Conducting geobotanical survey of pastures using gis technologies

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Abstract. The article considers the issues of geobotanical survey of the "Baytak-Ravat-Jakub" pasture spot of Batken city applying geoinformational technologies. A geobotanical survey of pastures is a survey conducted to determine the productivity of pastures, the botanical composition of herbage, the quality of herbaceous vegetation, its habitats, and the possibility of using pastures for grazing various types of farm animals. Traditional field method and the method of geoinformational mapping is applied for the geobotanical survey of pastures which is capable for storing and processing pasture monitoring data. As a result of monitoring pastures using geoinformational technologies, the cartographic material is created with the boundaries of pasture contours and the yield. The regional pasture committees determine geobotanical composition and assessment of the condition of pastures, organizing the rational utilization of pastures and their protection. The research materials will be may can be recommended for use.

Keywords: pastures, pasture rotation, geobotany, geoinformational technologies, forage stock, pasture productivity, pasture productivity, pasture load, fodder unit, land use.

1. Introduction

Natural pastures are the national wealth of Kyrgyz Republic [1]. These are mountain pastures, as they are located on mountain territory. They occupy 9.0 million hectares or 84% of the area of agricultural land, or 45% of territory and constitute the main fodder base for animal husbandry. Geobotanical survey of pastures allows studying the condition of vegetation of natural pastures and to identify ways of their most rational utilization in the future for the development of animal husbandry.

2. Materials and Method

The theoretical and methodological basis of the survey are the agriculture and land management regulatory legal acts of the Kyrgyz Republic, and the scientific papers of leading foreign and domestic scientists in the field of organizing the utilization and protection of pastures. During the research we used the materials from the State Enterprise for Land Management “Kyrgyzgiprozem”, materials from a geobotanical study of pasture lands of Kyrgyz Republic and Batken region, as well as planning, cartographic and other materials. The research is based

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on the guidelines "Methodology for conducting a geobotanical survey of natural fodder lands, compiling large-scale maps and adjusting geobotanical survey materials."

The purpose of the study is to monitor the condition of pastures at the administrative-territorial level for the timely detection of changes, prevention and elimination of the consequences of negative processes caused by human activities and the influence of natural and climatic factors.

It is necessary to solve the following tasks to achieve the goal:

- to conduct a geobotanical survey of pastures using the traditional method and with the help of geoinformational technologies and remote sensing tools;
- to develop a pasture rotation in the study area "Baytak-Ravat-Jakub";
- to develop practical recommendations for the rational utilization, conservation and restoration of pasture lands.

3. Results

In the administrative-territorial division system of Kyrgyz Republic, the land use of Batken city belongs to Batken district of Batken region. On the territory of land use, there are spring-autumn and winter pastures with a total area of 15864.8 ha, the winter pastures are 12756.1 ha, and 3288.7 ha are spring-autumn pastures.

The natural conditions of the mountainous and foothill areas influence to the distribution of pastures by seasons. The climate of Batken region is characterized by sharp continentality with insufficient precipitation, cold winters, short warm springs, hot summers and long warm autumns.

The relief is in a zonal sequence from the lowest places to the most elevated ones. The main part of the site is occupied by the northern slopes and foothills of Turkestan Range. The foothill and mountainous regions of Kyrgyzstan southern regions are characterized by a belt pattern of changes in climatic conditions.

The mountainous relief of the region and the difference in time of herbage development determine the order of pasture utilization. From spring, cattle are driven out to the foothills, then, as the grass grows, they are driven to the belt of middle mountains and further to high mountain pastures. At the end of grazing on them, in the autumn cattle graze again in the foothills.

The terms of grazing on pastures are different and depend mainly on the climatic conditions and development of vegetation. Generally, the resumption of vegetation and the beginning of growth occurs at a positive average air temperature +4-5°C. Three or four weeks pass between the beginning of the growing season and the budding phase of cereals. Thus, spring-autumn pastures located in the foothills can be utilized in April-May.

