Sustainable Management of Biodiversity, South Caucasus

Guidelines for Development and Implementation of Sustainable Management Plans for Pastures and Grasslands

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Ministry of Territorial Administration and Emergency Situations

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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Sustainable Management of Biodiversity Program, South Caucasus: Guidelines for Development and Implementation of Sustainable Management Plans for Pastures and Grasslands / G. Tovmasyan, Yerevan "TASK" LLC, 2015. – 60 pages.

"Guidelines for Development and Implementation of Sustainable Management Plans for Pastures and Grasslands"

The main goal of the guidelines is the organization of development of sustainable management procedures and programs for natural pastures of Armenia, based on justified scientific approaches. The guidelines identify measures and operational modes for management of pastures and grasslands. According to the methodology described in the guidelines, the development of programs on sustainable management of pastures and organization of effective management thereof shall create opportunities to further protect and restore the pastures, make them more effective, as well as contribute essentially to the conservation of the environment, reduction of risks that contribute to vulnerability of biodiversity, natural development of ecosystems, improvements in the system of feed production and increase in production from cattle husbandry.

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ISBN 978-9939-1-0239-9

CONTENT

1.0 INTRODUCTION

Production of high quality feed and sufficient feeding stock are the key prerequisites to successful cattle husbandry and agricultural production, in general. The role of natural feeding areas (e.g. grasslands and pastures), in particular pastures and pasture feed (pasture grass), is highly emphasized in developing the feeding stock. Natural feeding ensures over 60% of the feeding ration and about 70-75% of digestible proteins. It increases the overall productivity, in particular, milk yield and milk quality of cattle, during the grazing period. Most of the livestock products (around 60-70% of annually produced milk) are obtained during the grazing period. This is explained mainly by the nutrition value and digestibility and by the rich quantity of vitamins and minerals in the grass.

The role and significance of pastures and natural feeding grows, due to prolonged grazing periods, when sector related costs drastically drop and the productivity rises, thus ensuring the increase of income. That growth is guaranteed by appropriate organization of the grazing period and efficient pasture use to ensure higher productivity indicators, which has now, more than ever, a pressing issue.

The current economic conditions and setbacks in production of natural feed in the country make the production of quality feed a serious issue for the sector of livestock. Most of forage (around 75-80%, the grass and hay in total), required annually for separate and collective cattle breeding farms, is obtained from natural feeding areas, which become even more important for winter stock development.

Despite this significance of natural feeding areas, their bio-ecological conditions and efficiency have significantly worsened in the country over the recent years and are far from being satisfactory, not because of natural-historical, but rather economic-historical (anthropogenic) reasons, in particular impromptu pasture management, i.e. unlimited, irregular and careless uses, as well as lack of improvement measures necessary for preservation of the vegetation cover. This seems to be a key reason for current pasture degradation and erosion aggravation in all natural-historical zones of Armenia, which, if further persisting, can negatively affect the solution of the issues related to provision of forage and overall livestock productivity, thus causing serious environmental problems, often with irreversible consequences. All these will endanger the overall biodiversity and sustainable development of natural ecosystems, contributing to the reduction in absorption of carbon compounds and to development of desertification processes, which have become a world-wide issue in the current context of climate change.

For this very reason, today it is of utmost importance to develop and sustainably implement appropriate management systems for community pastures, which will allow addressing not only the issues of preservation and restoration of natural feeding areas, but also significantly contributing to solving feed security issues and protecting of environment.

1.1. OBJECTIVE OF THE GUIDELINES

The Republic of Armenia is a mountainous country with altitudinal zoning of lands and plants, and due to specific features of local natural-historical conditions, it is rich in diverse bioclimatic conditions, which, in their turn, create grounds for the development of quite rich and broad-ranging vegetation. Natural feeding areas constitute around 59% of agricultural land plots, located in Armenia. Pastures, prevailing among these areas, are a vital source for cattle breeding and a valuable biodiversity resource. Owing to the availability of spacious mountainous feeding lands, livestock has long been one of the most important

branches of agriculture in the Republic of Armenia.

Under current economic situation, establishment of the feeding stock is one of the most pressing issues in the effort to create enabling conditions for the development of livestock breeding in private farming and collective cattle breeding economies. The issue of providing high quality indoor maintenance and summer grazing has long been critical in the country. In order to ensure successful solution to this issue, it is necessary to implement a scientifically substantiated and balanced policy on natural feeding area development, along with the progress in field production of forage, which will help secure guarantees for increasing chances of efficient use, preservation and reproduction of natural feeding resources.

In order to make the right decisions on sustainable management and efficient use of natural feeding areas, it is crucial to have knowledge on the baseline conditions and efficient management of pastures and grasslands. Examination of natural feeding areas is of primary importance, which will explicate the condition of vegetation cover, the distribution of plant families in the botanical composition, their relationships and possibilities to grow, develop and reproduce. This is what lies behind the possibilities of the overall efficiency and use of natural pastures. Analysis of conditions of feeding areas is of utmost importance, as it shall clarify the state of vegetation cover and the place, distribution of botanical families, their relationships, chances for growth, development and reproduction, which account for the overall efficiency and use of pastures.

Awareness and knowledge on productive and bioecological characteristics of the plants that grow in natural feeding areas are the bases of efficient use of natural feeding areas and development and implementation of sustainable management functions.

This guidelines aims at developing regulations and a program for natural feeding areas' sustainable management, on the grounds of well-defined scientific approaches. The guidelines present the measures and practices required for the management of pastures and grasslands, where both international and local experiences and respective functions serve as a foundation for the development methodology and implementation of the above-mentioned measures and practices. Development of sustainable management regulations is based on the specifics and methodology of pasture monitoring and management systems in the Republic of Armenia, as well as on the procedures defined in respective decisions, made by the Government of Armenia on sustainable pasture management in the country (28.10.2010, N 1477-N and 14.04.2011, N 389-N).

The testing of the guidelines has been implemented in the framework of cooperation between the GIZ "Sustainable Management of Biodiversity in South Caucasus" Program and Strategic Development Agency NGO "Developing Animal Breeding in Syunik Marz" Project, financed by Swiss Development Cooperation.

Development of a sustainable pasture management program and organization of efficient uses, in accordance with the methodology described in this manual, will create opportunities for solving the issues of preservation, restoration and efficiency of natural feeding areas, and significantly contribute to the protection of environment, reduction of risks to biodiversity, as well as to the improvement of feed production systems and increase of livestock feed production volumes.

2.0

DESCRIPTION OF NATURAL FEEDING AREAS, BIOECOLOGICAL CHARACTERISTICS OF VEGETATION AND BOTANICAL-ECONOMIC GROUPS

Natural feeding areas are those plant-covered areas of nature, which are mostly covered with perennial plants, bushes or suffrutescent vegetation. The latter are used as sources of livestock feeding.

Natural feeding areas are divided into two main types, based on their use purposes and significance:

- pastures
- grasslands

In natural feeding areas, the potential and effective methods (pasture, grasslands) of using the vegetation cover are conditioned by several of their own features. Areas covered mostly with low-stem plants are used as pastures, where the main leafy mass of developing plants is concentrated on the stem base. Those feeding areas that mostly contain high-stem, even-leaf plants, thus forming large vegetative mass, are mainly used as grasslands (for haymaking).

