Problems of Efficient Use of Natural Pastures

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Abstract. The North-Eastern part of Russia is a large territory with a harsh climate. Here temperature range from -65 C to +35 C. Soil is cryosolic and pale-yellow. Native people living on that territory cultivate crops, breed horses, reindeers, and livestock animals. More than 90% of agriculturally used areas is a forage land. The article describes topical issues of range lands use – useless lands, areas with difficult access, the anthropogenic effect on range lands fertility. The evaluation method is recommended for research. Practical value is caused by the approbation of the evaluation method using modern geoinformation technologies. Also, the article shows the mathematical and economical model of forage lands use based on the method. The article concludes that modern information technologies contribute to an increase in forage lands use effectiveness.

1. Introduction

Land resources being the main factor of means production and spatial basis, they can be the major source of the wealth of nations. Harmonious and efficient use of land resources can be a basis for balanced sustainable social and economic national development. The development of agriculture is a priority direction of land resources use. Therefore, researches on land use in farm production are always relevant.

Agriculturally used areas structure in the Russian Federation and the Far East Federal district clearly illustrates land husbandry development (the share of tilled field is higher than any other land) while in the Republic of Sakha (Yakutia) forage lands occupy 90% of areas. This feature of the Republic’s agricultural lands is mainly caused by natural and climatic conditions and agriculture orientation on cattle breeding (livestock breeding, horse herding) (fig.1). Crop farming is mostly aimed at cattle forage base provision.
2. Background
Over the past two decades, in the period of reform, the issues of range lands use have been accumulated – cattle clustering near the settlements led to the lands depletion, and abandoning of areas with difficult access; lack of range lands in densely-populated municipal settlements. Pasture areas are in a little demand among the population. Why? The pasture season milking 70 % of milk, and young cattle growing fat. The first reason – livestock and horses graze not only in the range lands but also in the forest area. The second reason – traditional herding of livestock after haymaking. The third reason – the housing season lasts about 240 days, so the meadow plot is valuable than grazing lands. However, the problem of pasture degradation becomes acute because of population and livestock deconcentration across the territory in summer. Dairy cows have to walk tens of kilometers in search of soilage. It results in a lack of cows’ milk. For instance, if a cow walks ten kilometers to reach a pasture area per day, the peasant will not milk two-liter of milk per day, it is 120 liters of milk for the pasture period (two liters * 60 days). If the peasant gets 45 rubles, losses will be 5400 rubles for a cow. At present, in the Republic, the mid-year milk yield of a cow is 21250 kg milk, but it could have been more on 120 liters. The article proposes solutions to the issues.

3. Theoretical part
Assessment of land quality for natural forage lands requires a new method. Researchers [2] propose to assess the quality of the lands by grain equivalent given the technologies of their use. At the same time, it is recommended to leave only those land plots that hay yield is more than 10.4 c/ha. To determine the grain equivalent for haymaking plots, the crop productivity of improved haymaking grasses, harvesting costs, comparable prices, and a cost standard equal to the cost of 20 kg of grain is taken into account. When determining the grain equivalent of pasture land, the consumed dry mass yield, the daily intake of pasture forage per standard herd, and the day's pay of two neatherds are taken into account. It recommends considering actual yield based on geobotanical surveys when there is no information base.

Agriculture of the Republic of Sakha (Yakutia) has a livestock sector, and natural forage land is the main food base for farm animals. According to the system of agriculture [5,6,7], cattle are kept in stable pastures with a predominance of free grazing during the pasture period and year-round free grazing of herd horses. The value of forage land in the Republic is quite high because the high-quality land area is limited. All natural forage lands of the Republic are located mainly on three types of landscapes: floodplains, bottomlands, and alas (fig.2,3,4).
Forage lands potential assessment method has the following stages:
1st stage – clarification of assessed territory hydrography and forage lands squares;
2nd stage – detection of land drop-out;
3rd stage – assessment of land foulness;
4th stage – assessment of land potential
5th stage – decision to the land further use.

In the first stage, it is necessary to determine the researched territory hydrography in the electronic map to find a quarter of forage land landscape type, and according to that to find a required value. Electronic maps of the geoinformation system could serve as information sources. For example, public cadastral map, GIS-Panorama program map, agricultural land integral federal informational system (UFIS AUA) are available.

It is possible to detect lands drop-out by means of Earth's remote sensing satellite images, aerial photographs, or unnamed aerial vehicles use (UAH). The use of the UAH at the location is the most economical option.

Specialist experts assess land foulness at the locations. Assessment is performed on the predefined parameters: the existence of weedages on the land plot, area of their coverage. In parallel, experts can determine the destroyed lands. It can be made remotely without going to the land if there is high-quality photography with resolution down to 1 m.
Assessment of land potential ($P_{\text{пастб}}$), i.e. we offer to assess the possible fodder yield from the land plot using the formula:

$$P_{\text{пастб}} = S \times Y \times N \times K_v \times K_z \times K_\text{фол}$$  \hspace{1cm} (1)

where:
- $S$ - land plot area, ha
- $Y$ - crop productivity, dt/ha
- $N$ - food value of 1 kg feed stuff, feed unit
- $K_v$ - drop-out coefficient
- $K_z$ - foul coefficient

Decision about further using of forage land depends on the potential assessment. Land conservation can be a possible decision for restoration.

