Meadows and pastures in the agricultural landscapes of the Karelian province of the Middle Taiga zone of the North-West of Russia

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Abstract. In order to take into account the territorial differences of natural and economic conditions, to identify biological and ecological patterns, the agro-landscape and ecological zoning of natural forage lands (NFL) of the North-Western natural and economic region of the Russian Federation has been developed. The Karelian province occupies 23% of the area in the north of the Leningrad region, bordering Karelia and Finland. The Karelian province is located in the western part of the Middle Taiga zone, which is characterized by Eastern European Middle Taiga plains. Most of the area of the province (65%) is covered by forests. Agricultural land occupies only 4% of the total area of the province. Including arable land – 2%, hayfields and pastures – 1% each. The territory of the province is significantly moistened and swampy. Swamps occupy 11% of the area, under water – about 11%. Shrubs occupy 3% of the area of the province, other land – about 6%. The structure of NFL is dominated (53%) by normally moistened dry-grass grasslands on sod-podzolic soils. Fine-grained sweet-scented and fine-grained grasslands with a large participation of various grasses are common. The yield of hay is 9–13 c/ha, feed is 70 c/ha. Grass-mixed grass and grass-sedge-mixed grass lowland and swampy meadows on swamp-podzolic soils occupy 44%. Grass stands with the dominance of the sod pike are common. Swampy depressions are occupied by large-seeded grass stands. The yield of hay is 10–15 c/ha, feed is 9–11 c/ha. The ecological state of the province's landscapes is satisfactory-tense.

Keywords: agrolandscape-ecological zoning, soils, vegetation, hayfields and pastures.

1. Introduction
In the successful development of agricultural production, an extremely important role is played by information agro-landscape and environmental support, comprehensive accounting and evaluation of natural and economic resources. They are necessary to harmonize the interaction of man and nature, to ensure regional, landscape and environmental differentiation of agriculture. They are a necessary basis for the rational use of natural resources, the preservation of agricultural land, and the improvement and protection of the environment [1-3].
The development and development of science-based agricultural systems, including forage production, should fully take into account the specific agro-landscape, environmental and economic conditions of each natural zone, province and district, each administrative region, district and farm. This will ensure maximum consistency and compliance of the specialization and concentration of agricultural production, the development of crop production, agriculture and animal husbandry with the natural conditions and quality of land, the ecological state of agricultural landscapes and environmental protection, and the regenerative capabilities of nature [4, 5].

The importance of rational use of natural forage lands and perennial grasses in agroecosystems is not only to ensure an increase in the production of cheap bulk feed, but also that they act as a stabilizing factor in the agricultural landscapes of various zones, ensure the preservation and increase of soil fertility, protect them from erosion and other negative processes [6, 7].

Modern technologies can significantly increase the productivity and sustainability of meadows and pastures and ensure the production of environmentally friendly products [8-10].

2. Materials and Methods
In order to study the spatial distribution of biological and ecological patterns of meadows and pastures on the territory of the North-Western Natural and Economic region of Russia, we developed an agrolandscape-ecological zoning of the region using different information sources on the basis of the author's methodology (ecological-geographical, geobotanical maps, data of the state land accounting, natural-agricultural, agro-climatic, landscape-ecological, soil-ecological, biogeochemical zoning) [11-14].

The concept of preserving soil fertility is the basis of agro-landscape and ecological zoning (Federal Williams Research Center of Forage Production & Agroecology), as well as ecological and geographical analysis (Faculty of Geography of Lomonosov Moscow State University) and landscape-ecological balance (Institute of Geography of RAS).

The article is the result of many years of interdisciplinary research. It is based both on the data obtained by the authors as a result of agro-landscape-ecological zoning, in the course of field research, and on the analysis of remote data, statistical information, literary and stock sources.

3. Results and Discussion
The North-Western natural and Economic region (total area of 21033.2 thousand hectares) includes the Leningrad, Novgorod, Pskov and Kaliningrad regions.

According to the data of the agro-landscape and ecological zoning, it is established that the majority (more than 50%) of the territory of the North-Western natural and economic region is occupied by spruce and pine forests and their derivatives. Almost 10% of the area of the district is under water, 9% is occupied by swamps.

The share of agricultural land accounts for 19%, of which hayfields and pastures occupy about 8% of the area of the district (1596.4 thousand hectares), or 40% of the area of agricultural land in the North-Western district.

