Substantiation of the Need in Evaluating Effectiveness of Use of Land Resources for the Agricultural Sector in the Sakha Republic (Yakutia)

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Abstract. The authors discuss effectiveness of use of land resources for the agricultural sector in the Sakha Republic (Yakutia) and substantiation of the need in evaluating effectiveness thereof. They analyzed the contemporary condition of the republic's land resources and of the main sectors of industry in the countryside - agriculture. The authors also analyzed the interconnection of the primary agricultural indicators and the quality of land resources. The results demonstrate a rather low effectiveness and negative trends of primary indicators. Therefore, the need in evaluating effectiveness of use of land resources is substantiated. Also, there is a need in improving effectiveness of use of land resources in agriculture at the present time by means of continuous intensification.

1. Introduction
In the modern world, where both Russian and world economies are becoming globalized, evaluation of effectiveness of use of land resources for agricultural purposes has become especially important, as it is one of the critical sectors of economy in terms of subsistence of the population.

Land has from the earliest times been the main economic resource of the mankind. It ought to be noted that this resource is not made artificially and does not have a definite price. The total land area of Earth is approximately 149 m sq. km, and only 11% thereof are used for agricultural purposes. However, these 11% yield agricultural produce for almost the entire humankind.

Substantiation of the need in evaluating effectiveness of use of land resources for agricultural purposes is especially relevant due to ever-changing national economic circumstances, as different farming conditions affect end agricultural indicators in many ways. The Sakha Republic (Yakutia) deserves thorough analysis and evaluation of performance, as it is one of the largest regions of Russia and boasts a large area of land resources.

The issues of using land resources of the Sakha Republic (Yakutia) have been discussed by G.P. Basharin, G.I. Daianova, I.I. Poiseev, and other researchers. Despite the depth of the studies, the issue of evaluating effectiveness of use of land resources, particularly for agricultural purposes, remains open.
2. Theory

Agricultural activity results in specific changes of composition, properties and other parameters of parcels of land (PL), or the land as a resource.

In many countries, land resources are regulated by law and classified by the intended purpose. Classification of lands rationalizes distribution and use of resources. Currently, there is a problem of irrational use of land resources caused by two main factors:

- extraction of mineral resources, industrial development, industrial and household waste dumping (this results in the loss of large areas of fertile soil).
- growth of cities and towns, development of cities and towns on agricultural lands. This factor obviously results in the reduction in the area of cropping lands, forests and pastures.

One of the primary peculiarities of the land as the main economic resource is fertility, i.e. the ability to yield useful produce. Along with other indicators, the land's aggregate utility primarily consists in its agricultural output, which is why it is necessary to evaluate the interconnection of effectiveness of use of land resources and economic results of the agricultural sector in detail.

Land as a resource in agriculture features specific peculiarities that distinguish it from other means of production. These are such peculiarities as irreplaceability with other means of production, non-reproducibility, permanence of location (i.e. land cannot be moved), uneven quality, fertility (which means agricultural crops may be cultivated).

Lands of the Far Eastern (40.6%), Siberian (25.5%), Ural (10.6%), and Northwestern (9.9%) Federal Districts constitute the largest share in the structure of land resources of Russia, the area whereof is 1,712,519 thousand ha.

Table 1. Land area of the Russian Federation as per January 01, 2018.

| Region                          | Total land area (thousand ha) | Structure (%) |
|--------------------------------|------------------------------|---------------|
| Russian Federation             | 1,712,519                    | 100           |
| **Federal Districts (FD):**    |                              |               |
| Central FD                     | 65,020.5                     | 3.8           |
| Northwestern FD                | 168,697.2                    | 9.9           |
| Southern FD                    | 44,782.1                     | 2.6           |
| North Caucasian FD             | 17,043.9                     | 1.0           |
| Volga FD                       | 103,697.5                    | 6.1           |
| Ural FD                        | 181,849.7                    | 10.6          |
| Siberian FD                    | 436,172.7                    | 25.5          |
| Far Eastern FD                 | 695,255.5                    | 40.6          |
| **Regions of the Far Eastern FD:** |                              |               |
| Sakha Republic (Yakutia)       | 308,350                      | 18.0          |
| Kamchatka Krai                 | 46,428                       | 2.7           |
| Primorsky Krai                 | 16,467                       | 1.0           |
| Khabarovsk Krai                | 78,763                       | 4.6           |
| Amur Region                    | 36,191                       | 2.1           |
| Magadan Region                 | 46,246                       | 2.7           |
| Sakhalin Region                | 8,710                        | 0.5           |
| Jewish Autonomous Region       | 3,627                        | 0.2           |
| Chukotka Autonomous District   | 72,148                       | 4.2           |
| Republic of Buryatia           | 35,133                       | 2.1           |
| Zabaykalsky Krai               | 43,190                       | 2.5           |