The object of the survey is the pasture area "Baytak-Ravat-Jakub" in the land territory of Batken city. Table 1 shows the explication of the natural pastures of the object. The plot in the north borders with the Tortkul reservoir and Kara-Bulak village area, on the east it borders with Kara-Bulak village area, in the south it borders with on the lands of the forestry and in the west with the lands of Ak-Sai village. Table 1 shows the explication of the natural pastures of the survey object [3].

<table>
<thead>
<tr>
<th>Name of the plot</th>
<th>Pastures</th>
<th>Pastures</th>
<th>Pastures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring-autumn</td>
<td>Winter</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Area, ha</td>
<td>average yield, c/ha</td>
<td>area, ha</td>
</tr>
</tbody>
</table>

Table 1. Explication of natural pastures as of January 1, 2021
The pastures area of survey is 8767.9 hectares, where spring-autumn pastures occupy 3024.2 hectares, winter - 5743.7 hectares. The average yield of spring and autumn pastures is 2.1 c/ha, the yield of winter pastures is 2.0 c/ha.

The spring-autumn pastures are particularly important, as they provide the first green fodder after winter with a rich content of proteins. Overrun is common for most spring-autumn pastures because of early grazing. In early spring, when there is a large amount of moisture in the soil, cattle destroy the sod with their hooves, and the growing grass is immediately eaten and trampled down.

Improper utilization of these pastures leads to the oppression of valuable forage cereals, a significant part of them falls out of the herbage and replaced by poorly eaten and poisonous plants. The density of the herbage is reduced, there are failures, paths, and the soil erosion.

The vegetation cover of spring-autumn pastures is quite diverse. The most common are ephemeral types: campfire, ephemeral-sagebrush, sagebrush-ephemeral in flat areas and foothills, in the mountainous part they are replaced by steppe fescue and couch grass types. Part of the pastures is bushed with caragana, wild rose, barberry and honeysuckle. Small masses wedged among arable land, which are usually used in the autumn after harvest.

Yields on spring-autumn pastures are relatively low, due to high temperatures and low rainfall, as well as partial salinization of the soil and a large amount of stones and rubble. The most common poisonous herbs are desert beetroot, pink mustard, and common harmala.

Spring-autumn pastures are located in small massifs in the north-eastern and southern parts of the Baytak-Ravat-Jakub plot. Most of the Baytak-Ravat-Jakub territory is occupied by winter pastures.

The main condition for grazing on winter pastures is the insignificance of snow cover or its absence. These pastures are located on the foothills, plains, and middle mountains. Unfavorable soil and climatic conditions (hot and dry climate, gravelly soils, sometimes saline) leave a certain imprint on the formation of vegetation [3].

Desert saltwort, wormwood-saltwort, semi-desert wormwood-ephemeral and wormwood-feather grass types of plants prevail here. The herbage is sparse in most cases, and intensive use contributes to the oppression of plants and overgrazing. The yield of desert wormwood-saltwort pastures is 1.8 c/ha, and of saltwort-wormwood pastures is 0.9 c/ha. Semi-desert wormwood-ephemeral pastures with a yield of 2.1 c/ha are also noted here.

Unproductive pastures noted on this area, with a yield of 0.5 c/ha on sparse saltwort and wormwood-saltwort types of vegetation. These pastures are intensively utilized in winter and autumn, because after the first frosts the essential oils evaporate, and the wormwood is eaten by livestock. The same is with hodgepodge, where the mineral salts are washed out from rains and snow and they serve as good food for sheep and goats. The area of stony winter pastures is quite large, less than bushy ones.The area of unproductive pastures on the plot "Baytak-Ravat Jakub" is 2635.7 hectares.

It is advisable to give unproductive pastures to local residents for agriculture, since at a
certain cost they can grow peach and apricot orchards. It is much more economically profitable than utilizing it for grazing, because such pastures are practically not used.