2.1. FEEDING AREAS AS NATURAL RESOURCE AND PRODUCTION MEANS

A pasture is an agricultural area covered with natural vegetation and used for organizing the pasture (grazing) period of agricultural animals, as well as for other purposes (hunting, bee keeping, collection of medicinal herbs and edible vegetables, tourism and leisure).

Natural grassland is a meadow, typically covered with perennial, high-stem, moderately hygrophilous plants, used principally in the manner of haymaking for the purpose of collecting forage, necessary for indoor maintenance of livestock.

Natural pastures and grasslands are the most important components of natural eco-systems and as such, play a rather big and crucial role both in addressing the issues of feeding and in terms of existence and sustainable development of biodiversity in the environment as a whole.

This is an environment, where over the course of evolution, for ages, key representatives of flora and fauna have been ensuring their normal, equal growth and development. They have also been serving as primary genetic resources both for crops and for organizing and developing further selective breeding of certain domestic animals. Owing to that fact, the issue of using and preserving natural feeding areas, apart from their economic significance, may also be of crucial environmental impact.

Apart from the planned measures, a number of other natural factors, such as soil fertility and soil humidity, bioclimatic conditions and vegetation period, level of vegetation cover, its botanical composition, the landscape factors, altitude, etc., underlie sustainable and efficient management of natural pastures and grasslands.

All the aforementioned factors create conditions and possibilities in the environment for forming specific plant habitats and the vegetation cover thereof.

In natural conditions, the coexistence of pastures and

grasslands is mostly based on perennial herbs, bushes and suffrutescent vegetation (around 85-90%) of plant families with various botanical and biological features. Formation of their above-ground vegetation mass (stems, leaves) takes place during the entire vegetation period except for ephemerals (having short life cycle) and ephemeroids, which temporarily terminate their growth and development during summer depression (the low water period).

Those species of plants that more effectively use the ecological conditions of environment (light, water, heat, nutrients and carbon-dioxide), achieve high-level adaptability during evolution, win dominant positions and make larger above-ground mass from other components of pasture vegetation cover.

In general, there is an interconnection and interference among plants and the environment. In the wild plants find respective conditions for their development, based on which they develop cenoses with certain distribution areal and directly influence the habitat, changing the soil structure, quantity of nutritious elements, water and air regimes, etc.

Knowledge of the interconnection among certain species of perennial herbs and plant cenoses and their impact on the conditions of the habitat makes it possible to arrange the use and management of feeding areas more effectively, while ensuring further regular reproduction and sustainable development of the existing vegetation cover and the biocenosis that it contains.

2.2. BIOECOLOGICAL CHARACTERISTICS OF PERENNIAL PLANTS

Natural feeding areas of Armenia are rich in various plant species and vegetation, but their botanical-economic conditions are far from being satisfactory, while the efficiency of vegetation cover is hardly representing the real biological capacity. Therefore, geo-biological mapping and monitoring activity and the necessary improvement measures, coupled with the application of sustainable management systems, will create opportunities for increasing the vegetation cover efficiency, restoring the disturbed correlation of valuable economic elements of the vegetative cover, which is very important for preserving the biodiversity, sustainable management, efficient use of cenoses and advancements in cattle breeding.

Given the landscape, the natural feeding areas of Armenia formed and stretched along 6 different natural zones present in vertical zoning, where out of 3500 plant species around 1800 are meadow plants. Many of their species are highly valuable as feed, due to their bio-morphological specifics and biochemical compositions. Yet, they contain a range of non-esculent or low edibility species of meadow weeds (~367 species).

According to the RA National Atlas (2007), there are 10 landscape zones and intrazone ecosystems in Armenia:

- Foothill semideserts – 300-500 m.a.s.l.
- Mountain-valley semideserts – 500-1000 m.a.s.l.
- Low and mid mountain forest shelter belt – 400-1000; 1900-2100 m.a.s.l.
- Lowland, dry steppes – 1000-1600 m.a.s.l.
- Low and mid mountain forests – 800-2300 m.a.s.l.
- Mid mountain steppes – 1400-2300 m.a.s.l.
- Mid mountain meadow steppes – 2200-2600 m.a.s.l.
- Highland subalpine – 2400-2800 m.a.s.l.
- Highland alpine – 2800-3400 m.a.s.l.
- Snow-covered highlands – 3300-3400 m.a.s.l.

Vegetation cover of natural grasslands mainly consists of plants regrowing in a vegetative manner (non-gender). However, it has to be noted, that preservation of species' composition and legacy of genetic resources requires formation of reproductive organs and reproduction in seeds (gonial). The latter is a very important issue that has to be considered in defining management (utilization) procedures and elaborating pasture and grassland rotation plans.

In prolonged vegetative restoration the yield of a feeding area drops, because the grasses age and degrade. Based on biological features, perennial plants are of annual or multi-annual uses, depending on options of their use.

Perennials may grow and reproduce again after uses (mowing or grazing). Regrown green mass is called tomillares, and this biological capacity is called tillering. Given the tillering feature of perennial plants, feeding areas of grasslands may be used twice, and the pastures – multiple times. The latter is an important fact to be considered in defining alternate grazing rotation during the elaboration of pasture management plants.

Tillering and regrowth features of plants are biological features, yet they are largely conditioned by location of the plants and depend on the level of nutrient supply, and on

the periods of use. Grasses are more prone to regrowth and tillering when used at early development stages. Because of this, when defining plot rotation grazing in multiple-use pastures, the terms and duration of grazing should be defined for management units or confined paddocks to ensure the pasture plants accumulate reserve nutrients, which is the key guarantee for the survival of species and possibly the regrowth potential.

Regrowth and steady development of perennial plants is conditioned by their use of reserved (accumulated) nutrients, which store in vegetative organs or their modifications (root, rhizome, stem, bulb, bushing nodes, etc.) in the form of proteins, carbohydrates, fats and other compounds.

After the vegetation cover is used (grazing, mowing), most of the plants lose their green organs of synthesis (the stem and leaves); partial or complete lack of the process of photosynthesis makes the regrowth and maturing of new offshoots impossible. Therefore, to regulate this issue, all perennial plants use all of the nutrients they stored in their storage organs in advance. The nutrients are accumulated over the entire course of vegetation, which ensures sustainable winter maintenance and spring regrowth of the plants. To ensure a normal course of this extremely important process, we should focus on determining acceptable schedules for early spring pasture uses, duration of grazing in the management units, reasonable termination periods of late autumn grazing, as we develop efficient use regulations in the management plans.

The development process of perennial plants during the vegetation is rather diverse. Depending on their ripening or maturity periods, they are classified into four groups:

1. Super-early season – short-life perennial ephemeroids that flower and reproduce in early spring.
2. Early-season – flower and reproduce in late spring or early summer.
3. Mid-season – flower and reproduce during the entire summer (mostly moderately hydrophilous plants).
4. Late-season – flower and reproduce in summer (mainly drought-tolerant/xerophytes).

In the grazing season the differences in plant development periods allow defining efficient use periods for determining alternate grazing scheme during the elaboration of management plans.

Efficient use of natural feeding areas requires knowledge of bio-ecological features of a wide-range of plants in the vegetation cover, which are used as a basis for proving economic value of certain species as feeding plants and the ways and procedure for efficient use of a feeding area.