Note: compiled by the authors
Yakutia is the largest region of the Russian Federation; it constitutes almost a fifth of the Russia's territory (3,103.2 thousand sq. km).

![Map of the Sakha Republic (Yakutia)](image)

**Figure 1.** Map of the Sakha Republic (Yakutia) [1].

According to the Russian Federal State Statistics Service, the population of the republic amounts to 966,997. Population density is among the lowest among regions of the Russian Federation - 0.31 people per sq. km. Urban population - 65.45%.

**Table 2.** Population and area of administrative districts of the Sakha Republic (Yakutia) as per January 01, 2019.

| No. | Municipal divisions                        | Population (people) | Area (thousand sq. km) |
|-----|--------------------------------------------|---------------------|------------------------|
| 1   | Abyysky Ulus                               | 4,058               | 69.4                   |
| 2   | Aldansky District                          | 39,858              | 156.8                  |
| 3   | Allaikhovsky Ulus                          | 2,718               | 107.3                  |
| 4   | Amginsky Ulus                              | 16,719              | 29.4                   |
| 5   | Anabarsky National (Dolgan-Evenk) Ulus     | 3,500               | 55.6                   |
| 6   | Bulunsky Ulus                              | 8,404               | 235.1                  |
| 7   | Verkhnevilyuysky Ulus                      | 20,939              | 43.2                   |
| 8   | Verkhnokolymsky Ulus                       | 4,220               | 67.8                   |
| 9   | Verkhoyansky Ulus                          | 11,385              | 137.4                  |
| 10  | Vilyuysky Ulus                             | 25,004              | 55.2                   |
| 11  | Gorny Ulus                                 | 11,956              | 45.6                   |
| 12  | Zhigansky Evenk National Ulus              | 4,238               | 140.2                  |
| 13  | Kobyaysky Ulus                             | 12,554              | 107.8                  |
| 14  | Lensky District                            | 37,381              | 77                     |
| 15  | Megino-Kangalassky Ulus                    | 30,877              | 11.7                   |
| 16  | Mirinsky District                          | 72,914              | 165.8                  |
| 17  | Momsky District                            | 4,099               | 101.7                  |
| 18  | Namsky Ulus                                | 24,450              | 11.9                   |
| 19  | Neryungirinsky District                    | 74,986              | 93                     |
| 20  | Nizhnekolymsky Ulus                        | 4,366               | 86.8                   |
| 21  | Nyurbinsky Ulus                            | 24,135              | 52.4                   |
| 22  | Oymyakonsky Ulus                           | 8,852               | 92.2                   |
| 23  | Olenyoksky Evenk National Ulus             | 4,009               | 318.1                  |
| 24  | Olyokminsky Ulus                           | 25,139              | 166.7                  |
| 25  | Srednekolymsky Ulus                        | 7,512               | 125.2                  |
Land resources of the Sakha Republic (Yakutia) are primarily represented by forest reserve lands (approximately 82% of Yakutia's territory) due to natural, climatic and geographical conditions; other territories belong to undistributed lands, lands intended for agriculture, specially protected areas, water reserve lands and settlements; the aggregate share of these territories constitutes only 18% of the total area (Fig. 2).

![Figure 2](image)

**Figure 2.** Structure of land resources of the Sakha Republic (Yakutia) as per January 01, 2017.

### 3. Practice

Sakha Republic (Yakutia) is a unique region of Russia in terms of natural and territorial conditions boasting unique experience of organizing agricultural activity in the extreme conditions of immense complexity observed in the North. That is why it is very important to study the current state of the region's land resources, including in terms of their categories, and its use for agricultural purposes [2].

