

ISSN 2616-6771  
ISSN 2617-9962

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# ХАБАРШЫСЫ

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## BULLETIN

of L.N. Gumilyov Eurasian  
National University

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Евразийского национального  
университета имени Л.Н. Гумилева

**ХИМИЯ. ГЕОГРАФИЯ. ЭКОЛОГИЯ** сериясы

**CHEMISTRY. GEOGRAPHY. ECOLOGY** Series

Серия **ХИМИЯ. ГЕОГРАФИЯ. ЭКОЛОГИЯ**

№3(128)/2019

1995 жылдан бастап шығады

Founded in 1995

Издается с 1995 года

Жылына 4 рет шығады

Published 4 times a year

Выходит 4 раза в год

Нұр-Сұлтан, 2019  
Nur-Sultan, 2019  
Нур-Султан, 2019

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Мерзімділігі: жылына 4 рет.

Қазақстан Республикасының Ақпарат және коммуникациялар министрлігінде 27.03.2018ж. №16997-Ж тіркеу куәлігімен тіркелген. Тиражы: 25 дана

Типографияның мекенжайы: 010008, Қазақстан, Нұр-Сұлтан, қ., Қажымұқан к-сі, 12/1,

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**Bulletin of the L.N. Gumilyov Eurasian National University. Chemistry. Geography. Ecology Series**

Owner: Republican State Enterprise in the capacity of economic conduct "L.N. Gumilyov Eurasian National University" Ministry of Education and Science of the Republic of Kazakhstan

Periodicity: 4 times a year

Registered by the Ministry of Information and Communication of the Republic of Kazakhstan. Registration certificate №16997-ж from 27.03.2018. Circulation: 25 copies

Address of Printing Office: 13/1 Kazhimukan str., L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan 010008

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Собственник: РГП на ПХВ "Евразийский национальный университет имени Л.Н. Гумилева" МОН РК  
Периодичность: 4 раза в год. Зарегистрирован Министерством информации и коммуникаций Республики Казахстан.

Регистрационное свидетельство №16997-ж от 27.03.2018г. Тираж: 25 экземпляров

Адрес типографии: 010008, Казахстан, Нур-Султан, ул. Кажимукана, 13/1.

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BULLETIN OF L.N. GUMILYOV EURASIAN NATIONAL UNIVERSITY. CHEMISTRY.  
GEOGRAPHY. ECOLOGY SERIES

№3(128)/2019

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ИМЕНИ Л.Н.ГУМИЛЕВА. СЕРИЯ ХИМИЯ. ГЕОГРАФИЯ. ЭКОЛОГИЯ

№3(128)/2019

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**E. Galai**

*Belarussian State University, Minsk, Republic of Belarus  
(E-mail: kafgeoecol@mail.ru)*

**Ecological state of the land resources of the Republic of Belarus**

**Abstract:** The implementation of measures to intensify agriculture without taking into account natural conditions, compositional features and properties of individual components of the soil cover inevitably leads to its degradation. To the greatest extent, these changes are evident on drained peat soils, which are characterized by environmental instability. In this scientific work, an assessment of the land and resource potential was carried out using four main methodological approaches: a point system, index values, cost indicators and an assessment of the energy intensity of market products. Based on the results of the study, the land resources of the Republic of Belarus on January 1, 2018, a general assessment of land use is given.

**Keywords:** land resources, degradation, Republic of Belarus, natural resource potential

DOI: <https://doi.org/10.32523/2616-6771-2019-128-3-136-140>

**Introduction.** Lands are the national wealth of Belarus and one of the main natural resources ensuring the sustainable development of the country. The data on the types and categories of land are used to characterize the land resources of the country.

In accordance with the main purpose of the land fund, the following seven categories of land are allocated according to the Land Code of the Republic of Belarus: 1) agricultural land; 2) lands of settlements, gardening partnerships and country building; 3) lands of industry, transport, communications, energy, defense and other purposes; 4) lands of environmental, recreational, historical and cultural purposes; 5) forest fund lands; 6) water fund lands. Different types of land reflect the economic essence of land use. Depending on the agricultural use of the territory and its natural historical properties there are 14 types of land: arable, fallow, meadow, forest and other lands in Belarus.