Degraded pastures occupy a small area. This is due to the fact that the main territory is occupied by desert and semi-desert vegetation, represented by wormwood and saltwort. However, the presence of a large number of plants such as Turkestan sedge, desert beetroot and small weeds: negligible mallow, highlander bird, deaf nettle, white gauze speaks of degradation processes. Such plant species in the land use area, reaching 30% of the total mass of the herbage, their distribution in meadow and meadow-steppe types of vegetation, indicates a strong degradation of pastures. Most often, it happens in places of cattle camping, near wintering areas, paddocks.

There are no hard-to-reach pastures in this area. There is access to all pasture areas of Baytak-Ravat-Jakub, since the areas are mostly flat with roads and trails. The steep-slope pastures of Baytak-Ravat-Jakub are confined to the Almaly and Ak-Tash mountains and occupy a small area.

To determine the degree of cultural and technical condition of pastures, the following gradation was applied: clean, slightly stony (up to 25% of the total pasture area), medium-strong stony (over 25%), slightly shrubby (up to 25%), strongly shrubby (over 25%) [3].

On the "Baytak-Ravat-Jakub" plot there are clean (conditionally clean) winter pastures occupy 1977.9 ha, slightly shrubby - 682.5 ha, 669.8 ha - strongly shrubby, slightly stony - 1997.1 ha, medium, strongly stony - 248.2 ha, littered with non-eatable vegetation - 168.2 ha.

On the "Baytak-Ravat-Jakub" plot the area of spring-autumn pastures is 3024.2 hectares. There are clean pastures - 391.2 ha, 124.1 ha of weakly stony pastures, 176.9 ha of strongly stony pastures, 553 ha of weakly bushy pastures, 972.8 ha of heavily bushy pastures, and 770.2 ha of littered with non-eatable vegetation, slightly overgrown with forest - 20.5 ha and heavily overgrown with forest - 36 ha. Table 2 shows the cultural and technical characteristics of the pastures of the object of study.

<table>
<thead>
<tr>
<th>Plots</th>
<th>Total pastures</th>
<th>Season of use</th>
<th>Including</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>clean</td>
</tr>
</tbody>
</table>

Table 2. Cultural and technical characteristics of pastures
Table 3. Availability and productivity of object pastures

<table>
<thead>
<tr>
<th>Pastures</th>
<th>Total area, ha</th>
<th>Feed stocks area, ha</th>
<th>Spring and autumn area, ha</th>
<th>Winter area, ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village pasture</td>
<td>294.5</td>
<td>4170.9</td>
<td>122.8</td>
<td>-</td>
</tr>
<tr>
<td>Total for the plot</td>
<td>7096.9</td>
<td>4170.9</td>
<td>122.8</td>
<td>227.3</td>
</tr>
<tr>
<td>Baytak-Ravat-Jakub</td>
<td>3024.2</td>
<td>391.2</td>
<td>532.5</td>
<td>972.8</td>
</tr>
<tr>
<td>Total for the plot</td>
<td>5743.7</td>
<td>1977.9</td>
<td>682.5/494,7</td>
<td>669.8</td>
</tr>
<tr>
<td>Total for Batken city</td>
<td>8767.9</td>
<td>2369.1</td>
<td>682.5/494,7*</td>
<td>1642.6</td>
</tr>
<tr>
<td>Total for the plot</td>
<td>15864.8</td>
<td>6540.0</td>
<td>1337.8/49,4.7*</td>
<td>1642.6</td>
</tr>
</tbody>
</table>

Source: Compiled by the authors based on the materials of the geobotanical survey of the State Enterprise for Land Management "Kyrgyzgiprozem" 2021.