2.3. BIOCHEMICAL COMPOSITION AND ASSESSMENT OF FEEDING PLANTS

The edibility value of feeding plants is determined by their nutritional capacity, edibility and digestibility for animals.

The nutrition has to do with biochemical composition and development stage of the plant. Water is the main constituent of the biochemical composition of pasture grass, accounting for 75-90 %, and 10-25 % is the dry matter.

Dry matter consists of organic and mineral compounds. Organic compounds (key nutrients) consist of nitric and non-nitric compounds. The most important of all nitric compounds is raw protein – one of the key indicators of nutritional value of pasture plants and grasses. The most important and nutritional part of raw protein is the vegetable protein, which cannot be replaced by any other organic substance in terms of its significance and role. Protein content varies in plants, depending also on the biological and botanical properties of the plants. Meadow grass and pasture plants contain around 8-12% protein, mainly because of the botanical composition of the vegetation cover and its development stages. Legumes (Fabaceae) have the highest protein content, comprising in average 14-16% (dry matter), while true grass species (Poaceae) contain an average of 9-10%.

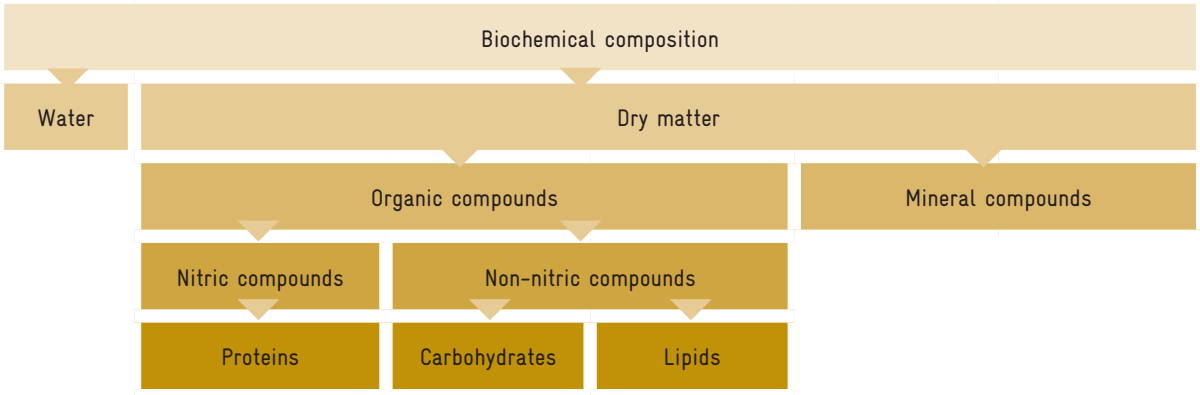


Figure 1: Biochemical composition of feeding plants

Non-nitric compounds can be found in plants in significantly higher quantities than proteins. These compounds have the form of carbohydrates and fats. Starch and sugars are the most important carbohydrates, as they indicate the feeding value. Carbohydrates are the main source of heat and muscle energy for the cattle. From all complex carbohydrates, plants are high in fiber and the development stage of the plant determines its fiber content. At early development stages, plants contain less fiber with higher digestibility. As the plant age advances, the quantity of fiber increases in the plant favoring to the roughening of plant, which results in reduced plant edibility and digestibility.
Animals digest fibers with difficulty, and high fiber content reduces the nutrition value of the forage. The content of fiber in plants is equally important as it is necessary for appropriate functioning of the digestive system of animals.

Fats play a crucial role in the feeding process as they supply the required energy and participate in the fat generation process. Green matter is not high in fat, as it comprises only up to 0.1% – 0.5%.

As a rule, nutrients (proteins, carbohydrates, lipids, vitamins and mineral salts) reach their highest composition at relatively early phases of plant development, before the formation of reproductive organs. At later development stages, reduction of nutrients in the green mass (leaves, stems) results in consumption aimed at formation of reproductive organs. During this period, the content of fiber increases drastically in the green mass, leading to plant solidification. This phenomenon is a biological feature typical to all perennial and ephemeral plants. Fiber content varies in different organs of the plant, amounting in 20 to 35%.

Along with water and organic compounds of biochemical components of pasture plants and true grasses, mineral (non-organic) compounds and vitamins are also of great importance for vitality and functioning of agricultural animals. Vitamins (A, B, D, C, E and K) are physiologically active substances that regulate metabolism and contribute to increase in the productive qualities and qualitative indicators of the obtained product. Fresh pasture grass ensures higher quantity vitamins and plays an important role in raising the productive qualities of cattle in the grazing period. Mineral salts (sodium, chlorine, phosphorus, calcium, potassium etc) participate in the most important physiological processes and help ensuring the sustainable functioning of the organs. The demand for them depends on the species, age and productivity of the animal.

Biochemical composition of the plants not only depends on the biological characteristics, but also on bioclimatic and soil conditions of their location (habitat).

The highest content of nutrients (proteins, carbohydrates, lipids, vitamins, mineral salts) exists in pasture-meadow plants at their earlier development stages, from spring regrowth to heading (true grasses) and budding (legumes). After that, during the next stages of fruit formation and ripening, protein content drops 2–2.5 times and the fiber content increases at the same rate, resulting in a lower quality of forage.

Reduction of plant nutrition value due to its development stages and solidification of the green mass, significantly affect the edibility and digestibility of the plants (forage). As a rule, the consumption of pasture grass is higher at its early development stage, and as it matures, the edibility

drops, because of its hardened parts (rich in proteins). The same is true for the digestibility of matter grazed by animals. They digest nearly 60-70% of the dry matter of plants. Fresh pasture grass is the most digestible at its foliage and tillering stages (70-90%). As the plant development advances, its digestibility drops by 15-40%.

Edibility depends on chemical composition, taste, smell, plant development stage and animal species. Edibility is an important factor of plant value assessment. As a rule, plants with good edibility have higher nutrition value and ensure higher productivity of animals. The edibility of feeding plants is assessed by a 6-score system.

Table 1. Edibility assessment of feeding plants

N	Edibility	Assessment score
1	Very high edibility	5
2	High edibility	4
3	Medium edibility	3
4	Low edibility	2
5	Very low edibility	1
6	No edibility	0

Plants are more esculent at early development stages, when the green mass is soft and nutritious.

The knowledge of edibility value (nutrition, edibility, digestibility) of pasture-meadow and field plants play an important role in organizing the feeding of agricultural animals, especially in terms of reducing possible malnutrition during winter maintenance and pasture periods and ensuring higher productivity. In organizing alternate pasture (plot) use, the schedule and duration of grazing in management units are determined according to calendar plans based on the species composition and development process of plants. This will help arrange grazing at possibly early development stages to ensure the use of highly nutritious pasture grass.

To regulate and solve this issue in possible effective manner, grazing periods in the management units should be determined as short as possible to also ensure opportunity for further tillering.

To apply the same principle for obtaining high quality grass from grasslands, the harvest must be organized in the heading-flowering (true grasses) and grain development (legumes) stages of plants, when higher nutrition and esculent mass can be obtained.

