State and use of land resources in the Republic of Tuva of the Russian Federation

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Abstract. The area of the Republic is 168,604 km² (3.28% of the territory of the Siberian Federal district, 0.98% of the area of the Russian Federation - the 20th in terms of area). Tuva basin, stretching more than 400 km from West to East along the Yenisei river, is an open hilly steppe space, located at altitudes from 500 to 1200 m. Mountain ranges, crossing it, divide the basin conditionally into three parts: Chemchik, Ulug-Khem and Turano-Uyu. Of the total land area, most of the land is classified as forest land (64.5%), agricultural land accounts for 19.9% of the main specialization of livestock (mainly sheep and dairy cattle, goat and horse breeding). The area of farmland is more than 4.5 million hectares. The peculiarity of the pastures of Tuva is the ability to use their considerable part all year round for grazing cattle and livestock. In the conditions of the high-altitude zone, a wide variety of types of territories determines the nature of land use. As we approach the mountain-foothill landscapes, the degree of development of the territory decreases, the share of agricultural land, the share of intensive types of agricultural land use (arable land, intensive crop rotations and so on) decrease. As the height increases, the cadastral value of land plots should be reduced, which is caused by an increase in the possibility of dangerous geomorphological, climatic, neotectonics, hydrological processes and an increase in the complexity of agricultural land use. In this regard, the basis for the formation of agricultural land use in the conditions of high-altitude zones should be the similarity of the types of natural environment.

1. Introduction
Land has always occupied a special place among other resources used in social production, especially in agriculture. The total world reserves of agricultural land are about 5 billion hectares (including 1.4 billion hectares of arable land). The Russian Federation has 9.5% of the world's arable land. Russia has a high supply of land resources. In Russia, there are about 12 hectares of land per 1 person, including 1.3 hectares of agricultural land; among these, 0.8 hectares of arable land, while the world average is 0.14 hectares [1-3].

The geographical position of Tuva has a direct influence on its socio-economic development. In Siberia, large enterprises are located in flat areas, whereas in the Republic all lands are used for production of agricultural production. The population of the Republic according to Rosstat is 324420 people (2019, 78th place in Russia). The population density is 1.92 people/km² (2019). The urban population is 53.59% (2018), despite the fact that the region has significant land resources for living. It should be noted that more than 2/3 of the population lives in the city of Kyzyl (116983 people, 2019). The rest of the population in the greater part of the 1/3 lives in the Tuva basin (Ulug-Khem coal, Kyzyl, Barun-Khemchikskaya, Dzun-Khemchikskaya, Pius-Khem coal districts) [3-7].
The territory stretches from west to east for 745 km with a width from south to north from 100 to 450 km. The area of the Republic is 168,604 km² (3.28% of the territory of the Siberian Federal district, 0.98% of the area of the Russian Federation – the 20th in area). The Republic of Tuva is part of 17 municipalities and two cities of Republican subordination of the subject are located in the steppe zone at the junction with the taiga areas of semi-deserts. The second feature of the geographical location is that the territory of the Republic is far from the seas and oceans (Atlantic, Pacific, Arctic oceans) at a distance of 2500 to 3000 km). The third feature is that the Republic is bordered by mountains (especially from Russia).

The relief of Tyva is characterized by the presence of small intermountain basins with a sharply different landscape from the surrounding mountains. Between the ridges and uplands are enclosed basin: the Tuvan steppe, semi-desert UVS Nur and the taiga-forest and Todzhu Tere-Khol. The average height of the basins is 650-1200 m above sea level. Throughout the year, the Republic is dominated by anticyclonic dry and clear weather, cold in winter and hot in summer. The most pronounced feature of the climate is a sharp continental. Cold winters with little snow, hot summers, low rainfall and high temperature range are characteristic features of Tyva climate. Especially noticeable effect on the climate is the influence of the absolute height of the terrain. There are three vertical climatic zones: low, middle and high mountains (figure 1).

2. Materials and methods

One of the methods of geomorphological research is morphometric analysis, which involves the study of quantitative characteristics of landforms (which include the absolute and relative height of individual
landforms, slope angles, exposure of slopes, areas occupied by positive and negative forms, etc.) by special measurements, in particular, using a digital elevation model (DEM). To conduct a vertical zoning of the relief, to highlight the main hypsometric levels that characterize a particular form of relief, allows the hypsometric map.

The use of GIS technologies and digital elevation models can significantly deepen and detail the study of the structure of river valleys, which is necessary in terms of giving them a significant role in ensuring the efficiency of agricultural land use in mountainous areas. In order to study the slope processes, and first of all, their manifestations such as landslides, landslides, mudflows, determine the scale and dynamics of these processes, which have a serious impact on the use of agricultural land in high-altitude zones.