Despite the complicated cultural and technical condition of the pastures of the area, they have a certain productive potential. The forage reserve on pastures is 3075 centners of fodder units. A feed unit is a conditional feed equivalent that characterizes the nutritional and productive effect of feed. One feed unit (f.u.) corresponds to the nutritional value of 1 kg of oats. The stock of fodder in the pasture provides pasture fodder for sheeps in the amount of 4.5 thousand heads with a daily requirement of 1.2 quintals of fodder units per one head. Characteristics of pasture lands in terms of their productive potential are given in Table 3.
An analysis of the economic condition of pastures shows that it is necessary to conduct a number of activities aimed to increase the yield and capacity of pastures. This can be achieved through a number of organizational and territorial activities for the rational utilization and protection of pastures.

First of all, it is necessary to abandon the unsystematic (free) grazing of livestock, which leads to the ever-increasing degradation of pastures and a decrease in their productivity. Resting of pastures is one of the most effective ways to increase pasture productivity. The point is to exclude the most overgrazed areas of pastures from utilization for two years (the year of seeding and the year of strengthening of young plants). Due to the seeding of semi-shrubs (wormwood and eurotia ceratoides) there is an activation of the growth and development of fodder plants, the herbage is enriched.

Cereals suffer the most from unsystematic grazing, which is primarily due to the too early start of grazing. Early use of plants negatively affects their afterlife and yield in subsequent years.

The rational use of pastures plays an important role in increasing the productivity of livestock, which depends on the proper organization of the pasture territory.

- creation of compact pasture users;
- establishment of pasture borders;
- use of pastures strictly according to the seasons of use;
- creation of cattle passes, cattle stopping and watering places.

To increase the yield, composition and quality of the herbage, it is necessary to consider:

- the use of herbage. To start grazing on pastures with ephemera not earlier than the end of March, the beginning of April. It is better to resume autumn grazing when plants are drying, when a large number of them already seeded, because secondary cultivation before seeding steadily leads to reduction of their productivity;
- the multiplicity of grazing pastures depends on the characteristics of the development of herbage on certain types of plants, in the time of occurrence and end of the vegetation period of forage grasses;
- the pasture load by different types should be regulated annually, then there will be no overgrazing, degradation, reduction of the projective cover and productivity of one or another herbage.
In general, the proper utilization of pastures involves the activities for utilizing and care of natural herbage. These activities can be implemented only in the pasture rotation system. Pasture rotation is a system of long-term utilization of pastures with alternation of plots according to the years of grazing, the timing of grazing, grass mowing and breaks in grazing. The basis for the design of pasture rotations are the materials of the geobotanical survey of pastures. As a rule, surveys conducted with the traditional ground method.

This activity is based on the “Methodology for conducting a geobotanical survey of natural fodder lands, compiling large-scale maps and updating geobotanical survey materials.” [2]

It’s important to note that the geobotanical survey of pastures is a costly activity. It is carried out in field and laboratory conditions by specialists of various profiles: geobotanists, soil scientists, land reclamators, zoo engineers, land surveyors. Table 4 shows the estimate cost for conducting a field traditional geobotanical pasture’s survey of the object of study.

<table>
<thead>
<tr>
<th>№</th>
<th>Name of types of geobotanical survey activities</th>
<th>The scope of activity costs, (KGS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Preparatory field activities</td>
<td>10 700</td>
</tr>
<tr>
<td>2.</td>
<td>Calculation of geobotanical contour areas</td>
<td>1 242</td>
</tr>
<tr>
<td>3.</td>
<td>Laboratory analysis of plant samples</td>
<td>2 457</td>
</tr>
<tr>
<td>4.</td>
<td>Desk activities (drawing up a map, tables, writing an essay)</td>
<td>36 017</td>
</tr>
<tr>
<td>5.</td>
<td>Study of &quot;Secret&quot; materials</td>
<td>1 070</td>
</tr>
<tr>
<td>6.</td>
<td>Production of documents</td>
<td>4 672</td>
</tr>
<tr>
<td>7.</td>
<td>Examination of documents</td>
<td>6 290</td>
</tr>
<tr>
<td>8.</td>
<td>Travel expenses</td>
<td>17 100</td>
</tr>
<tr>
<td>9.</td>
<td>Total estimated cost</td>
<td>79 548</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors on the basis of the Compilation of prices and time norms for work performed by the State Design Institute "Kyrrgyzgiprozem" [4]

Thus, for study and survey activities the total sum required is 79, 548 KGS.

