Efficiency of breeding work in dairy cattle breeding

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Abstract. The purpose of the work is to study the effectiveness of breeding work in dairy cattle breeding. The main indicators of efficiency in dairy cattle breeding are systematized, specific indicators for dairy cattle breeding are highlighted. Analysis of the dynamics of milk production showed the dependence of the development of the industry on government support measures, allowed to extract reserves for production growth. It was concluded that in terms of productivity per cow per year, the Sychevsk and brown Schwyz breeds are inferior to the Holstein breed, but the duration of use, the service period and the output of calves in Holstein breed are much lower. The lifetime productivity of these breeds was calculated. It is concluded that the genetic potential is not fully disclosed in any breed.

1. Introduction
For the organization of the production process in animal husbandry, it is necessary to raise livestock, reproduce the herd, keep and feed the animals.

The efficiency of production of dairy cattle breeding can be determined for the industry as a whole, for a specific unit of the herd, based on the feed area required for the production of this type of livestock production, for the organizational form of the industry (farm, complex, team, etc.) for the type of product.

The main indicators used to assess the effectiveness of dairy cattle breeding, systematized and presented by us in the diagram (Figure 1). The groups of general and specific indicators, as well as indicators that assess individual activities and breeding work in general, are highlighted.

Breeding work in cattle breeding is aimed at improving the genetic and productive qualities of animals based on the selection of the most valuable animals, aimed selection of parent pairs, directed rearing, creating good conditions for the animals and feeding [1].

The efficiency of breeding work can be determined at the level of commodity economy, at the level of breeding and replication of the super-repair molonyak, at the level of carrying out selection and breeding work. Modern reproduction of competitive breeding resources uses new reproductive informational, genomic technologies. Competitive breeding herd is the “growth point” for the stable development of cattle breeding.

2. Methods
Calculated-constructive, economic-statistical, and monographic methods of research were used. The data came from Rosstat and OJSC “Smolenskoye” (reportings on breeding).
Efficiency of dairy cattle breeding

| Indicators for the industry as a whole | Indicators for individual elements of the production process or event (on the actual state or justification of promising options) |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| **General**                           | **Specific**                                                                                                      |
| - Costs of production (per 1 hectare of farmland, 100 rubles. of fixed production assets of the industry, 1 conventional head of livestock, 1 employee); | - Comparative productivity of animals (taking into account the specific characteristics of their individual species); |
| - Costs of 1 center of products;      | - Additional gross output, gross and net income per unit of production potential (land, production assets, current production costs, labor, etc.); |
| - The net income and profit from sales of products; | - Changes in labor costs and means (cost, including feed) per unit of production; |
| - The level of product profitability; | - Change in the industry's profitability (profit, profitability); |
| - The labor costs per 1 center of production; | - The effectiveness of additional investments. |
| - The capital-output ratio and capital productivity of the dairy cattle breeding sub-sector; | - Animal productivity (average annual milk yield per cow; business output of young animals) and payment for feed with products; |
| - profit rate.                        | - Feed consumption per 1 center of product and 1 head; |

**Figure 1.** The system of performance indicators in dairy cattle, including breeding.
3. Results and Discussions

In dairy cattle breeding for 2013-2017, the productivity growth (1.93%) lags behind the rate of reduction in the livestock of cattle (up to 10.67%), the increase in livestock is observed only in peasant (farmer) farms (Table 2).

**Table 1.** Dynamics of changes in the number of livestock in farms of various categories, thousand heads.

| Indicators                          | 2013   | 2014   | 2015   | 2016   | 2017   | 2017 to 2013 |
|------------------------------------|--------|--------|--------|--------|--------|--------------|
| Cattle livestock (all categories of farms) | 19 564 | 19 263,7 | 18 992 | 18 752,5 | 18 643,9 | 95,30        |
| including cows                     | 8661   | 8530,8 | 8408,1 | 8263,7 | 8202,8 | 94,71        |
| Cattle livestock in agricultural enterprises | 8800,5 | 8522,6 | 8447,8 | 8355,9 | 8242   | 93,65        |
| including cows                     | 3532,5 | 3439,3 | 3387,4 | 3359,5 | 3319   | 93,96        |
| Cattle population in households     | 8715   | 8596   | 8301   | 8016,9 | 7915,6 | 90,83        |
| including cows                     | 4088,5 | 4005,4 | 3881,8 | 3716,6 | 3652,1 | 89,33        |
| Cattle livestock in peasant farms   | 2048,5 | 2145,1 | 2243,2 | 2379,8 | 2486,3 | 121,37       |
| including cows                     | 1040   | 1086,1 | 1138,9 | 1187,7 | 1231,6 | 118,42       |
| Reference:                          |        |        |        |        |        |              |
| Gross milk yield in farms of all categories, million tons | 30,53 | 30,79 | 30,8 | 30,76 | 31,12 | 101,93 |

The increase in the productivity of dairy cattle was largely achieved through the implementation of state programs and through a complex of veterinary and zootechnical measures, improved feeding and housing conditions, automation of complexes, herd renewal, purchase of breeding material (semen and embryos), and also import of purebred cattle. As of January 1, 2018, the number of dairy cows in the dairy direction of productivity is 1 million heads. The share of domestic breeding products in total sales in 2017 in dairy cattle was 60%.