Dry meadows predominate (64%), but a significant part of them are temporarily over-moistened pike meadows. Normal dry valleys are occupied by grass stands of grassland grasses (sweet-spined, thin-leaved, white-leaved, red-leaved). The share of lowland meadows is 18%, swampy – 14%, short-term-3%, long-term – 1%.

The Karelian province is the only one in the Middle Taiga zone of the North-Western natural and economic region. It occupies 23% of the area in the north of the Leningrad region, bordering Karelia and Finland.

Within the boundaries of the North-Western Natural and Economic Region, it is represented by two fragments, within which 3 districts are distinguished (Vyborg, Vepsovo-Andomsky and Ladoga-Onega).

The first fragment is located between the Gulf of Finland of the Baltic Sea and Lake Ladoga (District I).
The second fragment is located between Lake Ladoga and Lake Onega (Districts II and III).
In the I-th and II-th districts, elevations up to 100 m above sea level prevail.
In the third district, the central part is raised to 200 m, and the south-eastern edge, located on the Veps hill, is up to 300 m.
The province is located in the western part of the Middle Taiga zone, which is characterized by Eastern European Middle Taiga plains. Most of the area of the province (65%) is covered by forests. Agricultural land occupies only 4% of the total area of the province. Including arable land 2%, hayfields and pastures – 1% each. The territory of the province is significantly moistened and swampy. Swamps occupy 11% of the area, under water-about 11%. Shrubs occupy 3% of the area of the province, other land-about 6%.
The soil cover is dominated by sod-podzolic sandy loam and sandy soils. Lots of swampy soil.
The structure of natural forage lands (NFL) is dominated (53%) by normally moistened dry-grass grasslands on sod-podzolic soils, sands and cover loams of moderately drained gently undulating plains and gentle slopes. On the elevated elements of the relief, fine-grained sweet-spikelet and fine-spikelet meadows with a large participation of various grasses predominate, on strongly podzolic soils – whitebeard. The yield of hay is 9–13 c/ha, dry eaten mass (DEM) is 7–10 c/ha. The quality of the feed is average (1 kg of dry mass contains 0.6–0.8 feed units, 1 feed unit contains 70–100 g of digestible protein).
The share of grass-mixed grasses and grass-sedge-mixed grasses of lowland and swampy meadows on swamp-podzolic soils accounts for 44% of the total area of the NFL of the Karelian province. Their species composition is monotonous. In areas with excessive moisture, lowland and westerly, grass stands predominate with the dominance of sod pike. Swampy depressions are occupied by large-seeded grass stands. The yield of hay is 10–15 c/ha, DEM is 9–11 c/ha. The feed quality is average and below average.
The floodplains of the rivers are dominated (3% of the area) by red fescue and mixed grasses meadows on floodplain turf and floodplain meadow soils. The yield of hay is 15–18 c/ha, DEM is 11–15 c/ha. The quality of the feed is good (1 kg of dry mass contains more than 0.8 feed units. 1 feed unit contains more than 100 g of digestible protein) and average.
There are a lot of swampy large-grass meadows on floodplain meadow-swamp, floodplain swamp, silt-humus-gley, peat and peat soils. The yield of hay is 18–23 c / ha, dry feed is 6–10 c/ha. The quality of the feed is poor (1 kg of dry mass contains less than 0.6 feed units, 1 feed unit contains less than 70 g of digestible protein).
The ecological state of the province's landscapes is satisfactory-tense. In particular, arable land – satisfactory-tense, NFL – satisfactory, forests – satisfactory-tense, in the western part – good.
I. The Vyborg district of the Middle Taiga hilly moraine plains is characterized by a hilly-rocky and flat terrain, with lakes and swamps. Elevation marks range from 61 in the southern part to 130 m above sea level in the northern part of the district. The soil cover is dominated by subzols of illuvial-ferruginous-humus sandy loam and sandy and brown-humus sandy loam.
Large areas in the district are occupied by forests (59%). Pine forests predominate, in some places with an admixture of spruce and birch, and in the south-western part – spruce forests. 18% of the area of the district is under water. Swamps occupy more than 10% of the area.
Agricultural land – only 5% of the total area of the district. Of these, arable land occupies 3%, hayfields and pastures – 1% each.
The herbsage is quite monotonous. Dry-field locations (40%) are mainly occupied by thin-leaved and sweet-leaf grass stands. In the lowlands and depressions (30%), meadows with sod pike predominate. Especially common are meadows with pike and various grasses, pike and small sedges, pike and meadowsweet. A significant area in the district is occupied by swampy meadows with large sedges (27%).
The ecological condition of the landscapes is satisfactory. In particular, arable land – satisfactory, NFL – satisfactory, forests – good.
II. Ladoga-Onega district of the Middle Taiga lake-glacial sandy and sometimes moraine (in the north-west) plains. The terrain is mostly flat, but the northern part is dominated by undulating plains. Many swamps and lakes (28%).