4. Practical Part
When determining of forage land potential, an appraisal was conducted using the materials of Central Yakutia Megino-Kangalassky district. In the territory of research land’s hydrography was refined (tab.1), on the basis of which all forage lands were classified by type: alas – 51225,4 ha, bottomland – 38576,0 ha, floodplain – 10537,6 ha.

| Lakes’ names | Nasleg       | Square, ha |
|--------------|--------------|------------|
| Keyu with adjacent lakes: Solobut, Khotu-Urekh, Mayagan-Urekh | Zhabyl'skiy | 1657,0     |
| Suola        | Yotungolinskii | 171,3      |
|              | Altanskiy    | 67,4       |
|              | Bedeminskiy  | 5329,0     |
|              | Buteydyakhskiy | 277,9     |
|              | Zhankhidinskiy | 3136,0   |
|              | Mel' dzhekhsinskiy | 563,6   |
|              | Ternyshkiy  | 295,1      |
| Tiere        | Morukskiy    | 67,4       |
| Myla         | Khorobutskiy | 6394,0     |
| Khompo       | Batarinskiy  | 4319,0     |
|              | Nakharinskiy | 1024       |
|              | Taragas'kiy | 2116       |
|              | Khoranskiy   | 1672,8     |
| Tamma        | Nakharinskiy1 | 38 576,0  |
| Total        | Tyllymnisky1  | 38 576,0   |

Table 1. Hydrography of district territory.
Forage lands drop-out and foulness depend on the land plots location. For example, the most digressive lands are near the rural agglomerations. (fig.5)

![Satellite image fragment of rural agglomeration and located near agriculturally used areas.](image)

Rural conglomerations “Tyungyulyu-Tumul-Tarat” has three settlements of the same names, which place close to one other within a radius from 1.5 km to 3 km. Here about 3200 people live, and a large number of cattle are concentrated. In the Republic of Sakha (Yakutia) pasture season lasts 120-140 days depending on weather conditions. The issue is that the cattle graze near the settlements, this is creating a zoogenic and anthropogenic burden on nearby forage lands. Experts assessed the lands drop-out and foulness within a radius 5 km from the conglomerations taking into account the coefficient of destructiveness 0.6 and impurities 0.4, the potential of “Tyungyulyu” alas was 1258 feed units. The total sum of forage lands in the Megino-Kangalasskiy district is 54,300 ha, 40 % of which is degraded, and the herbage produce is 1.5-2.3 t/ha in maximum yield 27 t/ha. For aftergrowth in hayland, the herbage produce is taken as 10 dt/ha. The stock of pasture forage is 1255416 t taking into account of plant formation use coefficient 0.6-0.7 physical stock is 878791 t. Feed shortage – 121878 t. The proposed potential calculation method of forage lands by type of landscapes allows to plan an accurate feed input. The cattle aftergrass need reaches 1,000,669 dt, as calculated for the total ulus indicative livestock number (24,288 animals), with summer consumption rate 41.1 dt. The lack of pasture feed -121878 c. The proposed method for calculating the pasture feed potential by landscape types allows you to plan the feed input more accurately.

Planning of agricultural areas use can resolve the feed income issue for livestock and horses. To determine the optimum size of feed production from forage lands and croplands, we have established an economic and mathematic model based on the last researches [66], which has a further logical sequence: set a goal, determine model tasks, determine model restrictions. Objective function has the following form:

\[
Z(x) = x_1 + 220x_2 + 220x_3 + 300x_4 + 180x_5 + 180x_6 + 150x_7 + 8x_8 + 8x_9 + 13x_{10} + 5x_{11} + 10x_{12} + 5x_{13} + 40x_{14} + 20x_{15}
\]

The land plots were taken as a variables, they were recommended by the crop rotation zonal science: pure fallow, oats for silage, oats for haylage, sunflower, oats, pea and oat mixture; land for sowing perennial grasses; land for haymaking by landscape type (alasny, floodplain, bottomland); land for pasture by type (alas, floodplain, bottomland, forest, aftergrowth pasture lands). The electronic GIS-Panorama map was used to determine the land plots square.

Implementation of a mathematical problem numerical model on the example of "Megino-Kangalasskiy district "using the" Solver " procedure in Excel. The model can determine the optimal feed produce in other municipal areas as well [8, C. 116].
5. Proposals
Earth's remote sensing should be used for range lands use monitoring and assessment. This will certainly increase the land use efficiency because it will timely identify unused or too intensively used land plots, which leads to the range lands degradation. Effective management decisions will help to increase agriculture efficiency as a whole.

6. Conclusion
Proper organization of natural forage lands use, working conditions improvement of rural laborers should become an impetus for increasing the land resources use efficiency in agriculture for region sustainable development. The peoples of North-East Asia have accumulated invaluable experience of survival in harsh climatic conditions, overcoming difficulties to engage in agriculture. Today, with the help of vehicles, innovative technologies, and infrastructure, it is possible to develop this territory and obtain agricultural production to ensure food safety.

7. References
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