Each pasture user should keep in mind that the issue of fodder provision is not only related to the productivity of pasture, but rather to the quality indicators of pasture grass, which will provide higher edibility and digestibility, thus ensuring higher productivity indicators.

Given the bioecological peculiarities and economic value of plants, wild perennial plants are clustered into different economic-botanical groups.

2.4. BOTANICAL-ECONOMIC GROUPS OF PERENNIAL PLANTS

The wild perennial plant species are divided into different botanical-economic clusters, based upon their bioecological properties and economic value.

Perennial feeding plants developing in plant cenoses and growing in natural feeding areas (grasslands and pastures), are divided into 4 economic-botanical clusters:

1. True grasses (Poaceae)
2. Legumes (Fabaceae)
3. Sedges and rushes (Carex and Juncus)
4. Motley grass (hay)

Individuals of all 4 above-mentioned botanical-economic

clusters or larger groupings are common to feeding areas of various types, making the main components of vegetation cover.

TRUE GRASSES (POACEAE)

This is the most common plant family used as fodder. The representatives of this family are in dominant position across various natural zones, occupying vast territories. In dry zones and steppes, especially, they occupy more than 70% of pasture vegetation cover. They are basically moderately moisture demanding plants (mesophytes). Drought tolerant (xerophytes) species like feather grasses, crested wheat grass, etc., are mostly common for semi-desert and arid steppe pastures. These are mainly higher edibility plants both among pasture grass and in the hay. Higher edibility of most of its species has to do with the peculiarities of their vegetative mass and biochemical content. These grasses are also rich in organic and mineral compounds. Edibility is higher at early development stages. The edibility and nutrition value drastically drop during the maturing, because of solidification of the plants, as the fiber content grows. These characteristics determine efficient terms of using the plants of this family. These are mostly plants with good regrowth and tillering capacities. Most common types of high value species are found in natural feeding areas, such as the cock's-foot (orchard grasses), Bromopsisinermis (smooth brome), Kentucky bluegrass, meadow foxtail, various ryegrasses, Timothy grass etc. In natural pastures the wide coverage of true grasses is mainly explained by their longevity, resistibility and adaptability. They are especially resistance to trampling, which explains the fact that they are considered a plant community forming the main storey-factor in pasture vegetation cover.

Orchard grass
Dactylis glomerata L.

Tall oatgrass
Arthenatherum elatius L.

Creping bentgrass
Agrositis stolonifera L.

Perenial ryegrass
Lolium multiflorum Lam.

Crested wheatgrass
Agropyron pectiniforme Schult

Meadow timothy
Phleum pratense L.

Awnless brome
Bromus inermis Leyss

Meadow foxtail
Alopecurus pratensis

LEGUMES (FABACEAE)

These are the most widespread among flowering plants. They enjoy a substantial specific weight in the vegetation cover of natural feeding areas, after the true grasses. They can be found across all natural zones, developing more intensively in meadow-steppe, forest, true steppe and subalpine zones, covering up to 15-20 % of the vegetation cover.

The major part of plants belonging to this family have higher nutritional value and good edibility (92% have high and sufficient edibility from feed perspective).

High edibility is conditioned with the duration of flowering stage of most of its species; some species reproduce almost throughout the entire vegetation period. In pasture biocenosis, the edibility period is one and half times longer than among some true grass species. This is explained by the biological peculiarity that after reproduction the plants of this family harden less than those of true grass family. Owing to these specifics, the period of feeding animals with legumes in the grazing season almost twice surpasses the period of using pastures covered with true grasses.

High edibility has to do with formation of soft and nutritious vegetative mass, where compound leaves dominate. Their biochemical composition includes a high content of digestible proteins (the average of 50-60%, more than in the true grasses), which ensures high energy value and nutrition.

High contents of protein compounds pose certain risks particularly to natural pastures. During monsoons, grazing of larger cattle in pastures rich in legumes or in early morning vegetation covered with dew is not reasonable, as it causes drum belly (tympanitis) in cattle. This is a very important fact to be remembered by any pasture user and when developing management plans, defining the period of pasture use in management units, this has to be kept in mind to organize the use of true grasses, motley grass and legumes covered areas in successive order and within the daytime to avoid the bovine drum belly.

The economic and environmental significance of leguminous plants for natural feeding areas is enormous. By forming a rather exuberant and highly nutritious plant mass, they ensure higher feeding value and enable lasting use, thus resulting in increase of the overall pasture efficiency. They make quite strong tap roots and favor the betterment of soil structure and activation of turf-cladding processes. The organic acids detached from root system help the fission of hard-to-solve organic compounds in soil and turn them into simpler forms, which are used by all plant groups of the vegetation cover. Due to the activity of tuber bacteria co-growing on the roots, the soil is augmented with nitric compounds. They are important for amelioration, soil protection and anti-erosion. Most valuable species of the natural feeding areas are alfalfas, sainfoins, sweet clover, red clovers, common vetches, sweet peas, etc.

Purple alfa-alfa (Lucerne)
Medicago sativa L.

Yellow flower alfa-alfa
Medicago falcate L.

Red clover
Trifolium pratense L.

Sainfoin
Onobrychis vioiifolia Scop.

Yellow sweet clover
Melilotus officinalis Desr.

RUSHES (CYPERACEAE), SEDGES (JUNCACEAE)

They are mainly perennial, rarely annual plants, and are common across all natural zones, from semi-desert to high mountainous, alpine zones.

Based on existence in the wild and the capacity to generate above-ground vegetative mass, they are divided into high-stem and low-stem plants. High-stem species are basically developed in excessively humid lands, while the low-stem ones are mostly found in arid steppes, semi-deserts, as well as in higher mountainous, relatively colder zones.

Depending on the conditions of plant location, rushlands and sedgelands are classified into four groups:

1. Those developing in excessively humid conditions; economically less valuable group.
2. Those developing in moderately humid conditions; lower nutritional value with selective edibility.
3. Those developing in higher mountainous conditions; mostly high class and medium quality species from pasture perspective.
4. Those developing in arid conditions; plants of semi-desert and dry steppes with high pasture value.

Economically, rush and sedge plants are classified into medium and poor edibility feeding plants, despite the fact that their biochemical composition includes up to 14% of proteins. Limited and low edibility is due to high content of flint-based soil (stone cells), especially at maturing stages. They have high edibility and digestibility especially at early development stages (before flower-bearing stems occur), when they are even comparable to true grasses (Poaceae). After formation of reproductive organs, their feeding value drastically decreases, because of the hardening accompanied with declined digestibility, and sometimes they can even be harmful when used for longer periods as feed. It is not advisable to use rush (Juncus) and sedge (Carex) covered pastures for longer periods, as they lack calcium and phosphorus salts and may impair the bones of grazing animals, causing rickets in certain young animals.

Grazing or harvesting in feeding areas covered with

rushes and sedges can be more reasonable in relatively early development phases, when softer, more nutritious and higher edibility mass is available. At later stages of development, decline in their edibility creates favorable conditions for reproduction and further spread. Extensive development of rushes and sedges results in qualitative changes in pasture vegetation cover. Intense turf-cladding and tussock contribute to degradation and decomposition of pasture, hence reducing its economic value and productivity.

High and medium esculent carex or sedge group includes common rush, carex tristis, carex supine wild, carex leporine carex caucasica, etc.

