and know-how, revive breeding and breeding and use Russian breeds of animals is the quality of the meat obtained. The fact is that pork of Western breeds (Yorkshire, Landrace, Pietrain,
etc.) is characterized by low taste qualities. In it, between the muscle fibers, there are almost no fatty layers, therefore, when used, it is dry and solid. Professor, corresponding member of the Russian Agricultural Academy V.D. Kabanov notes that “stress-sensitive pigs, weakened by ultramuscular selection and producing exudative,” acidic “pork of poor quality, not suitable for producing high-quality hard sausages, are often imported to Russia. In many countries, the demand for such pork has been significantly reduced, and in Canada, for example, a federal scientific program has been adopted to increase the fat in meat and increase the slaughter live weight of pigs” [14].

As a result of this, the importation of more productive livestock, including pigs, in our opinion, should be carried out exclusively in breeding farms to create new specialized meat genotypes. Replacing the livestock of even one and the same breed is a very long-term, labor-intensive and costly process, therefore, taking into account the size of the territory and the variety of natural and climatic conditions of the Russian Federation, the availability of own parent breeds is of strategic importance. Correction of the direction and level of productivity is much more efficiently carried out in hybridization systems based on specialized paternal forms with segregated import of breeding material from other countries. The complete replacement of Russian breeds with foreign breeds will ultimately inevitably lead to the transformation of the breed-formation process over a vast area of the Eurasian space with unpredictable consequences due to the loss of valuable genes that determine disease resistance, resistance to negative environmental influences, adaptive capabilities organism to various ecosystems.

Meanwhile, in pig breeding in the Saratov region, one of the most significant regions-leaders of the country’s agricultural sector, there is currently no breeding sector. Over the years of agrarian reforms, they were closed: the “Perspective” pig complex in the Krasnoarmeysky district, the “Sotszemledeliy” pig complex in the Balashov district, the “Arkadak” pig complex in the Arkadak district, the “Crystal” and “Rodina” pig complex in the Saratov district, “Mikhailovsky” and the “Volga” breeding factory in the Marx district, the “Time Forward” breeding reproducer in the Engels district of the Saratov region. With regard to dairy and beef cattle breeding in the Saratov region, we note that the condition of the breeding base there is also unsafe. In recent years, the following have been closed: the Combine breeding state farm (now in its place is the Yubileiny market. The livestock, well-selected, has disappeared); Zvonarevka of the Marxovsky district of the Saratov region (involved in breeding cattle of the Black-motley breed of the milk direction of productivity); Experimental production farm “Centralnoe” of the Research Institute of Agriculture of the South-East (engaged in breeding Simmental cattle breed combined direction of productivity); in the city of Engels “Head breeding enterprise.”

In recent years, the Saratov State Agrarian University has been reduced by merging the department of animal husbandry: pig breeding, cattle, small cattle, poultry farming, breeding and raising livestock, milk processing, etc. Many disciplines for preparing specialists in the field of livestock breeding have been removed from the curriculum. The previously functioning regional Volga Research Institute of Animal Husbandry and Biotechnology was abolished and joined the Research Institute of Agriculture of the South-East as a department of animal husbandry. The number of its employees today is 7 people, there is practically no scientific work on feed production, breeding, etc.

The current situation induces agricultural enterprises to acquire doses of sperm for insemination of animals in the “Central Bank of the family” (Moscow region, Bykovo village). At the same time, the cost of one dose is at least $1.27–1.43. For insemination of one cow, as a rule, 2-3 doses are required. Thus, the costs of enterprises for insemination, taking into account the number of livestock, are very significant.

Today, the work of the Voronezh and Lipetsk breeding enterprises is getting better. However, this is clearly not enough to solve the problems of teamwork. It is important to note that it is undesirable to take sperm doses for insemination at the same breeding enterprise for a long time because of the noticeable increase in the risk of closely related mating.

In addition, it is important to note that in small-scale production, and especially personal subsidiary plots, where most livestock products are now produced, breeds cannot be improved and preserved. This requires enlarged structures, the production volumes of which make it rational to create
a streamlined network of breed enterprises and systematic breeding work. The implementation of these tasks is possible only with the use of a systematic approach and the unification of efforts at the state and private levels. One of the possible ways to develop the organization of pedigree activity can be the formation of an agro-industrial cluster in the livestock sector. At the same time, the pre-formed developed integration and cooperation structures (protocluster), which are respectively agricultural holdings and agricultural production (consumer) cooperatives combining small business forms, should become the main base. As a result, a schematic model of the livestock cluster in meat and dairy and food complexes was proposed using the example of enterprises in the Saratov region (figure 1), taking into account the specifics of the industry. Such a structure has all the necessary elements that make it possible to organize comprehensive qualified breeding work to increase the genetic potential of animals (Selection-hybrid centers).