**Material and research methodics.** The main natural resources are land ones, which are multifunctional. On one hand, land is the main and indispensable means of production, primarily in agriculture; on the other hand, it is the spatial basis. Spatial heterogeneity of the soil as the main component of the land is reflected in the location, territorial concentration, specialization and efficiency of agricultural production. The successful functioning of agricultural production is determined by agrochemical, water-physical and other soil properties, as well as the availability of labor, material and energy resources, in the process of interaction of which their ability to produce agricultural products is realized [5].

To assess the land and resource potential, four main methodological approaches are used: the point system, index values, cost indicators and the assessment of the energy intensity of market products [10].

The purpose of the work is to study the area dynamics of various land categories of the Republic of Belarus and identify their ecological state. For the research statistical data of the National Statistical Committee of the Republic of Belarus, the Register of Land Resources, literary sources are used [1-11].

**Results of the research.** According to the Register of Land Resources of the Republic of Belarus on January 1, 2018, the total land area is 20,760 thousand hectares [4]. The land resources are dominated by forest land (42.3% of the land area of the Republic) and agricultural land (41.0%) (Table 1). Sod-podzolic (34.2%) and sod-podzolic boggy (37.2%) soils predominate in the composition of the agricultural lands of the Republic according to the type of belonging. Significantly smaller areas are occupied by soddy marsh and sod-calcareous marsh (10.2%), peat-bog (11.3%) and other soils [1]. Sod-podzolic soils are most widespread in Grodno (47.2%), Mogilev (41.9%) and Minsk (39.7%) regions, sod-podzolic marshy soils - in Vitebsk (59.8%) and Mogilev (40.8%) [1].



Over a five-year period, there was a decrease in the area of agricultural land (Table 1). In 2018 the area of these lands decreased in comparison with 2014 by 224 thousand hectares. From year to year the area of forest land increases in the Republic. Since year 2014, the total area of forest land exceeds the area of agricultural land [11]. According to the data of 01.01.2018, the area of forest land in the Republic is 42.3% and exceeds the area of agricultural land by 1.3%. This occurs mainly as a result of expanding artificial forestation, planting of forest crops, especially on low-fertile lands, as well as unregulated overgrowing of lands by trees and shrubs. Forest plantations have begun to be actively used for the forestation of disturbed lands, the share of which in the general fund has decreased over the last decade by almost 85%. The creation of specially protected natural areas, such as national parks and reserves, contributes to the growth of forest land areas.

In the Republic of Belarus in the last 25 years there has been a gradual reduction in the area of marshy lands (in 2018 by 17% compared with 1992). The total area of disturbed, unused and other lands decreased almost twice in 2017, compared to year 1992. (from 944.6 thousand hectares in 1992 to 498.5 thousand hectares in 2017) [11]. At the same time, in 2017, their area slightly increased due to the increase in unused land by 3.4 thousand hectares (0.02%) compared to 2016. Long-lasting tendency of land area growth with roads and other transport connections is established in the Republic (by 51.1 thousand hectares since 1992 compared to 2018) [11].

**Table 1. Land resources of the Republic of Belarus [3].**

| Land resources           | Area, thousand hectares |       |       |       |       |
|--------------------------|-------------------------|-------|-------|-------|-------|
|                          | 2014                    | 2015  | 2016  | 2017  | 2018  |
| Land resources including | 20760                   | 20760 | 20760 | 20760 | 20760 |
| agricultural lands       | 8726                    | 8632  | 8582  | 8540  | 8502  |
| forest lands             | 8631                    | 8653  | 8742  | 8769  | 8774  |
| marshy and water lands   | 1328                    | 1309  | 1286  | 1271  | 1273  |
| other lands              | 2075                    | 2166  | 2150  | 2180  | 2212  |

