Rational use of floodplain ecosystems of the North

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Abstract. The purpose of the study is the spatial analysis of the factors of floodplain ecosystems and the calculation of rational use, through the calculation of technical and economic indicators and the calculation of the economic efficiency of haymaking. The assessment of the economic efficiency of the forage base was obtained based on the study of the grass stand and productivity of hayfields in five key areas of the Ob River floodplain, the study of soil properties, their qualitative characteristics necessary for understanding the soil fertility of floodplain ecosystems, on which land productivity depends. The spatial analysis of the rational use of the floodplain ecosystems of the Ob River was made in a semi-automatic way by decoding the Bing satellite image (the SAS Planet mapping and navigation program) in the Semi-Automatic Classification Plugin module in the QGIS geographic information system, the cartographic material was edited in the MapInfo Professional geographic information system.

1 Introduction

The rational use of natural and land resources in the northern territories is complicated by special climatic conditions. The territory of the Khanty-Mansi Autonomous region-Yugra, according to natural and climatic characteristics (located in the taiga zone of the West Siberian Plain), belongs to the zone of risky agriculture, this condition creates a low threshold for food security of the district, however, according to agricultural zoning, the territory belongs to the zone of animal husbandry, this is facilitated by natural conditions, in particular, the floodplain of the Ob River is a "storehouse of fertility", meadows with high productivity are formed here [1, 2]. Floodplain ecosystems of the Ob River, have a high natural capacity for food supply. The possibility of rational use of floodplain ecosystems of the Ob River is realized through the approach of calculating the economic efficiency of the feed base.

One of the main goals of the state's economic policy is food security. The increase in the volume of low-transportable high-quality crop and livestock products of local production partially ensures food security at the regional level. The implementation of the production of crop and livestock products is possible based on the possibility of taking into account the natural factors of the implementation of the feed base [3, 4]. The main purpose of the study

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is to study the economic efficiency of the forage base in the floodplain ecosystems of the Ob River, associated with natural soil fertility.

Research of rational use of floodplain ecosystems of the Russian Federation. The Ob is based on the basic concepts related to land management, in particular, we operate with the terms forage land, forage base, and also in geographical terms, a spatial analysis of the efficiency and rational use of floodplain ecosystems using GIS is made.

The analysis of the scientific literature shows that over the past 30-40 years in applied geobotany, the principles of mapping natural forage lands have not undergone any special changes, despite the fact that the developments of many domestic and foreign scientists devoted to ecosystems, geosystems, agroecosystems, agrogeosystems and agrolandscapes make significant improvements in our understanding of natural forage lands. In the assessment and land surveys prevailing today in agriculture, natural forage lands are considered mainly from the point of view of productivity, as sources of feed for animal husbandry [3, 4, 5].

Natural forage land is "agricultural land that has natural grass and is used for the production of feed", and it is also a special type of land resources in the floodplain ecosystems of the North, which are the object of land use and the means of production in agriculture [3].

As an independent object of research, natural forage lands began to be singled out only at the beginning of the XX century, in connection with the demands of practice, the development of soil science, geography, geobotany and the formation of the science of meadow science. The basics of an integrated approach to the study of land in relation to natural forage lands were developed by scientists V.R. Williams, A.M. Dmitriev, L.G. Ramensky, who considered meadows as complex natural and natural-economic dynamic systems that are elements of the geographical landscape [6].

After analyzing the theoretical and methodological aspects of mapping hayfields, we can conclude that it is necessary to create maps of natural forage lands for the territory of the Khanty-Mansi Autonomous region-Yugra for the purpose of rational land use, since many types of vegetation habitat have been formed in this territory that are promising for agriculture, including for haymaking [7].

The use of GIS, which is a tool for building models of the earth's surface, described by spectral, spatial and temporal characteristics and information received at certain intervals, allows you to monitor the use of land resources, create thematic maps of land use.

2 Materials and methods

The floodplain ecosystems of the North are the basis of natural forage lands. Methodological approaches to their rational use, mapping and monitoring are applicable to them. They are determined by the need for system characteristics of objects, environmental and industrial orientation of assessments. Natural forage lands should be evaluated from the point of view of their current importance as a source of feed, identifying the forage potential and the ecological state of the land.

The floodplain of the Ob River in the middle course passes in the latitudinal plan in the boreal zone. Floodplain meadows with mixed grasses are formed here. Alluvial soils are formed on alluvial deposits during river flooding on loamy alluvium.

In the floodplains of the Ob and Vakh rivers, alluvial sod gley and alluvial humus-gley soils (Histosol, Gleysol) are formed [8, 9].