One of the factors affecting the increase in milk production is technical modernization, including both the construction of new and the reconstruction of existing farms (Table 2).
**Table 2. Increase in milk production on the newly built, reconstructed, and modernized farms [2].**

| Indicators                                      | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2017 to 2008 |
|------------------------------------------------|------|------|------|------|------|------|------|------|------|------|--------------|
| Introduced new objects, units                  | 109  | 73   | 75   | 79   | 81   | 140  | 112  | 120  | 117  | 161  | 147,7        |
| Milk production at the commissioned facilities, thousand tons | 119,7 | 133,9 | 110,4 | 88,0 | 101,9 | 138,2 | 155,6 | 119,3 | 170,4 | 141,6 | 118,3        |
| Reconstructed and modernized facilities, units | 368  | 176  | 148  | 92   | 107  | 131  | 94   | 99   | 119  | 70   | 19,0         |
| Additional volume of milk production due to reconstruction and modernization, thousand tons | 92,4 | 56,2 | 30,1 | 18,7 | 21,1 | 41,4 | 6,5  | 57,2 | 61,7 | 17,8 | 19,3         |
| The share of additional production at the constructed and modernized facilities in the total volume of milk production, % | 0,7  | 1,2  | 1,7  | 2,0  | 2,4  | 0,59 | 0,52 | 0,57 | 0,75 | 0,51 | -0,2         |
| The number of places created for livestock due to the introduction of new objects, units | 67439 | 50647 | 46703 | 49563 | 38069 | 47504 | 46351 | 47710 | 53682 | 65357 | 96,9         |
| Number of places created for livestock due to reconstruction and modernization, units | 125529 | 43288 | 36660 | 19563 | 15624 | 25983 | 12071 | 21880 | 24957 | 49876 | 39,7         |
The improvement of domestic dairy cattle by the Holstein breed provides favorable prerequisites for obtaining 5000 kg of milk from a cow per year. The use of absorbing crosses has led to the widespread transfer of leading breeding farms to the status of improving breeds. Holsteinization of domestic dairy breeds leads to a loss of their genetic specificity.

Table 3. Production use of cows of the Sychevsk, brown Schwyz and Holstein breeds in the Russian Federation.

| Breed                   | Breeding farms |
|-------------------------|----------------|
|                         | Number of cows, thousand heads | Yield, kg | % fat | % protein | Live weight | Age 1 calving | Retirement, calving | Service-period, days | Output calves on 100 cows |
| Brown Schwyz            | 10.0           | 4906      | 3.97  | 3.29      | 534         | 926           | 4.31            | 113                  | 84.6                  |
| Holstein (black and motley) | 136.7         | 8100      | 3.85  | 3.24      | 570         | 768           | 2.78            | 147                  | 78.7                  |
| Sychevsk                | 3.6            | 4556      | 3.88  | 3.28      | 536         | 973           | 4.29            | 119                  | 90.1                  |

Analysis of the production use of cows showed that in terms of productivity per cow per year, the Sychevsk and brown Schwyz breeds are inferior to the Holstein breed, but the duration of use, service period, and output of calves in Holstein breed are much lower.

It is established that the coefficient of heritability of milk productivity is 20-25%, the fat milk content is 30-50%, the protein milk content is 30-50%, the body weight is 20-30%, etc. Therefore, the transfer of quantitative traits by parents to offspring occurs only to a certain extent and depends on heredity.

The efficiency of using domestic cattle breeds of the dairy direction of productivity was determined by us for the period from 2013 to 2017 on the example of the Smolensk region (Table 4) [3].

Table 4. The genetic potential of the bulls-producers of Sychevsk, brown Schwyz and Holstein breeds of OJSC “Smolenskoye” by breeding work.

| Breed    | On January 1, 1990 | On January 1, 2018 | 01.01.2018 by 01.01.1990 for the yield of mothers, ±, kg | 01.01.2018 +/- to 01.01.1990 on the fat content, kg |
|----------|--------------------|--------------------|----------------------------------------------------------|-----------------------------------------------------|
|          | Number of heads    | Mother's productivity | Number of heads | Mother's productivity |                          |                          |
|          | Yield, kg          | Fat content, %      | Yield, kg      | Fat content, %        |                          |                          |
| brown Schwyz | 22                       | 7794                 | 4.11          | 320.3                 | 12                      | 10623                   | 4.00                      | 424.9                   | +2829                        | +104.6                      |
| Holstein  | 14                       | 12260                | 4.19          | 513.7                 | 7                       | 12515                   | 4.24                      | 530.6                   | +255                         | +16.9                       |
| Sychevsk | 10                       | 6364                 | 3.87          | 246.3                 | 14                      | 8006                    | 4.00                      | 320.2                   | +1642                        | +73.9                       |

Genetic potential is not fully disclosed in any breed. The reasons hindering the realization of the genetic potential of the dairy herd are the condition of the food supply, protein deficiency and energy in the feed.