Agricultural land is one of the most significant concepts in the sphere of land matters in whole. The distribution of these lands in the republic is given below.
Table 3. Structure of agricultural lands of the Sakha Republic (Yakutia) in 1990-2017 (%).

| Agricultural lands          | 1990  | 2000  | 2010  | 2015  | 2017  | Change from 1990 to 2017 |
|-----------------------------|-------|-------|-------|-------|-------|-------------------------|
| Arable lands                | 14.0  | 9.1   | 11.4  | 8.8   | 10.4  | 6.4                     |
| Fallow lands                | 20.0  | 1.2   | 19.2  | 1.2   | 19.2  | 1.2                     |
| Haylands                    | 71.7  | 46.8  | 42.2  | 32.5  | 71.8  | 43.8                    |
| Pastures                    | 67.5  | 44.1  | 76.4  | 58.8  | 79.4  | 48.5                    |
| Perennial plantation        | 1.0   | 0.1   | 1.0   | 0.1   | 1.0   | 0.1                     |
| TOTAL                       | 1,532 | 10.0  | 1,300 | 10.0  | 1,638.5 | 10.0   | 1,640.2 | 10.0 | 1,640.2 | 10.0 | 108.2 |

Note: compiled by the authors on the basis of the data provided by the Russian Federal State Statistics Service

The area of agricultural lands has had a tendency to increase (the total increase amounted to 108.2 thousand ha). As per January 01, 2018, the area of agricultural lands was 1,640.2 thousand ha (8.4% of the total area of lands of this category).

The area of arable lands decreased by 34.9 thousand ha to 105.1 thousand ha. The main reason for this tendency is deterioration in quality of lands (erosion, floods, etc.). Arable lands grow over with bushes and become bogged up. Deterioration in quality of deer pastures must be noted in particular. Other reasons for the degradation of agricultural lands include land pollution with emissions of industrial enterprises, transport, etc. This resulted in the transfer of some arable lands in the republic to the category of fallow lands, as they cannot be used as intended.

The area of other types of agricultural lands has been steadily increasing for 20-30 years.

A distinguishing feature of the region is a low share of plowed lands. The area of arable lands may be considerably increased at the expense of fallow lands in several uluses. The general reasons preventing the increase in the area of plowed lands in the Sakha Republic (Yakutia) are underground frost, long cold season, lack of heat and sunlight, and relatively low land fertility.

The agriculture in Yakutia is characterized by specific peculiarities due to natural and climatic conditions of this region and is one of the leading productive forces in the agrifood sector.

The region is characterized by hostile permafrost lands and harsh continental climate. However, it still features such primary kinds of agriculture as meat-and-dairy cattle farming, horse breeding, reindeer herding, vegetable farming, potato farming, fishery, berry picking, and wild harvesting. About one half of the area under crops is occupied by forage crops, the other half - by cereals, leguminous crops, potatoes and vegetables [4].
According to the preliminary data, the gross agricultural product of Yakutia in 2018 was 26 bn rubles in current prices, so in 8 years it had grown by more than 50%; the highest growth was observed in the sphere of horticulture, where the output almost doubled in monetary terms to ca. 9 bn rubles. Animal husbandry secures ca. 65% of the gross agricultural product (in 2010 - 72%). The share of the agricultural product in the gross regional product is about 2%.

Given the difference in natural and climatic conditions affecting agriculture, traditional activities are developed in the arctic zone of the republic, whereas transfluvial and central districts, as well as the Vilyuy group of districts are productive in terms of cultivating cereals and forage crops, potatoes and vegetables. Animal husbandry as one of the main kinds of agriculture is well-developed in all districts.

The food industry is represented by a sufficiently wide range of works. The republic features about 700 facilities of food and processing industry.

Smallholdings maintained primarily not for profit play an unusually large part in agriculture.