Minsk region is distinguished by the maximum area of agricultural land, Grodno region - the minimum (Table 2). For 5 years, the area of land in this category has decreased by 80.2 thousand hectares in Mogilev region and by 47.6 thousand hectares in Vitebsk region. The decrease in agricultural land has happened due to several reasons. First of all, over the past 10 years, low-productive lands with soils that are characterized by unfavorable conditions for the cultivation of crops haven't been used. Secondly, one part of the agricultural land was taken to accommodate buildings, transport communications and other non - agricultural needs. In recent years, the expansion of urban areas, the construction of cottages, the reconstruction of old roads and the construction of new ones are increasingly carried out on agricultural lands.

**Table 2. Dynamics of agricultural land area in the Republic of Belarus [3].**

| Republic, region        | Agricultural lands, thousands hectares |         |         |        |        |
|-------------------------|--|---------|---------|--------|--------|
|                         | 2014                                   | 2015    | 2016    | 2017   | 2018   |
| the Republic of Belarus | 8874,0                                 | 8817,3  | 8726,4  | 8632,3 | 8581,9 |
| Brest region            | 1 420,1                                | 1 414,8 | 1406,4  | 1388,7 | 1388,1 |
| Vitebsk region          | 1 502,4                                | 1 490,0 | 1 474,3 | 1467,2 | 1454,8 |
| Gomel region            | 1 354,2                                | 1 346,7 | 1 330,4 | 1323,8 | 1322,7 |
| Grodno region           | 1 243,0                                | 1 236,5 | 1 233,0 | 1230,8 | 1218,2 |
| Minsk region            | 1 851,4                                | 1 849,0 | 1 845,1 | 1846,1 | 1842,7 |
| Mogilev region          | 1 355,3                                | 1 295,3 | 1 292,7 | 1283,6 | 1275,1 |

The most common types of land degradation include water and wind erosion; salinity of drained peat soils; chemical and radioactive contamination; violation of land by the extraction of minerals.

The peculiarities of the relief and geomorphology, the nature of the soil-forming rocks and the intensive anthropogenic load on the soil cover have led to the development of erosion processes on the territory of the Republic. Soils with a potential manifestation of water-erosion processes occupy about 32% of arable land, including about 10% of already eroded land [1].

The main reasons of soil erosion in Belarus are:

- 1) permanent reduction of areas with natural vegetation;
- 2) the intensification of economic development by using erosion-hazardous soils;
- 3) the violation of agro technology of agricultural crops cultivation due to non-compliance with soil protection measures;
- 4) unfavorable combination of natural and climatic conditions for farming.

In the north of Belarus water erosion prevails, in the central part - water and partially wind erosion, in the southern part - mostly wind erosion.

The largest areas of agricultural land, prone to erosion processes, are confined to Minsk region (23.5% of the total land area prone to erosion), the smallest areas - to Gomel (6.1%) (Table 3). The share of arable land in the total area of agricultural land, prone to erosion, ranged from 83% in Vitebsk and Minsk regions to 93% in Grodno region [7].

The largest areas of agricultural land, prone to water erosion, are located in Vitebsk and Mogilev regions. The minimum areas are in Gomel region (11.9 thousand hectares).

Wind erosion areas are insignificant. Most of them are confined to Gomel (21.8 thousand hectares), Grodno and Minsk regions. The minimum area of these lands is typical for Mogilev region.

**Table 3. Distribution of agricultural lands, subject to erosion, according to administrative regions of Belarus, thousand hectares [7].**