Comparing indicators of the use of cows with optimal, E. I. Semenova [4] notes a lower yield of calves per 100 cows (85-95%), a higher duration of the dry period for 3-5 days (optimum 50-60 days), the average age at the first calving is 2 months, the low age of retirement cows (3.58 calving), i.e. until they reach maximum productivity. Reproduction rates do not correspond to the optimum not only in ordinary farms but also in breeding plants and pedigree farmers.
V. I. Fisinin estimates losses of livestock enterprises up to 13 billion rubles due to the lack of getting of the offspring and milk due to the content of barren cows [5]. At the 14th World Congress of Animal Reproduction, a decrease in the efficiency of reproduction with an increase in the milk productivity of cows was emphasized. The main causes of reduced reproductive functions are metabolic diseases caused by a prolonged negative energy balance (NEB) stage [6-8].

Dairy cattle breeding has reserves to increase production. The main producers of milk are large-scale farms with higher productivity of livestock and the proportion of breeding livestock in the population. Milk production in small farms is characterized by the use of extensive technologies, reduction of the number of cows.

### Table 5. Possible increase in milk production in the Russian Federation due to the restoration of the livestock of cows and their productivity.

| Farm category                        | 1990 | 2002 | 2007 | 2012 | 2017 | Possible increase in livestock, thousand heads |
|--------------------------------------|------|------|------|------|------|-----------------------------------------------|
| Livestock of cows, thous. heads on 01.01. |      |      |      |      |      |                                               |
| Households of all categories         | 20556,9 | 11854,2 | 9320,2 | 8858,6 | 8226 | 4181,4                                        |
| Agricultural organizations           | 15322,1 | 5652,9 | 3974,5 | 3640,1 | 3315,5 | 3323,1                                        |

| The actual productivity of cows, kg | Possible increase in productivity, kg |
|-----------------------------------|--------------------------------------|
| Households of all categories      | 2731 2797 3501 3898 4368 294,7       |
| Agricultural organizations       | 2783 2802 3758 4541 5660 64,9         |

| Possible increase in milk production in all farms, thousand tons | 1232,2 |
| Possible increase in milk production in agricultural organizations, thousand tons | 215,7 |

According to the Table 5, when the livestock of cows is restored to the average value for the analyzed period and when the productivity level of cows is reached, there are opportunities to double its production compared to the actual level of 2017, which is primarily due to the large-scale production [9, 10].

### 4. Conclusions

Investments in breeding, technical, and technological modernization of the dairy cattle breeding industry, strengthening the feed base contribute to the growth of milk production. Further innovative development will make it possible to effectively use the resource potential available in the industry, to solve the problem of providing the country's population with high-quality dairy products of domestic production.

### References

[1] Gavrish V G et al 2006 *Modern reference book of the doctor of veterinary medicine: studies. manual for students of agricultural universities in the specialty “Veterinary”* (Rostov-on-Don, Russia: Phoenix) p 570

[2] Government of Russia 2018 *National report “On the progress and results of the implementation in 2017 of the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food for 2013-2020”* (Moscow, Russia: Federal State Scientific Institution “Rosinformagrotekh”)
[3] Shumeiko N 2018 Efficiency of using domestic cattle breeds of dairy productivity direction *Economics of Agriculture of Russia* 7 pp 58-65

[4] Semenova E I 2013 Problems of increasing the efficiency of using cows in dairy cattle breeding *AIC: Economics, Management* 7 pp 63-68

[5] Fisinin V I 2006 On the state and measures to stabilize the number of cattle population, including cows *Implementation of the priority national project “Development of the AIC”* 8 p 77

[6] Butter W R 2000 Nutritional interactions reproductive performance in dairy cattle. *Animal Reproduction Science* Special Issue 60-61 pp 449-457

[7] Roche J F, Mackey D and Diskin M D 2000 Reproductive management of postpartum cows *Animal Reproduction Science* 60-61 pp 703-712

[8] Esseltmont R J, Rossaibati M A The use of databases to fertility *Animal Reproduction Science* Special Issue 60-61 pp 725-741

[9] Bogoviz A V, Lobova S V, Saveleva N A, Lysak I V and Makarenko S N 2018 Highly-effective management of the process of innovations commercialization as a basis of development of modern human society *Advances in Intelligent Systems and Computing* 622 pp 298-304

[10] Popkova E G, Bogoviz A V, Ragulina Y V, Alekseev A N 2018 Perspective model of activation of economic growth in modern Russia *Studies in Systems, Decision and Control* 135 pp 171-177