The methodological foundations and principles of classification of natural forage lands are considered in the works of L.G. Ramensky. The essence of this technique was that when mapping forage lands, territories with the same growing conditions of plants were identified, as well as the relief (meso - and microforms), soils (type, difference, thickness of

horizons, mechanical composition, etc.), moisture, etc. were considered. The type of plant habitat consists of different points with similar habitat conditions [10].

Thus, the mapping of forage lands is carried out by the type of habitat (place of growth) of plants and their characteristics. The main role in identifying the type of place of growth is played not by vegetation, but by terrain, soil, and land moisture.

During the cameral work, as a result of the semi-automatic interpretation of the Bing satellite image (the SAS Planet mapping and navigation program) in the Semi-Automatic Classification Plugin module in the QGIS geographical information system and edited in the MapInfoProfessional geographical information system, the boundaries of the hayfields in the latitudinal segment of the Ob River floodplain were determined (Fig. 1).

In addition, we carried out the calculation of technical and economic indicators and calculated the economic efficiency of haymaking.

3 Results and discussion

Hayfields are formed in the floodplain of the Ob River on alluvial-sod soils. Qualitative characteristics distinguish these soils from zonal types of soils in the taiga zone of Western Siberia [2, 5; 7]. The use of floodplain soils and the structure of agricultural land (hay, pasture, arable land) determines the degree of development of the floodplain of the Ob River. Digital processing of the Landsat satellite image showed that the floodplain of the Ob River is the basis for hayfields [1].

The studied key sites occupied by hayfields are located in the floodplain of the Ob River and additional sites in the mouth of the Vakh River, up to the village of Bolshetarkhovo, Nizhnevartovsky district. The objects of the study were alluvial sod gley soils, which are located in the middle course of the floodplain of the Ob River on 5 key sites. The studied sites are represented by alluvial-turf soils (Histosol, Gleysol). The studied soils showed gleyness, which negatively affects the productivity of hayfields. The geobotanical description shows a high percentage of sedge vegetation and a very low percentage of grass vegetation.

The results of the analysis of the granulometric composition showed that mainly the Histosol, Gleysol of the floodplains of the Ob and Vakh rivers are composed of light loam, that is, due to the hydrological regime of the river, organic matter accumulates during the low-water period. These types of soils have the ability to form a powerful grassy layer of grass and sedge vegetation. During the vegetative period, a small humus layer is formed, which has a positive effect on soil fertility and high productivity of hayfields (Fig. 1).

Fig. 1. The main qualitative characteristics of alluvial soils of the floodplains of the Ob and Vakh rivers

In 2021-2019, the productivity of hayfields was very high. The prevailing climatic and hydrological conditions of the territory, water levels during high water and their duration greatly affect the productivity of land, but these conditions also significantly affect the availability of land and haymaking (Table 2).

Table 2. Productivity of hayfields at key sites

keysite No.	Key sites	Productivity of hayfields, c / ha		Hayfiel ds, ha	Total weight of hay, kg
		bygreen mass	by weight of dry grass		
1	Poaceae central floodplain of the river Ob on River soil. Histosol. Gleysol.	149.3	34.6	1,583.5	5,975.1
2	Cyperaceae flooded part of the river Big Yegan on River soil. Histosol. Gleysol.	72.6	25.3	3	40,062.6
3	Poaceae central floodplain of the river Ob (mouth of the Vakh river) River soil. Histosol. Gleysol.	135.1	31.6	378.6	94.8
4	Poaceae central floodplain of the river Vakh on River soil. Histosol. Gleysol.	159.6	43.8	165.1	16,582.7
5	Cyperaceae central floodplain of the river. River soil. Histosol. Gleysol.	95.5	39.0	172.7	6,440.1
	Notsure			2,137.8	62,715.1

Having analyzed the above results of soil-geobotanical studies of hayfields, it can be concluded that due to the high fertility rates, optimal granulometric composition and high productivity, Histosol, Gleysolsoils located in the lower reaches of the Vakh River are the most suitable for their use for agricultural purposes, namely for haymaking. To assess the economic efficiency of the use of forage land, it is necessary to calculate the cost indicators for 1 ha of hayfields, profit and profitability [3]. On the site No. 5 — 644 tons were collected from an area of 172.7 hectares, which amounted to 1.074 bales. The price of dry grass on the local market is 4 thousand rubles, i.e. the gross output is 4.3 million rubles, i.e. 26 thousand rubles per 1 ha. Total expenses for haymaking amounted to 582.8 thousand rubles, gross profit - 3713.2 thousand rubles. The profit and profitability indicators are shown in Table 3.