**Table 4.** Gross agricultural product of the Sakha Republic (Yakutia) (including farming units of all categories) (m rubles).

| Indicators                      | 2010  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | Change from 2010 to 2018 (%) |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-----------------------------|
| Agricultural produce specifically | 17,064.2 | 19,443.4 | 20,254.9 | 20,722.8 | 21,930.0 | 24,972.2 | 26,377.2 | 154.6                        |
| Horticulture                    | 4,741.4 | 5,933.2 | 6,463.9 | 6,039.9 | 6,512.4 | 7,789.1 | 9,134.6 | 192.7                        |
| Animal husbandry                | 12,322.8 | 13,510.2 | 13,791.0 | 14,682.9 | 15,417.6 | 17,183.1 | 17,242.6 | 139.9                        |

Note: compiled by the authors on the basis of the data provided by the Russian Federal State Statistics Service.
The level of subsistence with the main agricultural produce in the Sakha Republic (Yakutia) is about 52%, specifically, with meat - 26.3%, milk - 58.2%, eggs - 61%, potatoes - 64.5%, vegetables - 47.4%, fish and fish products - 55.2% [3].

In 2018, the total area under agricultural crops in farming units of all categories increased by 1.1% in comparison with 2017 by means of expanding the territory intended for forage crops by 9.6%. The total amount of harvested cereals, potatoes and vegetables also increased (by 63.4%, 9.7% and 11.6%, respectively) due to the increase in the yield of potatoes (by 12.0%) and vegetables (by 18.0%).

Figure 4. Indicators of agricultural crops in the Sakha Republic (Yakutia) in 2013-2017.

As per the beginning of 2019, the cattle population in farming units of all categories amounted to 183.3 thousand (2.5% fewer than in the same period in the previous year), including cows - 70.1 thousand (5.5% fewer); pigs - 21.1 thousand (9.8% fewer), horses - 178.6 thousand (3.0% fewer), reindeer - 146.4 thousand (5.3% fewer), poultry of all kinds - 850.9 thousand (2.3% fewer).

The structure of the livestock of smallholdings was as follows: 53.9% - cattle (in the end of December 2017 - 52.7%), 25.6% - pigs (24.4%), 36.2% - horses (33.1%), 2.9% - reindeer (2.1%), 5.6% - poultry (5.2%).

The republic's output in 2018 was as follows: 35.6 thousand tons of meat (live weight of the livestock and poultry for slaughter), 165.7 thousand tons of milk and 119.4 m eggs. This means that the output of the main kinds of livestock products is decreasing.

Figure 5. Output of livestock products in the Sakha Republic (Yakutia) in 2010-2018 (thousand tons).
In 2018, increase in the total amount of harvested cereals (by 90.2%), potatoes (by 1.7%) and decrease in the output of vegetables (by 18.4%) were observed. The output of animal products is also decreasing (live weight of the livestock and poultry for slaughter - by 7.4%, milk - by 1.5%, eggs - by 2.3%).

Therefore, the main indicators of the republic's agriculture reflect all the prerequisites and grounds for the search for and fulfillment of the ways to overcome downtrends, including the increase in the effectiveness of use of agricultural lands and, therefore, of lands resources of Yakutia.

4. Experimental part

The effectiveness of use of land resources is primarily indicated by output per unit of area and prime cost of produce.

In the market economy, the goal of agricultural producers is to ensure maximum commodity output per hectare of used land and minimize costs. There is a lot of indicators reflecting effectiveness of one or another object. In this study, we used three groups of indicators that reflect economic effectiveness of the land as a resource most objectively.

Group one: indicators reflecting the degree of development of one or another territory: structure of lands, agricultural lands, area under crops.

Group two: relative indicators of land use: output per 100 ha of arable lands etc.

Group 3: indicators reflecting economic effectiveness of land development or use: return on investment, share of the gross product per unit of area, etc.

| Table 5. Evaluation of use of the productive territory of the Sakha Republic (Yakutia) (%) |
|-----------------------------------------------|--------|--------|--------|--------|
| Indicators | 2000 | 2010 | 2017 | Change |
| Structure of agricultural lands - percentage of the area of arable lands in the total area of agricultural lands | 8.8 | 6.4 | 6.4 | -2.4 |

According to the calculated indicators of the structure of agricultural lands in 2000-2017, the effectiveness of their use has been reducing, as the total area of arable lands has decreased by 2.4% within the past 17 years; this affected the gross agricultural product of the territory negatively.

