Methods for reducing erosion on degraded pastures of slope lands of the RSO-Alania

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Abstract. A wide variety of vegetation in mountain pastures is a valuable food base for animals. In order to preserve various plant species, quality and quantitative composition are systematically monitored. However, due to erosion processes on mountain slopes, a number of valuable forage plants are disappearing and a number of measures are being carried out to restore disturbed lands aimed at reducing the adverse factors of natural feed sources. On pastures of sloping lands that have steep slopes, vegetation is better preserved, thanks to the corrals located around the camp or across the slope. In the course of research, the areas of degraded pastures and the consequences of erosion processes were studied, where the composition of the plant community was determined. Crops with high accumulating properties were sown in degraded areas to reduce toxic elements in the soil.

Keywords: degradation of pastures, erosion, plant communities, plant community, slope of the land

1. Introduction.

On the pastures of the slope lands, a huge number of cattle, sheep, goats, and horses are produced. The lack of constant monitoring and irrational use of land provokes the emergence of erosion processes. Erosion processes significantly affect not only the environment, but also the economy. To solve the above problems, it is necessary to identify as clearly as possible the land that has been eroded and, accordingly, to assess the degree of erudition of the soil cover. This is necessary to create certain measures to combat erosion processes and increase soil fertility.

These findings can also be used to fully justify the use of pastures. But to date, there is no complete assessment of the erudition of the soil cover of slope lands. The extent of soil erosion can be estimated using the mapping method. However, it is not always possible to apply methods for assessing the erudition of the soil cover of flat territories to the soil cover of pastures on slope lands. For example, since Alpine and subalpine horizons have a high productivity of the soil profile. Territories with low vegetation cover are practically not exposed to erosion processes. They also perform an accumulative
function. To implement agricultural practices that improve destructive meadows, it is necessary to study their condition, assess plant communities, and find out the causes of degradation [1,7].

Thanks to research, it was possible to determine that if pastures of slope lands are deprived of vegetation, this leads to even greater soil erosion, as a result of which these areas can be called highly eroded. Some scientists believe that on pastures of slope lands where there is no vegetation, the soil cover is washed away to the very bedrock [2, 3, 8].

The full use of grass for paddock grazing increases to 60-85%. Paddock grazing helps to normalize the load of animals, which prevents the appearance of soil erosion and destruction of vegetation. On pastures of sloping lands that have steep slopes, vegetation is better preserved, thanks to the corrals located around the camp or across the slope. With the end of winter, vegetation intended for grazing appears in the lower part of the southern slopes, so grazing begins from below. With such grazing, cattle graze across the slope, the strength of vegetation is preserved, productivity increases, and agricultural techniques become more effective, and there is also a noticeable decrease in water erosion processes. To preserve vegetation and reduce erosion processes to a minimum, it is necessary to identify the permissible load and duration of grazing animals on pastures of slope lands. After heavy precipitation, the soil becomes sufficiently moist and more exposed to erosion, subsequently trampled by grazing cattle.

According to the research of K. Kh. Byasov [8], the increase in slope steepness for every 5° the duration of the pasture period should be reduced by a factor of 0.1, which ensures the same safety of the sod on slopes of different steepness. Therefore, a generally accepted formula is used to calculate the permissible load of animals per unit area of pasture. In addition to these parameters, soil conditions must also be taken into account when determining the load. With a decrease in soil capacity, the load should be reduced so that the natural physical, chemical, water – air properties of the soil are not disturbed and do not stimulate erosion.

To preserve the turf and prevent surface runoff, it is important to properly distribute the animals along the steepness and orientation of the slopes. In the RSO-Alania, the process of plowing slopes in the foothills and mountain areas is actively underway, taking into account the high dissection of the terrain [9-11].

Therefore, there is a problem of restoring degraded pastures by studying erosion processes in detail and developing methods for their reduction.

2. Methods and materials

To assess the erudition of mountain areas, the designed cover of the soil cover was taken into account (table 1):

1) if it is more than 90%, they can be evaluated as unwashed,
2) 90 - 80%– slightly washed,
3) 50 - 70% -medium washed,
4) 40 - 50% strongly washed

| Degree of erosion | Total area of paths per unit area, % | The decrease in yield of green mass, % |
|------------------|-------------------------------------|----------------------------------------|
| Slight           | up to 25                             | up to 15                               |
| Average          | 25-50                                | 15-30                                  |
| Strong           | 50-75                                | 30-60                                  |
| Very strong      | >75                                  | >60                                    |

Additional methods for assessing soil erosion: humus content, NPC, and other indicators. The degree of erosion of the pasture soil cover can be determined by the tone of the photo image, structure, and other data of K. Byasov. The disadvantage of this method of erosion is the determination of only strongly convex areas [8, 12].
The development of measures to combat erosion processes is primarily necessary to improve the condition of pastures of slope lands and their rational use. At the same time, the fencing of pastures, the corral system of pasture, the introduction of fencing of pastures with pasture rest is of great importance. Improving vegetation cover, on the one hand, reduces erosion processes, on the other hand, contributes to increasing the productivity of livestock kept on these lands. The study of self-developing ecosystems is of interest from the point of view of developing methods for diagnostics and forecasting the dynamics of optimization of their functions [12-14].

Technogenic ecosystems are characterized by three stages of development of soil-biological processes: initial, dynamic, and metastable. Plant groups of the following stages of succession are distinguished on embryos: pioneer grouping on the initial embryosem; simple plant grouping on the organo-accumulative embryosem; complex plant grouping on the sod embryosem; established closed community on the humus-accumulative embryosem.