Table 3. Economic efficiency indicators at key sites (million rubles)

keysite No.	Grossoutput	Grossprofit margin	Cost price	Net profit	Profitability, %
1	4.0	3.4	1.5	2.5	165
2	26.7	21.1	11.1	15.6	140
3	0.06	0.05	0.02	0.04	158
4	11.1	9.7	3.9	7.2	187
5	4.3	3.7	1.6	2.7	176
Notsure	46.1	38.0	18.0	28.1	156

The gross profit in the key areas will be 38 million rubles, the cost of production - 18 million rubles, net profit - 28.1 million rubles. The average profitability of the project on the sites will be 156%.

Hayfields on Histosol, Gleysolsoils can be used in agriculture (haymaking, harvesting of green fodder), but it is necessary to equip these territories (agrotechnical, agromeliorative and hydrotechnical measures), which meets the principles of rational nature management of the territories.

During the desk work, using the data obtained, a map was created in the geographical information systems MapInfo Professional and QGIS with the hayfields, coniferous and deciduous stands, hydrography, settlements, roads, soil sampling points and an attribute block to them (Fig. 2).

The mouth of the river The Vakh reaches 40 km, which distinguishes the main floodplains of the world's rivers. This feature affects the formation of highly productive hayfields. Therefore, based on this characteristic, the determination of the soil fertility of hayfields, the latitudinal segment of p. The Ob can be divided into two groups: 1) the central section of the floodplain of the Ob River, which roughly has borders from Surgut to the Big Yegan River; 2) the Vakhsky section has borders from the Big Yegan River to the Bolshetarkhovo village, located in the area of the floodplain of the Vakh river. The area of hayfields of the central section was 246 thousand hectares, the Vakhsky section - 61 thousand hectares.

Fig. 2. Map of hayfields of the latitudinal segment of the floodplain of the Ob River. Key sites designations on the map: 1. key site Poaceae central floodplain of the river Ob on River soil. Histosol. Gleysol. 2 key site Cyperaceae flooded part of the river Big Yegan on River soil. Histosol. Gleysol. 3 key site Poaceae central floodplain of the river Ob (mouth of the Vakh river) River soil. Histosol. Gleysol. 4 key site Poaceae central floodplain of the river Vakh. River soil. Histosol. Gleysol. 5 key site Cyperaceae central floodplain of the river. River soil. Histosol. Gleysol.

4 Conclusions

1. The middle course of the Ob River, within the Khanty-Mansi Autonomous region-Yugra, according to natural and climatic characteristics belongs to the zone of risky agriculture, this condition creates a low threshold for food security of the district, however, according to agricultural zoning, the territory belongs to the zone of animal husbandry, this is facilitated by natural conditions, in particular the floodplain ecosystems of the Ob River are highly productive meadows with high productivity of the feed base.
2. After analyzing the theoretical and methodological aspects of mapping hayfields, we can conclude that it is necessary to create maps of natural forage lands for the

territory of the Khanty-Mansi Autonomous region - Yugra for the purpose of rational land use, since many types of vegetation habitat have been formed in this territory that are promising for agriculture, including for haymaking.

3. The results of studies of the qualitative characteristics of the soils of the Ob River floodplain showed that these soils have a high content of humus, the intensity of the bioaccumulative process depends on the presence of clay particles in the mechanical composition of the soil and on the water regime of the soil. Under conditions of excessive moisture, the process of soil humification slows down. Floodplain areas are reserves of agricultural land, and they are able to produce high yields, but only if they are cultivated and used efficiently. Hayfields on Histosol, Gleysol soils can be used in agriculture (haymaking, harvesting of green fodder), but it is necessary to equip these territories (agrotechnical, agro-reclamation and hydrotechnical measures).
4. Improving the economic efficiency of agricultural production primarily depends on improving the use of the main production resource – land. The profitability of the use of forage land in the territory under consideration is quite high and amounts to 156%.
5. Based on the conducted research on the use of satellite imagery materials in mapping hayfields in the latitudinal segment of the floodplain of the Ob River, it was established:
 - decoding the satellite image made it possible to solve the following tasks: to highlight the contours of the hayfields in the image, to select the most characteristic key sites and observation routes;
 - satellite images allow you to create cartographic materials that more fully and objectively reflect the current state of hayfields.
 - The map, compiled using the semi-automatic decoding method, significantly clarifies and details the boundaries of natural areas, reflects the current dynamic state and trends in the development of the studied territory.

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