Acute Sedge
Carex gracilis Curt.

Black alpine sedge
Carex atrata L.

Inflated Carex
Carex aguatilis Vahl.

Blister sedge
Carex vesicaria L.

Tussock sedge
Carex stricta

Spiny rush
Juncus acutus L.

MOTLEY GRASS VEGETATION

Motley grass group includes all grass plants of other botanical families, except for true grasses, legumes, rushes and sedges. Motley grasses are the main economic group of all other types of natural feeding area vegetation covers, due to their spread and profusion. From economic perspective, motley grasses have multiple designations. This group includes both valuable and low value and noxious species for grasslands and pastures. In this specific group, representatives of Asteraceae family are dominant, based on their spread and significance, comprising around 15-20% of natural vegetation. Many species are comparable to true grasses (Poaceae) and legumes (Fabaceae) in terms of nutrition and edibility. Feeding areas of semi-desert, steppe and forest zones are rich in motley grass vegetation. Active development of motley grass in mountainous alpine and subalpine meadows forms carpet-like alpine meadows, which later acquire landscape significance, as they occupy a wide range of pasture territories. The vegetation cover in these areas contains over 60-70% of motley grass.

Motley grass vegetation is composed of significant amount of hard, low-value, harmful and poisonous plants, which is explained by the expansion of motley grasses and richness of plant groups.

Motley grass vegetation is grouped into 3 categories based on economic value (nutrition, edibility):

1. Valuable – esculent motley grasses
2. Sufficient – selective edibility motley grasses
3. Unwanted – non esculent weeds.

Depending on the feeding value and edibility of specific species, this group is marked with its highly esculent species. Their high content especially in pasture vegetation cover allows raising pasture grass feeding units and increasing productivity. Such motley grasses include carum, Alpine chervil, veronica species, broad leaf plantains, goat's beard, sickle weed, etc.

Many of the plants in this group are equal to true grasses and legumes in terms of their edibility, nutrition value and digestibility. Biochemical composition of many motley grass species with their sufficient or selective edibility are comparable with true grasses (Poaceae) or legumes (Fabaceae), yet due to the content of aromatic ethereal compounds, they are esculent at certain development stages, especially at early period. The importance of such species becomes more accentuated in winter pastures. In late autumn or winter season, due to termination of vegetation and climate change, aromatic alkaloids preserved in vegetation mass of plants dissolve (because of cold wind) into much simpler forms with partial loss of acute smell and bitter taste, while the hardened stalks turn into good-quality pasture under the influence of natural precipitations.

Such motley grasses are wormwoods, saltwort, cinquefoil, lady's mantle, wild carrot, milfoil, which are mostly spread in feeding areas of semi-desert to post-forest zones.

All motley grass species have even more importance for pasture vegetation cover, as they get harden faster in grasslands and lose their feeding value.

Yarrow (Milfoil)
Achillea millefolium L.

Common plantain
Plantago major L.

Saxifrage
Saxifraga L.

Sorrel
Rumex crispus L

Wormwood
Artemisia Lercheana Web.

WEEDS

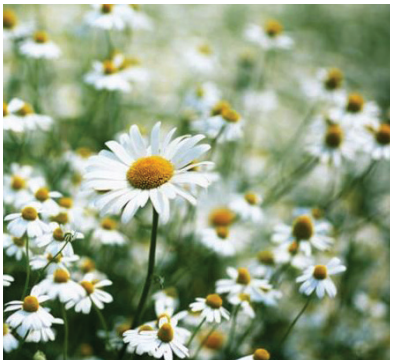
In natural feeding areas (grasslands, pastures), the plants belonging to botanical families with zero feeding value because of their structural peculiarities and biochemical content (are hard, non esculent, harmful or poisonous), are called weeds and with their existence they only deteriorate the grass and pasture forage quality. Over time, they develop intensively and cause degradation of feeding areas, at the same time physically harming or poisoning domestic animals.

The spread of weeds in natural feeding areas is also connected with insufficient level of economic-historical (anthropogenic) factors and impacts, in particular the irregular, untimely and overgrazing by livestock in pastures, untimely harvesting of grasslands and lack of any care of natural feeding areas. Apart from that, weeds may thrive in feeding areas due to normal, equal changes of vegetation in the soil, when intensive turf-cladding changes the aeration of soil and leads to slow and ordered aging of the natural feeding area. It has to be noted that reduction of weeding in natural feeding areas greatly depends on implementation of sustainable management. Based on that, it will be possible to slow down the natural feeding area aging process as a result of natural-historical factors, by making the turf-cladding processes more stable and ensuring soil aeration, consequently contributing to lasting preservation of natural feeding areas and increasing their efficiency.

Perennial sow-thistle
Sonchus arvensis L.

Common tancy
Taracsacum vulgare L.

Greater burdock
Arctium lappa L.



Chamomile
Matricaria

Poppy
Papaver monanthum Trau

Shepherd's purse
Capsella bursa pastoris M.

Common St. John's wort
Hypericum perforatum L.

Camint
Nepeta L.

HARMFUL PLANTS

These plants belong to diverse economic groups and plant families, which due to their structural peculiarities of above-ground vegetative mass (spiky, rich in stone cells) or biochemical composition (containing alkaloids, ethereal compounds and different pigments), affect harmfully the livestock in case of contact or being fed with.

At certain development stages, the harmful plants with structural peculiarities cause serious skin, peroral, stomach damages of cattle, spoiling their wool and skin. Such harmful plant species include eryngo, thistles, certain species of Astragalus genus, certain feather grasses, Onobrychiscornuta, Acantholimon, globe thistles, Lucerne, etc. These species spreading around especially in mountain pastures harm the grazing animals, litter and reduce effective space of pastures and lower economic efficiency. Their maleficence resulting from their biochemical composition is more vividly expressed through qualitative changes of the obtained livestock products, which in most cases ends up making the products unusable. In particular, certain species have high edibility, because of pigments and alkaloids they contain, giving different color, taste and smell to the milk or meat. Similar harmful plants include cow wheat, forget-me-not (Myosotis), Yellow bedstraw, Euphorbia (spurge), wild onions, Thlaspi, peppercress etc.

It is worth noting, that expressions of harmfulness that result from the plant's biochemical characteristics, have no lasting features, they are released from animal's body maximum in 1 day's (24 hours) period losing their aftereffect. Knowledge and identification of such harmful species when in the pasture, requires removal of milked animals to other pastures with no or little content of harmful plants, to avoid negative impacts on the quality of milk.

White-felted thistle
Cirsium incanum Fisch

Curly plumeless thistles
Carduus crispus L.

Common eringo
Eringium campestre L.

Euphorbia marschalliana
Euphorbia marschalliana

Sainfoin
Onobrychis cornuta DSV

Mayweed
Anthemis melanoloma Trautv.

Astracantha aurea
Astragalus aureus willd.

POISONOUS PLANTS

Natural feeding areas contain many species of various plant families, which, if consumed, may cause symptoms of such sickness that mostly leads to the death of the animal. The biochemical composition of these plants includes special chemical compounds (alkaloids, glucosides, essential oils, organic acids), which generate the toxicity of the plant. Apart from being a feature of these species, toxicity is also the result of ecological and climate conditions of the plant habitat. As a rule, poisonous plants that grow in shadows and arid conditions are more toxic, than those, which grow in relatively sunny and humid areas.