At the same time, the main feature of the current stage of remote land monitoring development is the development and application of new technical means for collecting and processing information. Due to the large volume and complexity of data processing tasks, geoecological monitoring should be based on efficient technologies, on remote sensing methods.

The application of geographic information systems (GIS) and satellite observations in monitoring pastures in the modern world helps to obtain objective information over the entire territory occupied by agricultural land.

The most rational and efficient method of storing and processing monitoring data of natural territorial systems is the method of geoinformational mapping [5].

This method is based on the application of special software for geographic information systems (GIS) designed to collect, store, process and visualize spatially coordinated data, i.e. data with a specific territorial reference. Therefore, the method of geoinformational mapping is initially adapted for processing data related to ecosystems, which are territorial systems.

Informational systems that can effectively accumulate and process the results of ecosystem studies, in addition to the database, should include:

- electronic maps with layered division of images;
- software for statistical and more complex mathematical data processing;
- a system for constructing of predictive models for ecosystem development.

Computer maps with a layered division of images should display the features of the relief of the area, the structure of the soil and vegetation cover, the species composition, the number and distribution of livestock. The results of geological, soil, botanical and geobotanical, as well as zoological surveys conducted on pastures are the basis for creating electronic maps. In the long run, it is necessary to conduct field research to clarify the map legend, to determine the relationship between various components of the natural environment, and include key parameters in map legends. Refinement and detailing of maps conducted as actual data on various components of inanimate and animate nature are accumulated [5].

On the basis of the Law of the Kyrgyz Republic “On pastures”, Pasture Committees have been established in the villages, and they annually develop a plan for the utilization of pastures, according to the capacity of pasture plots and the number of livestock available [6]. Development of plans for the utilization and improvement of pastures based on maps is conducted on the basis of pasture monitoring, reflecting the current state of pastures. As a result of field surveys, it is necessary to obtain the following materials for each pasture plot:

- general information, location of the pasture area, climatic conditions, type of grazing livestock, terms of use, livestock buildings on the plot, land composition according to land explication;
- a map of pasture types and hayfields indicating vegetation, soils, relief features, and the nature of moisture;
- a map of the cultural and technical state of pastures (overrunning, overgrowth, hummockiness, productivity and seasonality of use);
- a map of measures for the improvement and rational utilization of pastures;
- information on the productivity of pastures and hayfields of direct and secondary use;
- characteristics of pastures water availability [5].

Currently, the country is in the development stage of agriculture digitalization; the Portal of Geoinformational and Climate Data of the Kyrgyz Republic has been created. The portal is a cartographic WEB-interface for access to spatial information on the territory of Kyrgyzstan with the ability to access extended information from existing databases and document repositories.

The Portal contains data from different areas of the republic's production complex.

The figure 1 reflects the spatial and attributive data of the pasture site location, contour, contour boundaries, altitude, productivity and land area. In particular, the figure quite clearly reflects unproductive pastures (marked in yellow) and pastures of the normal range (marked in pink) of the pasture area "Baytak-Ravat-Jakub".

![Pasture lands of Batken oblast](http://nsdi.kg/)

**Fig. 1. Pasture lands of Batken oblast**

On the figure 2 fragmentarily the pasture area "Baytak-Ravat-Jakub" characterizing winter pastures. The figure characterizes attributive data by location, contour numbers, area, season of
utilization, pasture productivity.

Winter pastures are marked by contour No. 2 with an area of 394 ha. The herbage consists of different vegetation and its included in the II class of foothill semi-desert pastures. They are represented by wormwood bushed ephemera, desert saltwort, wormwood-couch grass, semi-desert wormwood-ephemeral and wormwood-feather grass types of plants. The yield of pastures in the contour is 1.1 c/ha.