The formation of the cluster will also contribute to the restoration of headaches in small farms, which is possible if they cooperate and integrate with large-scale production, characterized by a high zoosanitary status in terms of protection against skidding and the spread of pathogens of especially dangerous diseases. At the same time, the cluster structure will facilitate the joint creation by the participants of a sustainable forage base (supplying and serving satellites). The cluster provides for the formation of slaughter and procurement points (with the function of primary sanitary and veterinary control and the automated certification system "Mercury" developed by the Rosselkhoznadzor) and milk collection points based on cooperatives. And also the cluster will form the basis for achieving high productivity through the most effective combination of production factors, free access to information and better coordination of activities (Cluster Development Center). At the same time, within the framework of the cluster, rationalization of the processes of expansion, thinning and modernization of the product lines of participating enterprises is observed, anticipating fluctuations in the needs of customers in all markets of presence, the acceleration of the process of promoting new products on the market. For example, chilled and frozen semi-finished products, quick-frozen dishes, broths and canned soups, which are in demand by consumers.

**Figure 1.** A schematic model of a regional livestock cluster on the example of enterprises in the Saratov region. Source: Developed by the authors.
The high-tech development of the regional livestock cluster is achieved through the formation of a joint scientific base of participants, concentration of investments on the most cost-effective and promising innovative projects, operational accommodation for the transformation of consumer preferences, minimization and distribution of high costs and risks associated with the development and the introduction of innovation between enterprises belonging to the cluster structure [30].

Comparison of the added value when using the traditional channel of distribution of goods and the livestock cluster made it possible to establish that in the second case there is a significant reduction in transaction costs due to the joint development and implementation of innovative technologies for the collection, storage and processing of milk, slaughter, reduction resource intensity, growth of productivity and labor remuneration, increase of capital productivity. At the same time, the overall decrease in commodity circulation costs will amount to an average of 29.8 % for meat and meat products, and 26.0 % for milk and dairy products.

**Figure 2.** The scheme of organization of breeding in a cluster structure. Source: Developed by the authors.
Also, as a result of the study, a scheme was developed for organizing breeding work in livestock breeding clusters on the platform of the Breeding Hybrid Centers being created (figure 2). It takes into account the specifics of the industry, which is expressed in the need for skilled comprehensive breeding, increasing the genetic potential of animals, restoring livestock on farms and pig farms, and is an organic element of the scientific and innovative component of the cluster multisystem. For example, in cattle breeding, the inclusion of the Selective Hybrid Center in the cluster will allow replacing imported livestock breeds (Limusin, Black Angus) with domestic improved breeds – Hereford, Kalmyk, Kazakh white-headed, as well as reducing the corresponding costs of agricultural organizations in the region.

6. Conclusion

In conclusion, we note that the loss of a unique gene pool of Russian animal populations is fraught with a loss of the country's food security, the consequences of which are irreparable in the event of military conflicts, an epidemic of dangerous zoonoses, an embargo or economic blackmail. It is necessary as soon as possible to take measures to revive the breeding business in animal husbandry. Otherwise, to solve the problem of the industry's dependence on imported breeding products, it will take at least half a century, since the process of creating new breeds is very long.

The developed clustering model in animal husbandry provides for a comprehensive all-round improvement of breeding on the basis of the proposed Hybrid Breeding Centers within the framework of a full-fledged scientific and innovative infrastructure, the active and efficient use of land supplying and servicing satellites in order to form their own resource and raw material base. As well as the recombination of production cycles in a cluster, free access to information, qualified coordination of activities by the Center for Cluster Development. It allows leveling the existing differentiation of business schemes in the industry through the formation of cluster cores based on the specifics of the process. And at the same time, hierarchize the principles of distribution of state support and the priorities for investing capital investments using the production and investment potentials of the cluster. Also, the proposed model predetermines: expanding the coverage network for procurement activities of supply and marketing cooperation, concluding collective agreements at all levels of the cluster, an integrated systematic approach to the formation of added value of products by streamlining the logistics system and pricing policy. All this ultimately allows us to ensure maximum satisfaction of the interests of participants, the intensification and maintenance of expanded reproduction, the formation of reserves and the organization of our own scientific and innovative activities, especially in the field of breeding. And the introduction of the proposed model of the livestock cluster into the practice of clustering agribusiness enterprises will create the prerequisites for reducing the added value of certain types of livestock products by an average of 28% by optimizing the areas of production, processing, supply, maintenance, marketing, etc. that will promote successful competition with foreign counterparts to solve problems of import substitution.

Thus, integration and cooperation based on clustering serve as a powerful means of achieving the goals of economic policy to increase efficiency, competitiveness, and innovation. In the future, it is territorial-production clustering that will be the most important direction of the distribution of productive forces in the agricultural sector of the Saratov region.

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