Toxic substances appear and accumulate in diverse forms and density in the plants, depending on the development stage. Many poisonous plant species become poisonous already in early development stages, while in majority of plants the toxicity mostly appears at much later development stages, in particular, at reproductive stage.

Depending on the species of poisonous plants, the toxins accumulate in different organs or segments. The poisonous plants, which have the toxins accumulated in the stalks and leaves, are considered to be the most dangerous for pastures.

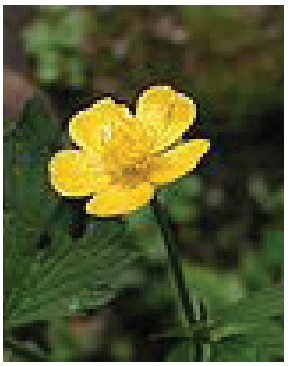
Poisonous plants are found in all plant families and even in the motley grass group.

The most poisonous plant families are the Euphorbiaceae, Solanaceae and Ranunculaceae, which do not constitute a large part of the vegetation cover. More widespread and higher edibility plant families with economic significance contain relatively less poisonous plants. In true grasses (Poaceae) and legumes families they do not exceed 2–5%.

The most common poisonous species for feeding areas in various natural zones are euphorbia, Ranunculaceae, hellebores, henbane, nigella, cowbane, hemlock, etc.

Henbane
Hyoscyamus niger L.

Euphorbia virgata
Euphorbia virgate M.B.



Cursed buttercup
Ranunculus sceleratus L.

Cowbane
Cicuta virosa L.

False hellebore
Veratrum Lobelianum Bernh

Hemlock
Conium maculatum L.

Leafy spurge
Euphorbia esula L.

HARD AND NON-ESCULENT PLANTS

This group covers the representatives of diverse plant families, which have powerful growing capacity, forming a lavish above-ground mass with high fiber content. Their biochemical composition includes various acids and bitter alkaloids. As a rule, they develop hard, stiff above-ground mass not used by animals. Such plants flourish mostly on untended over-grazed feeding areas, where they grow massively turning into widespread vegetation cover, littering the area and reducing its economic value. The development of these plants leads to suppressing of high quality feeding plants and hinders efficient use of the feeding area. Meanwhile, over the years, the residual waste accumulated on the surface, creates a layer of semi-deteriorated/ crumbling organic matter, worsening of turf-cladding, favoring the regress of soil aeration (air penetration) processes, often leading to aging and degradation of the feeding area.

It should be noted, that inadequate use of pastures and grasslands will create opportunities for intensive development and spread of non-esculent, hard weed species resulting in the reduction of useful space of the feeding area and the overall efficiency decline.

Most common types of hard and non-esculent weed species include Danthonia, sorrels, hippomarathrum, lavender, Onobrychiscornuta, a number of sedges and rushes, Astragalus, prickly thrift, fescue, etc.

Hogweed
Heracleum trachyloma Fisch. et al.

Stipa
Stipa capillata L.

Curly dock
Rumex crispus L.

Mullein
Verbascum pyromidatum Bied.

3.0

VEGETATIVE CHANGES IN THE NATURAL FEEDING AREAS (SUCCESSION)

As part of ecosystems, natural feeding areas are in a constant connection with and dependence from natural processes taking place in the environment. Over time, this results in changes of quantity mass (the yield), as well as species' composition of the same habitat, where biocenosis is upgraded. This succession can happen both under the influence of natural factors, as well as over the course of industrial activity induced by the man.

The endodynamic succession, happening under the influence of natural factors is, as a rule, normal and takes place at a slower pace, lasting for centuries.

This succession is due to the course of natural feeding areas' development, which can have both progressive and regressive expressions. As a rule, by its natural course, regressive expressions are more explicit in feeding areas, based on which each type of a feeding area goes through prematurity, maturity and aging stages due to turf-cladding process in the nature. At each stage, both the productivity of the vegetation cover and the correlation of the species' composition change. This phenomenon is self-regulated and ensures the development of general biodiversity and the correlation of elements resulting from inevitable biodiversity changes.

Succession of species composition in vegetation cover influenced by natural conditions takes place in the same habitat also due to interaction between elements of cenoses (plant species) and is often temporary. Such changes include also seasonal successions, when over a certain period of time; one plant in the vegetation cover is replaced by another.

From production perspective, seasonal natural short-term changes have a significant role in keeping the natural feed in a proper condition for a long time and in increasing the efficiency, especially through prolonging its possible use period. Seasonal succession is also observed when the growth of various cenoses elements and the development stages do not happen simultaneously. These phenological successions give the cenoses temporary appearance (aspects).

Irregular changes of vegetation, which take place in the result of human economic activity, are even more clearly observed. These successions are diverse, in direct or indirect ways (exodynamic succession). In the process of using the feeding area, by influencing it (haymaking, grazing, agricultural engineering), the vegetation cover and the overall productivity change within a short period of time.

The harvest date and repeated harvesting has a huge impact on the species composition of the vegetation cover of the natural feeding area (e.g. a meadow). Unsustainable management disturbs the high-stem, mostly seed reproducing species' composition, and their reproduction (seed formation) process. Consequently, the botanical and economic value of the grassland vegetation cover decreases, the habitats for biodiversity species degrade and the possibilities of natural development reduce.

Pasture use (grazing) affects also the longevity, the energy and the growth of the vegetation cover and its species.

It has to be noted, that regular grazing does not lead to drastic quality degradation in the natural life and biologically balanced conditions of pastures, unless the norms ensuring the balance are violated.

Irregular, improperly timed and overcrowded use of pastures may result in hardening of soil, because of trampling; changes in aerial and hydrological, and feeding regimes, disturbance in the natural course of turf-cladding and the plants' ability of self-restoration and regrowth, due to which the vegetation cover and its productivity drastically change. High altitudinal species with high feeding value do not survive in these conditions and are expelled from the vegetation cover and replaced by low-growth, more resistant species, which in their turn, over time are replaced by lower value and poor quality tussock grasses. In such cases, the natural pasture development process is rapidly breached leading to early depletion and degradation.

The pasture should be used in such a way that the harmful consequences of grazing either reduce or disappear in order not to hinder the normal development of the vegetation cover, which is a guarantee for ensuring pasture preservation and increasing its efficiency. To prevent possible qualitative and quantitative changes to the vegetation cover of the feeding areas, which may occur in the result of natural-historical and economic-historical factors, as well as to restore and make the conditions of the feeding area more efficient in economic and environmental perspectives, every now and then needs and necessities arise for studying the vegetation cover of the feeding areas through organization of monitoring to discover the level of degradation and its causes, as well as to develop and apply preventive and rehabilitation measures.

3.1. DEGRADATION AS AN ENVIRONMENTAL ISSUE AND ITS UNDERLYING CAUSES

The preservation and use of resources of natural feeding areas must exist in synergy, rather than conflict. Along with the use of meadow or pasture vegetation covers, measures should be undertaken, in the meantime, to ensure opportunities for self-regeneration and replenishment with new species. The vegetation cover should be used in such a way that the harmful consequences of grazing either reduce or disappear. For that very reason, it is very important to keep the basic parameters of grassland or pasture uses, such as the terms, duration, level and order.