3. Land use efficiency in high-altitude zones

Of the total land area, most of the land is classified as forest land (64.5%), agricultural land accounts for 19.9% (table 1). If the average size of the land plot, given per inhabitant of Russia, accounts for 2.5 hectares of agricultural land in the study area according to statistics in Tuva - 12.66 hectares. The area of agricultural land in all categories of land in 2017 amounted to 3833.2 thousand hectares or 22.7% of the total land fund of the Republic (table 7). The share of non-agricultural land accounts for 13027.2 thousand hectares or 77.3% [5, 8–10].

| Land category                              | 1976  | 1990  | 2000  | 2007  | 2017  |
|--------------------------------------------|-------|-------|-------|-------|-------|
| Agricultural land                          | 4623.2| 6812.2| 2831.6| 3164.8| 3366.0|
| Lands of settlements                       | 59.0  | 61.8  | 39.7  | 43.5  | 45.2  |
| Industrial lands and other special-purpose | 28.5  | 25.7  | 16.8  | 16.2  | 20.1  |
| Lands of specially protected territories and objects | -     | 336.6 | 659.1 | 655.1 | 655.2 |
| Lands of the forest Fund                   | 11048.9| 8486.6| 10874.3| 10874.6| 10874.6|
| Water Fund lands                           | 46.9 | 26.2 | 96.3 | 96.3 | 96.3 |
| Reserve lands                              | 1053.9| 1111.3| 2342.6| 2009.9| 1803.0|
| Total for Republic                         | 16860.4| 16860.4| 16860.4| 16860.4| 16860.4|

The main specialization is animal husbandry (mainly sheep and dairy cattle, goat and horse breeding). The area of farmland is more than 4.5 million hectares. A feature of the pastures of Tuva is the possibility of using a significant part of them throughout the year for grazing small and cattle, the total number of which in Tuva can reach 2 million heads. The peculiarity of natural and climatic conditions of the Republic has historically determined the features of the agricultural sector. Traditionally, the priority is the development of animal husbandry. Cattle, sheep, goats, pigs, horses, poultry are bred in the farms of the Republic.

Analysis of the dynamics of the land fund shows that significant changes occurred from 1990 to 2000 and only since 2000, the dynamics of the land fund has become stable. Agriculture of the Tuvan ASSR (1985-1990) is characterized by land development and, as a result, an increase in the area of agricultural land by 66.8%. At the same time, the creation of Arat and peasant farms was of great importance, and in the process of privatization — the reorganization of collective and state farms. Therefore, the change in the area of agricultural land during this period was insignificant.

Since 1995, negative general economic problems did not allow one to take advantage of the newly created economic structures. In the conditions of unstable production relations, reduction of state support, reduction of consumer purchasing power, growth of non-payments, loss of working capital, as
well as increased costs, many agricultural enterprises have become unprofitable, which has led to their liquidation (reorganization) and subsequently reduced the area of agricultural land.

During the observed period (2016-2017) there were no changes in the structure of the land fund. The area of agricultural land in all categories of land in 2017 amounted to 3833.2 thousand hectares or 22.7% of the total land fund of the Republic. The share of non-agricultural land has 13027.2 thousand hectares or 77.3% (Table 2).

Table 2. Structure and dynamics of agricultural lands of the Republic of Tuva, thousand hectares

| Grounds      | 1976  | 1990  | 2000  | 2007  | 2017  |
|--------------|-------|-------|-------|-------|-------|
| Arable       | 493.1 | 429.5 | 155.7 | 131.4 | 191.3 |
| Deposit      | 5.7   | 1.3   | 49.6  | 61.4  | 147.9 |
| Hayfields    | 107.5 | 56.0  | 53.2  | 52.1  | 76.5  |
| Pastures     | 4016.6| 3086.8| 2233.2| 2209.4| 3416.6|
| Perennial plantings | 0.3 | 0.2 | 0.2 | 0.1 | 0.9 |
| Total for Republic | 4623.2 | 3573.6 | 2491.9 | 2454.4 | 3833.2 |

Grasslands consisting of agricultural land have always prevailed. During the existence of the large farm, households (aratskiy) of farms were supported by the planned system pastebot (until 1991). However, too much density of cattle and excessive load were allowed, conditions of pasture rotation were not maintained, other measures for restoration of vegetation cover were not carried out. The change in the form of management has only led to a change in the spatial distribution of the pasture load: some pastures are abandoned and not used; others still experience overgrazing.

Hayfields, occupying a small area, spread in narrow ribbons in river valleys and on the slopes of mountain uplands. They represent a highly productive and valuable by the composition of the herbage of the meadows. Their economic use decreased during the analyzed period. It is possible that part of hayfields was transferred to pastures [8].

The main negative process developing in the steppes is desertification, which leads to a decrease in productivity, an increase in the nudity of the earth's surface, a decrease in the reproduction of steppe ecosystems. A number of changes in the parameters of the geographical environment for the duration and consistency allowed one to establish some trends and patterns of development of desertification.

In the conditions of high-altitude zone, a wide variety of types of territories determines the nature of land use. As we approach the mountain-foothill landscapes, the degree of development of the territory decreases, the share of agricultural land, the share of intensive agricultural land use (arable land, intensive crop rotations, etc.) decreases. At the same time, the degree of fainting out of the territory development, which consists in the formation of land use on the basis of individual elements of the relief, types of soils, meadows and pastures, depending on the orographic conditions of the area, is increasing [6, 8].