The figure 3 fragmentarily shows the pasture area "Baytak-Ravat-Jakub" characterizing the spring-autumn pastures. The figure characterizes attributive data by location, contour numbers, area, season of use, pasture productivity.

The area of spring-autumn pastures on contour 44 is 666 ha. The vegetation cover is diverse. These are ephemera, fescue and other herbs. The yield of pastures on contour 44 averages 1.5 c/ha.

Thus, the monitoring of pastures applying geoinformational technologies, the clarification and creation of cartographic digital material with the boundaries of pasture contours, the determination of productivity, geobotanical composition and evaluation of pastures condition will allow reliable planning of pastures utilization by the Batken Pastures Committee [8].
By applying the obtained data, it will be possible to solve the problem of designing pasture rotations. A plot of spring-autumn pastures of the “Baytak-Ravat-Jakub” with its attributive data was chosen as an object.

Pasture rotation schemes may differ depending on the natural features of the pasture area, the area and productivity of pastures, the type of herbage, the timing and intensity of its growth. Intra-season pasture rotations have been developed in the republic for summer and spring-autumn pastures.

In any case, to conduct the project activities it is necessary to have technical indicators with the definition of baseline indicators. These are the minimum threshold indicators that determine the rate of livestock load per hectare of pasture land per head, including the yield coefficient, the content of feed units in one centner of feed and the yield of dry mass eaten.

The pasture load is the number of animals per hectare of pasture land for the entire pasture period. The load of the conditional head on 1 ha of pasture is determined by the formula:

\[ L = \frac{Y}{F}, \]

it indicates:

- \( L \) - load on 1 ha of pastures, heads;
- \( Y \) - yield of fodder units, c/ha;
- \( F \) - the daily rate of consumed feed per conventional head, feed units (http://cbd.minjust.gov.kg/).

\[ L = \frac{1.5}{1.2} = 0.9 \]

Thus, on the studied contour No. 44, the load of the conditional head per 1 ha of pasture is 0.9 heads. To calculate the area for pasture turnover, the following data is required: the type and number of animals that are planned to be kept on pasture;
- the need for green feed of each animal according to zootechnical standards;
- indicative pasture use calendar (information on pasture type, timing and number of animal grazing cycles, green fodder yield and its distribution over grazing cycles during the pasture period);
- the number of required paddocks [10].

First, it is necessary to determine the area of one paddock of the next bleed. The area of 1 paddock is determined by the formula:

\[ S = \frac{N \times n \times D}{Y} \]  

\( S \) - paddock space area, ha;
\( N \) - number of grazing animals, heads;
\( n \) - daily norm of pasture feed per 1 head, kg;
\( D \) - grazing duration for 1 grazing cycle, days;
\( Y \) - estimated grazing area, ha.

\[ \frac{666 \times 7 \times 4}{666} = 28 \]

Thus, the area of one paddock of the next bleed is 10.5 ha.
According to the proposed formula, it is possible to determine the number of paddocks for the next bleed:
\[ Y \]

\[ N_p = \frac{666}{28} = 24 \]

Therefore, in the planned pasture rotation it is necessary to have 24 regular grazing paddocks, on a total space area of 666 ha.

The pasture rotation scheme and the justification of the extended pasture rotation scheme with the division of the pasture area into the next grazing paddocks are based on the above calculations. For spring-autumn pastures, the most acceptable and simplest basic scheme of pasture rotation for the conditions of the republic is a four-year four-field scheme.

In the first year of rotation, the approximate period of grazing in spring is from 10.04 to 10.06, and in autumn is from 15.09 to 15.11. It should be noted that the terms of utilization are quite arbitrary, and they are adjusted depending on the location of the pasture area.

According to the Pasture Committee of Batken city, the approximate period of grazing on spring pastures begins on April 1 and ends on June 1, and the autumn grazing begins on September 15 and ends on October 15. The most acceptable concept of pasture rotation for spring-autumn pastures is a four-year four-field, it is indicated in Table 5.