The soil cover is dominated by alfeegumus sandy podzols, a lot of marsh soils. There are a lot of forests in the district (58%). These are mainly long-term pine and birch forests, but in the northern part spruce forests predominate. A lot of land (28%) is under water and occupied by swamps.

Agricultural land occupies only 5% of the total area of the district. In particular, 3% of arable land, hayfields and pastures occupy 1% each.

Forage areas are quite diverse in the composition of vegetation. On the elevated elements of the relief, which occupy 55% of the area of the NFL, there are a lot of dry-grass sweet-grass, thin-grass meadows with a large participation of various grasses, including deposits.

On strongly podzolic soils, meadows with belous are common, and on flat plains – with whiteflies and small sedges, grass stands are common. In the lowlands and depressions (25%), pike meadows with small sedges and small-sedge meadows are common. The district has a lot of swampy (17%), mainly large sedge meadows. The floodplains (3%) are dominated by meadows with red fescue and various grasses.

The ecological state of the district's landscapes is satisfactory-tense. In particular, arable land – satisfactorily stressed, NFL – satisfactory, forests – satisfactorily stressed.

III. Vepsovo-Andomsky district of the Middle Taiga hilly moraine plains. The terrain is undulating, hilly-ridged, hilly-withered with swamps and lakes, karst craters, less often flat and shallow-hilly. The maximum elevation is 291 m on the north-western spurs of the Veps upland. The elevated area of the district has significantly fewer reservoirs (7%) and marshes (10%).

The soil cover is dominated by medium-, weakly- and strongly podzolic, podzolic surface-gleeveate medium- and light-loamy soils.

The district is more than 70% covered with forests – medium-taiga spruce and secondary birch and aspen-birch.

There are few meadows. Dry grass stands predominate (60%). More often than others, there are scented-grass meadows on elevations and slopes. There are a lot of whiteflies, especially mesophilic-motley grasses. In the depressions (15%), pike and small sedges are common, in the deeper depressions – thickets of veinica and meadowsweet. The floodplain is dominated by meadows with red fescue, sweet spikelet and various grasses, red fescue with bluegrass. Swampy meadows occupy 20% of the district's forage land.

The development of negative processes of waterlogging, irrational use and lack of care has led to the fact that most areas of hayfields and pastures are in unsatisfactory condition.

Almost all forage areas need surface and radical improvement: drainage, clearing of shrubs, fertilization, and seeding of forage grasses.

4. Conclusions
Assessments of the current state of agricultural landscapes, agricultural land, the development of negative processes are given in order to take into account the territorial differences in natural and economic conditions, geographical, biological and ecological patterns. In the strategy of adaptive intensification of agriculture, zoning of the territory occupies a central place. On the basis of agrolandscape-ecological zoning, the scientific support of adaptive intensification of forage production, increase of productivity and sustainability of agrolandscapes, rational nature management is given.

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The structure of natural forage lands (NFL) is dominated (53%) by normally moistened dry-grass grasslands on sod-podzolic soils, sands and cover loams of moderately drained gently undulating plains and gentle slopes. On the elevated elements of the relief, fine-grained sweet-spikelet and fine-spikelet meadows with a large participation of various grasses predominate, on strongly podzolic soils – whitebeard. The yield of hay is 9–13 c/ha, dry eaten mass (DEM) is 7–10 c/ha. The quality of the feed is average.

The assessment of the state of meadows and pastures in the agricultural landscapes of the Karelian province of the Middle Taiga zone of the North-Western Natural and Economic region allows us to obtain the necessary information for the development of highly productive and environmentally friendly agriculture, ecosystem management, rational use of natural resources and environmental protection.

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