The most important prerequisite for efficient use of the natural feeding areas has always been the good quality of feed and high productivity of the vegetation cover. Sporadic, unlimited and spontaneous uses, with violations of the basic parameters, result in gradual thinning, reduction of valuable plant species of the vegetation cover, which harms the efficiency of the feeding area as a whole.

The aforementioned negative processes may cause degradation of feeding areas, which may aggravate in those grasslands, where the annual harvest that takes place in the same period, disturbs natural fertility of seed plants, while in overgrazed pastures there is overcrowding of cattle and the grazing process is not managed.

As ecosystems, feeding areas degrade in the result of certain processes (natural or anthropogenic), when the potential of fodder or grass production drops, and the number of plant species drastically lowers in cenoses (biodiversity decreases).

Two main types of degradation are possible in feeding areas:

1. Natural degradation
2. Anthropogenic degradation

Natural degradation is an inevitable process that occurs because of natural and historical events, proceeds in a slow pace in the result of changes in the habitat. As a result, quality changes take place in the nature, worsening the turf-cladding in the vegetation cover, bringing thinning of that cover, reduced level of plant coverage and its quality constitution, reducing the overall efficiency of the feeding area. In the long run, this process may undergo self-rehabilitation.

The reasons for natural degradation may be the delayed uses or long-lasting irregular uses of feeding areas, when upon completion of annual vegetation, the dead residual vegetative mass (waste), accumulated on the soil surface contributes to accumulations of semi-deteriorated organic mass on soil surface leading to soil aeration reduction. As a result, feeding areas go through natural development stages at a fast pace (premature, mature and aged), age, corrupt and degrade.

Anthropogenic degradation emerges under the impact of economic-historical factors, economic activity of the man and has a rather fast pace resulting in decomposition, plant deprivation and corruption of the feeding areas. As a consequence, not only the overall feeding area efficiency

drastically drops, but also the general biodiversity is endangered, sustainable development of natural ecosystems, bio-geo-cenoses is hindered instigating serious environmental disasters.

Antropogenic degradation happens in grasslands as a result of annual harvesting within the same period, when in the case of not practicing crop rotation the process of self-rehabilitation and natural fertility of plant cenoses is breached. Anthropogenic degradation is mostly developed and deepened as the consequence of overgrazing and unregulated, irregular uses, when the allowable grazing pressure (AGP) is not considered.

Cattle overcrowding in pastures leads to soil trampling and overgrazing of vegetation cover. Consequently, gradually bare (devoid of vegetation) territories and trampled sods are formed, which all end up in creation and development of erosion (soil runoffs) on the landscape. The changes that take place in the pastures, which were damaged in this way are actually irreversible, and bringing the pasture to its initial or more fertile condition will require quite a long time and measures (improvements). Reduced efficiency of degraded pastures will also have abrupt impact on the livestock productivity, causing severe environmental issues often with disastrous consequences.

Milder types of vegetation cover degradation, such as thinning of vegetation cover can be prevented and even restored by not using the feeding area for a certain period of time, allowing it to restore through self-seeding or by improving via artificial interference (by making improvements) in the growth conditions of the existing vegetation cover.

Depending on the level of degradation and the restoration potential of the vegetation cover, in this case respective measures will include ungrazing of pasture for a while (1–2 years), or reducing the quantity of cattle, no harvesting in grasslands (1–2 years) or mowing at later development stages of plants, after the fruiting of good quality feeding plants.

The efficiency of a feeding area, degraded through artificial interference, can be restored and even increased through various agrotechnical measures (improvements) targeting the refinement of plants growth conditions, or improvement and increase of quality and quantity constitution of the grass cover.

In order to determine and examine the degradation level, baseline assessments and consistent monitoring of conditions of the feeding areas is needed. It will help identifying the feeding area's conditions to develop and define the procedure and methods of efficient management measures.

4.0 CRITERIA FOR DEVELOPING SUSTAINABLE MANAGEMENT SYSTEMS OF NATURAL FEEDING AREAS

Sustainable management of natural feeding areas is conditioned by a number of interconnected functions, where the priorities are given to:

- studying the current state and characteristics of the feeding area
- identifying the existing issues
- assessing the economic and environmental situation

Fundamental information on the condition of the feeding areas provides guarantees for the development and implementation of effective measures (regulations) designed for further management. For this very reason, to provide fundamental information on the plant location and vegetation cover conditions, as well as on the course of potential regression, there is a need to conduct comprehensive and objective monitoring.

4.1. MONITORING OF NATURAL FEEDING AREAS

The most important issue of conservation of plant resources, creation of reproduction opportunities in the natural feeding areas is the implementation of efficient use (management), which is based on the examination and assessment of the current state and potential of the given resource. The process of studies and situation assessment is linked to implementation of monitoring, which is a vital means to obtain information on natural-historical and economic-historical (human induced) impacts.

To make justified and effective decisions on implementing sustainable management of the feeding areas, including pastures of the Republic of Armenia, a monitoring procedure and a methodology for pasture monitoring has been elaborated and introduced (Manual for Monitoring of Pastures, Armenia, 2014). The main objective of elaborating the above-mentioned manual was to arrange a comprehensive and objective monitoring of the pastures in Armenia, based on proven scientific approaches and analyses. As an outcome (according to the monitoring), sound recommendations on sustainable pasture use (management) are provided, which will help not only raise the efficiency of pastures, and consequently – growth in animal production, but will also significantly support in the preservation, restoration of natural feeding areas, reduction of the overall biodiversity vulnerability.

The purpose of monitoring is to identify current change developments in natural pastures, be it positive (quantity and quality improvement), negative (decline), or none (stable situation).

The chronology of pasture monitoring is as follows: first the baseline situation of certain pasture plots should be recorded, which should be selected on the basis of certain criteria, so that the assessment has its explanation.

As a second step of monitoring, the same observations and assessment should be conducted in the same plot after a while (e.g. two years later) in order to identify the developments in vegetation cover to be used for explaining the efficiency and sustainability of ongoing pasture uses. Firstly, baseline studies reveal the current state and issues to serve as a basis for developing recommendations and functions for the given pasture management (use),

which aim at ensuring solutions to identified issues by developing sustainable management regulations. In the process of pasture monitoring, the degradation and erosion susceptibility indexes are determined using the inventory conducted on the basis of studies, which reveals and determines the state of pasture for the purpose of making realistic, justified decisions by developing sustainable management procedures/regulations for preventing advancement of degradation and to restore and increase pasture efficiency.

Preliminary baseline assessments and consistent monitoring in the feeding areas are based on comprehensive studies of vegetation cover and habitat in compliance with the procedures specified for conducting phyto-topological and phyto-cenological assessments.

Comprehensive studies of the habitat (physical conditions of area) reveal availability of conditions and the situation for the development of natural vegetation cover based on the nature-climatic, soil reserves, altitude and landscape. Studies of vegetation cover (phyto-cenological) explain not only the productivity of the feeding area, but also the economic elements present in it, their content and ratio (qualitative indicators), as well as the level of vegetation cover, level of use and overall efficiency of the feeding area.