**Table 5. Pasture rotation scheme**

<table>
<thead>
<tr>
<th>Years of utilization</th>
<th>Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>First</td>
<td>In the spring, the first term, again in the autumn</td>
</tr>
<tr>
<td>Second</td>
<td>In the spring, the second term, again in the autumn</td>
</tr>
<tr>
<td>Third</td>
<td>In the autumn or repose</td>
</tr>
<tr>
<td>Fourth</td>
<td>In the spring, the third term</td>
</tr>
</tbody>
</table>

Source: The table was compiled by the authors based on recommendations for the rational use of pastures in Kyrgyzstan (Recommendations for the rational utilization of pastures in Kyrgyzstan, 1981).

Figures 4-7 show a detailed scheme of pasture rotation with the division of the pasture area into paddocks for the next grazing.
666 ha, second time grazing in autumn

<table>
<thead>
<tr>
<th>Paddock №1</th>
<th>Paddock №2</th>
<th>Paddock №3</th>
<th>Paddock №4</th>
<th>Paddock №5</th>
<th>Paddock №6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
</tr>
<tr>
<td>4 days of grazing</td>
<td>4 days of grazing</td>
<td>4 days of grazing</td>
<td>4 days of grazing</td>
<td>3 days of grazing</td>
<td>3 days of grazing</td>
</tr>
</tbody>
</table>

Fig. 4. 1st field, paddocks from 1 to 6

<table>
<thead>
<tr>
<th>Paddock №7</th>
<th>Paddock №8</th>
<th>Paddock №9</th>
<th>Paddock №10</th>
<th>Paddock №11</th>
<th>Paddock №12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
</tr>
<tr>
<td>3 days of grazing</td>
<td>4 days of grazing</td>
<td>5 days of grazing</td>
<td>2 days of grazing</td>
<td>2 days of grazing</td>
<td>5 days of grazing</td>
</tr>
</tbody>
</table>

666 ha, second time grazing in autumn

<table>
<thead>
<tr>
<th>Paddock №7</th>
<th>Paddock №8</th>
<th>Paddock №9</th>
<th>Paddock №10</th>
<th>Paddock №11</th>
<th>Paddock №12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
</tr>
<tr>
<td>3 days of grazing</td>
<td>3 days of grazing</td>
<td>2 days of grazing</td>
<td>2 days of grazing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5. 2nd field, paddocks from 7 to 12

<table>
<thead>
<tr>
<th>Paddock №13</th>
<th>Paddock №14</th>
<th>Paddock №15</th>
<th>Paddock №16</th>
<th>Paddock №17</th>
<th>Paddock №18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
</tr>
<tr>
<td>repose</td>
<td>repose</td>
<td>repose</td>
<td>repose</td>
<td>repose</td>
<td>repose</td>
</tr>
</tbody>
</table>

666 ha, restore in spring, grazing only in autumn

<table>
<thead>
<tr>
<th>Paddock №13</th>
<th>Paddock №14</th>
<th>Paddock №15</th>
<th>Paddock №16</th>
<th>Paddock №17</th>
<th>Paddock №18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
<td>Area—28 ha</td>
</tr>
<tr>
<td>6 days of grazing</td>
<td>6 days of grazing</td>
<td>6 days of grazing</td>
<td>6 days of grazing</td>
<td>6 days of grazing</td>
<td>6 days of grazing</td>
</tr>
</tbody>
</table>

Fig. 6. 3rd field, paddocks from 13 to 18
666 ha, grazing in spring, restore in the autumn

Fig. 7. 4th field, paddocks from 19 to 24
Source: Figures 4-7 designed by the authors

4. Discussion

The work of domestic scientists K.I. Isakova, T.A. Attokurova, K.D. Dzholdosheva, A. Kulataeva, A. Abdaimova, K. Abdymalikova, T.V. Semenova and others is devoted to the study of the pastures condition, their improvement and utilization.