3. Results and discussion
As our research has shown in experiments conducted at the research Institute of mountain and foothill agriculture of the VNC RAS, mountain pastures are well developed with year-round herd keeping of meat-producing horses.

Numerous studies have found that reducing the load of livestock or excluding it for 2-3 years in areas with pathways contributes to the appearance of sod and the cessation of erosion processes. (table 2).

Table 2. The effect of the structure of sown area on the productivity of arable land and the erosion of soils in the foothill and mountain areas

| Experience option | Projective covering of the soil surface by plants, % | The erosion of the soil, t/ha |
|-------------------|------------------------------------------------------|-----------------------------|
| Normal use        | 11                                                   | 226                         |
| Rest 2 years      | 22                                                   | 230                         |
| Rest 3 years      | 35                                                   | 116                         |
| Rest 3 years + planting herbs | 55                                           | 96                          |
| Control + planting herbs | 11                                        | 240                         |
| Rest 2 years + N60-90 P 60-80 | 28-32                                    | 122                         |
| Rest 3 years +N60-90P 60-80 | 25-28                                   | 122                         |
| Control +N60-90P 60-80 | 16-18                                      | 225                         |
| Rest 2 years + planting herbs +N60-90P 60-80 | 68-75                                   | 16-22                       |
| 3 years + planting +N60-90 P 60-80  | 80-84                                     | 9-13                        |

A plant community is a system-forming structure, the type of which is formed in specific external conditions and is determined by the ability of the soil cover of a particular habitat to maintain functioning, as well as the phytocenotic features of plants that form it and the ecological properties of the habitat. Since biota functions both as a factor and as a consequence of soil formation, it always develops along with the soil. Floristic composition and species saturation are important features of phytocenoses, which are determined by the arrival of plant germs from outside and the ability of species to grow in certain environmental conditions.

Species that are part of a community are not equal. The appearance of the community and the amount and composition of the annual plant mass produced by the community depend on the dominant species. Pioneer plant groups of initial embryosemes are represented chaotically by scattered
single species with predominance of one- and two-year-old ruderal species, with a predominance of monocarpic herbaceous vegetatively immobile species. Initial embryosems are characterized by the absence of any organogenic horizons and correspond to the initial stage of development of a technogenic ecosystem, the share of its area in the southern part of the forest-steppe zone is 18.2%.

The formation of litter is associated with an increase in the floristic composition and growth of species. With optimal numbers of hydrothermal conditions, the absence of steeply sloping surfaces, and sufficient nitrogen enrichment of the substrate, the transition from simple plant groups to complex cereal-legume and grass-mixed communities occurs. The development of underground shoots of vegetative mobile species of communities contributes to their intensive mobile growth, and due to the abundant root system of dominant loose and dense cereals, rhizomatous perennials, the organogenic part of the soil profile becomes more complex and another horizon—sod is formed. The duration of the dynamic development stage is difficult to determine exactly. The largest part (58.5%) is at the initial stage of dynamic development, or at the initial (initial) stage. This is due to the presence of an environmentally negative factor (high content of stony fraction, sloping surface, lack of moisture, low water-holding capacity of rock dumps, low content of physical clay, etc.) or a set of these factors that will limit the development of soil-forming and phytocenotic processes.

The initial and organo-accumulative embryos that have been preserved on the old dumps up to the present time will remain unchanged indefinitely. Their restoration under the influence of natural processes is impossible without forced reclamation. If there are no limiting factors, the development of the ecosystem under the influence of natural factors within 10-20 years passes into a metastable stage, which is diagnosed by the appearance of embryos in the profile.

Restoration of the soil cover and its purification from various chemicals is an urgent task today. One of the main methods of soil cover cleaning is phytoremediation—a set of measures to restore soil cover by cultivating plants that have a highly absorbing function (in particular, legumes). This method is highly effective in solving this problem. This method can be used to clean the soil cover from pesticides and various metals. There are three main methods of cleaning polluted land using plants: phytoextraction, rhizofiltration, and phytodegradation [9-14].

Phytoextraction is used to restore mainly soil cover and reservoirs that contain various heavy metals and radioactive substances. This occurs through the absorption of pollutants by the root system. The efficiency of phytoextraction is determined by the bioaccumulation coefficient, which is equal to the ratio of the concentration of metals in the vegetation of translocation processes in plants to their concentration in the soil or in polluted water. Rhizofiltration is a method in which various plants form a microenvironment around the root system.

The method of photodegradation (phytotransformation) is based on the ability of soil microflora plants to perform together enzymatic cleavage of organic toxicants of the soil cover. The results of numerous experiments conducted in mountain and foothill conditions have shown that with the help of accumulating plants, soil fertility is restored, and toxic elements are reduced by 3-4 times.

4. Conclusions.

It is established that the largest part of the studied territory is represented by the dynamic phase of ecosystem development (the area share is 71%). A diagnostic sign of the syngenetic succession transition is the formation of an accumulative horizon on the surface of the embryos of the litter, the appearance of which has a number of important consequences: hydrothermal gradients are softened, and additional moisture retention occurs. It was determined that complex communities with sod embryosem are formed by 10 years only on a leveled and slightly inclined surface, with their subsequent transition to the metastable stage of the humus-accumulative horizon due to the activation of microbiological activity.

Accumulator plants can restore soil fertility and reduce the amount of toxic substances in the study area.
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