| Region  | Land area, prone to water and wind erosion |             | Land area, prone to wind erosion |             | Land area, prone to water erosion |             |
|---------|--|-------------|----------------------------------|-------------|-----------------------------------|-------------|
|         | total                                      | arable land | total                            | arable land | total                             | arable land |
| Brest   | 51,0                                       | 43,0        | 11,5                             | 10,3        | 39,4                              | 32,7        |
| Vitebsk | 121,1                                      | 100,8       | 4,2                              | 3,7         | 116,9                             | 97,1        |
| Gomel   | 33,7                                       | 30,2        | 21,8                             | 19,6        | 11,9                              | 10,7        |
| Grodno  | 107,1                                      | 99,4        | 21,5                             | 20,5        | 85,7                              | 78,9        |
| Minsk   | 130,6                                      | 108,6       | 21,4                             | 9,1         | 109,2                             | 99,5        |
| Mogilev | 113,0                                      | 97,5        | 2,7                              | 2,2         | 110,3                             | 95,2        |
| Belarus | 556,5                                      | 479,5       | 83,2                             | 65,4        | 473,3                             | 414,1       |

The development of erosion processes has a negative impact on the quantitative and qualitative indicators of soil. Long-term stationary observations of the Institute of Soil Science and Agro chemistry show that yearly up to 10-15 tons of the solid soil phase, 150-180 kg of humus substances, 10 kg of nitrogen, 4-5 kg of phosphorus and potassium, 5-6 kg of calcium and magnesium are annually removed with the current way of using erosion-prone and eroded lands with washed and blown soil from one hectare. The loss of humus and nutrients, the deterioration of the agro physical, biological and agro technical properties of eroded soils adversely affect their fertility. At the same time, there is a significant decrease in yields of cultivated crops on eroded soil types from 12 to 60%.

In Belarus, non-eroded, low-eroded, medium-eroded, highly eroded and very strongly eroded soils are distinguished [9].

On slopes with a steepness of 1–3 °, low eroded soils are mainly located with a potential washout of 2.1–5.0 ton/hectares. The arable horizon is partially destroyed and the underlying podzolic horizon is used with it. In comparison with non-eroded soils, the humus reserves are lower by 20–30%, that's why the density of the upper horizon significantly increases, and the porosity decreases. Medium-eroded soils include lands located on slopes with a steepness of 3-5 °. The annual loss of fine earth is 5.1–10.0 ton/hectares. [9].

It leads to the complete destruction of the arable horizon and the plowing of the podzolic and even upper part of the illuvial horizon. Humus reserves are reduced in 2.0–2.5 times compared with full-profile soils. At the same time agro physical properties sharply deteriorate. The lands located on steep slopes ( $5-7^\circ$ ) are usually strongly degraded, the arable horizon is formed from an illuvial horizon. The average annual washout is 10.1–20.0 ton/hectares of fine earth. The humus reserves in the upper soil layer are 10–15 ton/hectares, which is five times lower than in the soils of the first group. Very highly eroded soils are located on slopes with a steepness of more than  $7^\circ$  and with a potential wash of more than 20.0 ton/hectares per year. Their arable horizon is formed from the illuvial horizon and the underlying rock, which leads to the formation of extremely unfavorable agronomic properties of the soil. Humus reserves do not exceed 10 ton/hectares [9].

The implementation of measures to intensify farming without taking into account the natural conditions, peculiarities of the composition and properties of the individual components of the soil cover inevitably leads to its degradation. To the greatest extent, these changes are obvious on drained peat soils, which are distinguished by ecological instability. Their use in grain-tilled crop rotations leads to large losses of organic substance due to mineralization and erosion, in average of 10 ton/hectares per year, under cereal crops - 5-6 ton/hectares, with constant cultivation of perennial grasses - 2.0 – 3.2 ton/hectares [2, 6]. On the place of drained small-area peat lands, as a result of partial or complete depletion of peat and plowing of the underlying rock, mainly of sandy granulometric structure, degraded peat soils have been formed. In the arable horizon the organic substance content is less than 50%. The soils formed as a result of peat production are less fertile in comparison with peat soils and their degree of suitability for cultivating crops has changed.