Research work on the study of the condition and development of measures for the improvement, rational and efficient utilization of mountain pastures indicates that, despite the knowledge and the availability of scientific publications on these problems, the issues of conducting special field surveys have not been fully resolved. Methods of geobotanical survey in solving the issues of rational utilization of pastures require elaboration. We have proposed a modern approach to conducting a geobotanical survey of pastures applying geoinformational technologies.

The issues of rational utilization of pastures and the system of introducing pasture rotations are also considered by foreign scientists.

For example, Narbaev Sh.K. considers the creation of an innovative form of organizing the utilization of pastures through the Association of Pasture Users of Farms on the principles of voluntariness, payment for land utilization, self-financing and self-government of activities, land management of pasture lands in the Republic of Uzbekistan. This management form provides: granting the population the right to permanent utilization of pastures; eliminates land disputes in pasture utilization; releases the state budget from financing pasture land utilization; ensures the prevention and control of pasture degradation; stimulates the population for the sustainable utilization of pastures and their protection; transition from centralized state management level to the level of local governments [12].

The system of pastures proper utilization is pasture rotation - alternating over the years of grazing, mowing grass and taking care of the herbage. The pasture rotation system provides: driven grazing of livestock, fertilizing the herbage with fertilizers, mowing uneaten plants, combating weeds and poisonous plants, leaving the herbage with valuable forage grasses until the seeds shed, sowing seeds of legumes and grasses to strengthen this group of plants on pastures, delaying or removal of melt water [13].

According to the opinion of B. Taubaev, the basis of pasture conservation is pasture rotation as a system for utilizing pasture care aimed at maintaining and increasing their productivity. To improve pastures, pasture rotation should include activities of alternating grazing with haymaking [14].

Mustafaev B.A. believes that the system of pasture utilization and care within one year is called the annual turnover, and the change in use and care over the years is called pasture rotation. Further, the author writes that in pasture rotation, the main type of land use is considered to be the alternation of pasture utilization with haymaking or leaving it for seeding or oversowing grass, etc [15].

According to Tømmre R.I. grazing is not just a process similar to mowing, that is, cutting grass at a certain height, but is the set of relationships between pasture grass and its use by animals. Animals mow plants in a certain phase of growth and the same height, but they also trample it [16].

In the studies of Vauzen A. he showed that proper rotational grazing should not harm the herbage, but, on the contrary, increase its productivity. Despite the fact that as a result of
grazing, the density of the upper layer (0-5 cm) of the soil increases and its water permeability decreases, this does not adversely affect either the yield of grasses or the crops following it. Decrease in the yield of growing plants in the pasture occurs only with a strong compaction of the soil. According to his observations, the formation of grass of cultivated pastures is primarily influenced by the frequency and method of grazing. Further, he claims that in the rational utilization of pastures, the timing of the first grazing is essential. It should be carried out when the height of the grasses does not exceed 10 cm. In the second half of the summer, especially at the end of the growing season, should avoid the strong grazing, as they can significantly reduce the next year's harvest [17].

5. Conclusion

As a result of the study, we found out that the correct systematic utilization of pastures provides not only their qualitative condition at present, but also in the future. It is necessary to move from unsystematic free (grazing) to regulated utilization of pastures in the pasture rotation system with the allocation of paddocks for the next grazing. This will allow planning the placement of livestock on pastures, considering their actual yields, observing the normal load and frequency of grazing, utilizing pasture lands evenly and grazing livestock when fodder plants reach the optimal development phase.

Geoinformational technologies, remote sensing software of land, which are combined with ground-based survey methods, are becoming an effective tool for conducting geobotanical surveys and monitoring pastures in the context of digitalization. New technologies for digitalization, analysis, collection, storage, monitoring and processing of data should be introduced for that. This will make it possible to conduct a qualitative assessment of pastures condition, to predict their utilization based on the electronic maps and plans.

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