Accordingly, the forms of agricultural land use are changing. Animal husbandry comes instead of irrigated agriculture in the plains, using pasture resources on the territory of mountain landscapes. Forest-steppe zones of foothill landscapes are characterized by agriculture based on alternation of irrigated and rainfed lands in combination with natural forage lands. Consequently, the formation of agricultural land use in the conditions of high-altitude zone should be based on the similarity of the types of natural environment, which allows us to distinguish the following groups of land uses:

- agricultural land use, characterized by a high level of development of land with a combination of irrigated and rainfed agriculture (based on the use of flat-terraced land forms of relief), involving crops of grain crops, row crops, annual grasses;
- agricultural land use, characterized by a pronounced development of livestock sectors of agriculture
(based on the use of land mountain landscapes), involving the organization of summer pastures and providing seasonal livestock farms lowland areas;
- agricultural land use, characterized by continuous rain-fed agriculture with high ploughing (based on the use of land foothills and low mountains), providing for planting vegetables, potatoes, fruit and berry plantations, etc. This type of agricultural land use involves the management of dairy and beef cattle.

4. Conclusion
The final assessment of lands for agricultural land use in the conditions of the high-altitude zone is derived taking into account the degree of influence of the composition of vegetation and their percentage in the landscape-ecological contour. The predominant type of land use in the landscape-ecological contour (type of pastures when using land for transhumance) takes into account the geographical features of the territory. Thus, the assessment of land depends on the productivity of land, natural biological resources within the boundaries of landscape and ecological contours. Although steppe landscapes in Tuva make up no more than a third of the Republic's area, the region has a very high degree of preservation of steppe ecosystems, occupying one of the first places in Russia. Accordingly, the steppes today occupy large areas, and the complex mountainous terrain and the biological geographic transition character of the region determine their significant diversity.

Thus, in order to improve the cadastral registration of land in the territories of the high-altitude zone, it is proposed to introduce a local indicator – a coefficient that depends on geographical conditions and affects the cadastral value of land in the conditions of high-altitude zone. The locality of this indicator is its distribution in the territory, characterized by processes that complicate agricultural human activity in the conditions of high-altitude zones, and the dependence on these processes. Its introduction will allow one to objectively correlate the cadastral value of land and agroecological parameters of land, taking into account the geographical features of the territory.

The differentiation of the local indicator and the analysis of areas characterized by the possibility of occurrence of such dangerous and negatively affecting agricultural land use as earthquakes, mudflows, avalanches, low temperatures, hurricanes, etc. lead to the following conclusion. As the height increases, the cadastral value of land plots should be reduced, which is caused by an increase in the possibility of dangerous geomorphological, climatic, neotectonic, hydrological processes and an increase in the complexity of agricultural land use.

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References
[1] Volkov S N, Shapovalov D A, Klyushin P V, Shirokova V A and Khutorova A O 2017 Solutions of problems in defining indicators of agricultural land within the framework of activities for the implementation of the concept of development monitoring in the Russian Federation Int. Multidisciplinary Scientific GeoConf. SGEM 17(52) 819-828
[2] Shapovalov D A, Klyushin P V, Shirokova V A, Khutorova A O and Savinova S V 2018 Problems and efficiency of land use in the North Caucasian federal district 18th Int. Multidisciplinary Scientific GeoConf. SGEM 18(5.1) 667-674
[3] Murzakmatov R T, Koshkarova V L and Farber S K 2014 Ordination of forest types Ulug Khem forest district Tyva in terms of climate and terrain Siberian forest journal 3 107-116
[4] 2017 Report on the state and use of the lands of the Republic of Tuva in 2017 (Kyzyl: Office of Rosreestr in the Republic of Tuva)
[5] Dubrovsky N G, Namzalov B B and Oorzhak V A 2014 Steppe, and deposits of Tuva (Kyzyl: Publishing house RIO Tuvgu)
[6] Zhulanova V N 2012 Evaluation of agricultural land use and fertility of Tuva arable soils Vestnik of BSAA named after V R Filippov 1(26) 46-52

[7] 2000 Programme of action to combat desertification for the Republic of Tuva (Abakan)

[8] Zhumaliyeva A S, Seromycin M V and Chistyakov K V 2017 High-Altitude landscape zones and nature use regimes of the ridge At-Bashi Society. Environment. Developments 1 101-108

[9] Zharova T F 2017 Introduction of environmental resource-saving technologies based on soil protection systems of agriculture in the Republic of Tuva Regional Economics and management: electronic scientific journal. Category: agribusiness and agriculture of the region [in Russian – Regionalnaja ekonomika i upravlenie] 1-1(49) 1-11

[10] Christen M, Kowalski J and Bartelt P 2010 RAMMS: Numerical simulation of dense snow avalanches in three-dimensional terrain Cold Regions Science and Technology 63(1–2) 1–14