The Republic of Belarus suffered from the accident at the Chernobyl nuclear power plant in 1986. As of January 1, 2015, radioactive contamination of the territory was 14.5% of the country's territory. More than 2/3 of the total area of this zone occupied areas with the level of contamination with cesium-137 from 1 to 5 Cu / km<sup>2</sup>, 21.9% - from 5 to 15 Cu / km<sup>2</sup>, 7.3% - from 15 to 40 Cu / km<sup>2</sup>, 1.4% - more than 40 Cu/km<sup>2</sup> [7]. Forest lands (15.0% of the total forest area) are more susceptible to radioactive contamination among other land types. The area of agricultural land contaminated with Cesium-137 amounted to 941.3 thousand hectares (10.9% of the total area) [7].

The largest percentage (more than 50%) of the land contaminated by radio-strontium is concentrated in Bragin, Vetka, Narovlya, Retsitsky and Khoyniki districts of Gomel region. The main blocks of radio-cesium contaminated land (with the density of 5 Cu/ km<sup>2</sup> and above) are concentrated in six districts of Gomel region (Vetka, Kormiansk, Khoyniki, Narovlya, Chechersk, Buda-Koshelevsky) and in three districts of Mogilev region (Slavgorod, Kostukovichy, Cherikov). The main fund of polluted lands is represented by sod-podzolic, sod-podzolic marshy and peat-marsh soils [8].

**Conclusion.** Thus, in recent years in the Republic of Belarus the area of agricultural land decreases and the area of forest land increases. Territorial differences are revealed in the distribution of various land categories. The maximum area of agricultural land has Minsk region, the minimum - Grodno. Erosion prevails of the various types of land degradation in the Republic. At the same time, wind erosion is widespread in the south in contrast to the northern and central parts of the country.

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**Е.Галай**

*Белорусский государственный университет, Минск, Беларусь*

#### **Экологическое состояние земельных ресурсов Республики Беларусь**

**Аннотация:** Реализация мероприятий по интенсификации сельского хозяйства без учета природных условий, композиционных особенностей и свойств почвенного покрова неизбежно приводит к его деградации. В наибольшей степени эти изменения проявляются на осушенных торфяных почвах, которые характеризуются нестабильностью окружающей среды. В научной работе дана оценка земельно-ресурсного потенциала, которая проводилась с использованием четырех основных методологических подходов: системы баллов, значений индексов, показателей стоимости и оценки энергоёмкости рыночных продуктов. На основании полученных результатов исследования земельных ресурсов Республики Беларусь на 1 января 2018 г. дана общая оценка землепользования.

**Ключевые слова:** земельные ресурсы, деградация, Республика Беларусь, природно-ресурсный потенциал.

**Е.Галай**

*Беларусь мемлекеттік университети, Минск, Беларусь*

#### **Беларусь Республикасы жер ресурстарының экологиялық жағдайы**

**Аңдатпа:** Ауыл шаруашылығын қарқынды жүргізу барысында іс-шараларын табиғи жағдайларды, композициялық ерекшеліктерді және топырақ жамылғысының жеке компоненттерінің қасиеттерін ескермей жүзеге асыру оның деградациясына әкеліп соқтырады. Көптеген жағдайда бұл өзгерістер құрғатылған шымтезек топырақтарында кездеседі, бұл дегеніміз қоршаған ортаның тұрақсыздығымен сипатталады. Мақалада жер ресурстарының әлеуетін бағалауда төрт негізгі әдіснамалық тәсілдер жүзеге асырылды: балдық жүйелер, индекс мәндері, шығын көрсеткіштері және нарықтық өнімдердің энергия сыйымдылығын бағалау. 2018 ж. 1 қаңтардағы Беларусь Республикасы жер ресурстарын зерттеу нәтижесі негізінде жерді пайдаланудың жалпы бағасы берілді.

**Түйін сөздер:** жер ресурстары, деградация, Беларусь Республикасы, табиғи-ресурстық әлеует.

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#### **Information about authors:**

*Galai E.* - Associate Professor of the Department of Geographical Ecology, Candidate of Geographical Sciences, Belarusian State University, Minsk, Belarus.

*Галай Е.*- географиялық экология кафедрасының доценті, география ғылымдарының кандидаты, Беларусь мемлекеттік университети, Минск, Беларусь.

*Received 20.12.2019*