| Table 6. Indicators of the structure of the area under crops in the Sakha Republic (Yakutia) in 2013-2017 (%) |
|-----------------------------------------------|--------|--------|--------|--------|
| Indicators | 2013 | 2015 | 2017 | Change |
| Structure of the area under crops (cereals) | 25.9 | 23.0 | 23.4 | -2.5 |
| Structure of the area under crops (potatoes) | 18.7 | 18.5 | 17.3 | -1.3 |
| Structure of the area under crops (field vegetables) | 4.6 | 4.7 | 4.5 | -0.02 |
| Structure of the area under crops (forage crops) | 50.8 | 53.8 | 54.7 | 3.9 |

Calculation of the structure of the area under all types of crops also indicates reduced effectiveness of their use, because the output of cereals, potatoes and vegetables per 100 ha of the area under crops is decreasing.

Results of calculating group two and group three indicators of effectiveness demonstrate overall decrease in the effectiveness of use of agricultural lands in the Sakha Republic (Yakutia).
Table 7. Indicators of the level and economic effectiveness of use of land resources in the Sakha Republic (Yakutia) in 2013-2017 (%).

| Indicators                                                      | 2013 | 2015 | 2017 | Change |
|-----------------------------------------------------------------|------|------|------|--------|
| Grain production per 100 ha of arable lands                     | 12.1 | 8.2  | 6.3  | -5.8   |
| Potato production per 100 ha of arable lands                    | 73.0 | 68.4 | 75.4 | 2.5    |
| Output per 100 ha of agricultural lands                         | 10.4 | 10.0 | 10.1 | -0.3   |
| Output of eggs per 100 ha of area under cereal crops (thousand of eggs per 100 ha of area under cereal crops) | 1,160.0 | 1,278.5 | 1,070.0 | -90.0 |
| Share of the gross produce per unit of area (m rubles)         | 11.9 | 12.6 | 15.2 | 3.4    |

Thus, production of the main types of agricultural produce (except for potato production, which has increased by 2.5 tons per 100 ha of arable lands) has been decreasing.

On the whole, the cost effectiveness of use of agricultural lands in the republic in terms of the gross product has a tendency to grow by 3.4 m rubles per ha; however, this fact does not ensure objective evaluation of effectiveness of use of land resources, as the gross agricultural product is given in current prices for 2013-2017.

In the Sakha Republic (Yakutia), crops are grown in extreme climatic conditions; this results in very high risks for the agricultural production. Even the zones most favorable for growing crops are characterized by recurrent droughts or flooding of lands.

At the same time, intensive development of horticulture and animal husbandry is only possible if the land is used effectively. Merchantability of the agricultural produce may be increased by improving quality of the food supply. At the same time only 56 out of 105 thousand ha of arable lands are used; 49 thousand ha are not used for a variety of reasons [3].

Necessary measures may include recovery of 50 thousand ha of retired lands intended for agriculture before 2030 by means of land clearance operations. The output of feeds must be increased primarily by means of improving yield of forage crops and cereals and the structure of seeding thereof, increasing productivity of natural and artificial cultivated grasslands, i.e. on the basis of intensification [3].

Results of calculations of indicators of the three groups characterizing the actual effectiveness of use of one or another type (category) of the republic's land resources to one degree or another demonstrate quite low effectiveness and negative trends of the main parameters. That is why the need in improving effectiveness of use of agricultural lands at this time by means of continuous intensification appears reasonable.

Agricultural production primarily requires most accurate data about the parameters of the land itself and its fertility; information about the cultivated crops is only secondary. Historically, land plots are legally assigned to individual users without comprehensive analysis of their qualitative composition, soil quality and other important parameters. This hinders development of an objective and reliable database and a technique of evaluating effectiveness of use of lands.

5. Conclusion

We may conclude that objective evaluation of effectiveness of use of land resources taking into account quantitative and qualitative parameters remains the most significant and relevant issues in the current conditions of farming. It should be noted, however, that evaluation thereof is based on ever-changing economic conditions in whole, as well as on the system of indicators characterizing effectiveness of use of land resources in particular. The practicability of evaluating effectiveness of land resources is substantiated by ever-changing socioeconomic conditions of farming in the country in whole and in the republic in particular. The described evaluation technique objectively demonstrates the need therein for the regional agriculture; however, techniques and tools of evaluating effectiveness require continuous improvement to comply with the changing national economic conditions.
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