Periodic (repeated) studies and assessments of the plant locations and vegetation cover according to selected variables, will ensure factual data which if analyzed will explain the current state of the given pasture and potential developments. This kind of data will serve as a basis for organizing further efficient management. In the meanwhile, to prevent the degradation of pasture detected through monitoring results, to reduce erosion susceptibility, agricultural engineering equipment and amelioration activities should be developed and exercised for the improvement. To exclude overgrazing, the allowable grazing pressure (AGP) per cattle unit is determined, a pasture rotation plan and plot grazing schedule is developed based on the indicator of pastor state.

With the help of monitoring, the explanation of pasture conditions, based on erosion susceptibility and degradation index allows introducing certain changes to the management plans from time to time, for improvement purposes.

4.2. IMPROVEMENT SYSTEMS OF NATURAL FEEDING AREAS

The efficiency of natural feeding areas is conditioned by not only economic elements of pasture, vegetation level, but also by application of sustainable maintenance and use methods.

To organize the feeding of livestock and to establish sustainable, quality feeding stock in general, it is necessary to, along with the use of natural pastures and grasslands, occasionally implement organizational and agrotechnical (improvement) measures addressed at raising the vegetation cover maintenance and efficiency (productivity, quality).

The above-mentioned measures are very important for the processes of sustainable management of natural feeding areas, as they ensure the reduction of weeds and lower quality plants in the vegetation cover, promoting growth and development of forage, which will lead to regeneration and preservation of cultural condition of the feeding area. Functions like this become even more crucial in terms of decreasing overall biodiversity vulnerability risks and increased productivity of the feeding areas.

The measures targeting the preservation, regeneration and efficiency of vegetation cover in the feeding areas are mainly related to the results of baseline studies (monitoring), when the study and assessment of habitat and vegetation cover results in identification of existing issues, depending on the index of the feeding area conditions (degradation and erosion susceptibility indexes).

IMPROVEMENTS

Improvements are scientifically justified agronomical and amelioration measures. Key tasks of their application are to improve the soil, water, air and nourishment regimes required for natural growth of feeding grass, make turf layer and vegetation cover improvement and enrichment activities, contributing to increase of useful space of the feeding area, preservation of cultural condition and increase of efficiency, and in certain cases, even by devitalizing the deteriorated turf and artificial grass seeding to create new planted artificial feeding areas.

There are two main types of improvements of natural feeding areas:

- Superficial
- Fundamental

SURFACE IMPROVEMENTS

These are agricultural measures, addressed at the care of natural turf and vegetation cover to help the refinement of growth and development conditions of economic elements, their enrichment, expansion of the useful surface of the feeding area, and hence, resulting in the increase of overall efficiency (yield, quality) and productivity of the feeding area.

Surface improvement activity can justifiably be conducted in the feeding areas, experiencing the juvenile or ripening stages (based on the course of turf-cladding), where the vegetation cover is mostly comprised of bunchgrasses and rhizomatous grasses and their composition in the legumes (Fabaceae), true grasses (Poaceae) is not less than 20-25%.

The technological operations of surface improvements are expressed as follows:

- Cultural-technical activity;
- Measures for improved water, air and nourishment regimes of the habitat;
- Elimination of weeds, poor quality and poisonous plants;
- Enrichment of plant cover and rejuvenation with underseeding.

Cultural-technical actions are performed to bring the feeding areas into regular, industrial appearance. These actions also include stone gathering, waste removal, turf and shrubland elimination and restoration of bare (void of vegetation cover) areas.

Stone gathering helps expand the useful (fertile) space and creates more opportunities for efficient use. In areas cleared from stones leveling and underseeding with perennial grass plants should be organized in order to form a vegetation cover.

Gathering of stones is more reasonable to conduct in autumn, after the end of the vegetative period or in early spring, before the regrowth of plants.

Shrublands occupy a considerable space and as such reduce the useful surface of the feeding area, serving as hot spots of weeds, pests and diseases. Certain species (thorny) cause mechanical injuries to animals. If shrublands make 20-25% of the feeding area, they should be removed to have larger useful spaces.

Tussocks (tramping, plants, ants, mole etc) also reduce the useful surface of the feeding area, worsening the degradation and erosion susceptibility in slopes. After the elimination of tussocks, the area should be leveled and planted through underseeding.

In feeding areas, the grazing area of animals, watering surroundings, as well as near the temporary residences, sometimes widespread bare soil areas can be found mainly because of heavy trampling. To reduce such areas and form a vegetation cover, raking and sowing of perennial plant seeds should be carried out.

REGULATION OF AERATION REGIME

Those overgrazed and trampled feeding areas, where hardened soil hinders the aeration, it is necessary to do racking (by wheel rakes) in order to increase soil aeration level. It is reasonable to rake in spring, parallel to the fertilization, which ensures fast regrowth and regeneration of plants.

It is not advisable to do soil raking in autumn, as the root crowns of wintering plants are stripped, which causes plant freezing.

REGULATION OF WATER REGIME

Feeding areas of different natural zones of the country are located on various slope ranges, most of which are low in water and even arid. To regulate water regime in especially low-water semi-desert and steppe zones, irrigation should be organized, if possible, or undertake measures for adding more moisture in the soil, e.g. for arranging flap planting, or installation of mobile snowhedge to add more snow piles. To increase moisture accumulation in the slopes and prevent potential water erosion, basins can be constructed to serve as temporary watering points for animals during grazing period.

In natural landscapes, for water regime regulation, effective regulation and use of surface waters, and in particular, creation of artificial water collection basins (reservoirs) play a great role.

The majority of natural feeding areas are located on slopes with different disposition and steepness, hills and intermountain plains, where in most cases significant part of the feeding areas are not used, because of absence of drinking water. The latter is a serious issue in terms

of organizing efficient and uniform utilization, as well as maintaining the allowable grazing pressure norms. Very often animals going to pastures are taken to remote areas, which affects their productivity negatively, Therefore, to use the pasture areas and food efficiently, to provide the livestock with water, and where possible, to use and distribute surface and ground waters purposefully, and special watering points on certain distances to irrigate pasture areas should be constructed.

Water points of relatively plain pastures should be constructed on 1,5 – 2,0km distance, while for slopes the distance must be 0,8–1,2km. Construction of watering points in farther areas has a negative impact on animal productivity, since the longer the distance is from the watering point, the more energy they spend.

REGULATION OF SOIL NOURISHMENT REGIME

Regulation of nourishment regime by means of fertilization is one of the most efficient measures of surface improvements. Fertilization not only doubles and triples the feeding area productivity, but also significantly improves the yield quality, changes the species' composition of vegetation cover, regulates the water and air regimes of soil, the valuable soil bacteria develop and adverse impact of turf-cladding processes mitigates.

Through fertilization, the quantity of nutrients required for plants accumulates through fertilization, leading to increased further growth and tillering opportunities as it helps accumulate reserve nutrients of perennial plants fully. These nutrients serve as the main guarantee for intense regrowth and development of plants.

Depending on the type of the feeding area, bioclimatic conditions of the given lands and the presence of nutrients in the soil, it is possible to change the botanical composition of the feeding area in any direction by defining fertilization standards, applying both single and combined mineral fertilizers, which will increase the productivity and nutritional value of grazing forage and grass.

Natural feeding areas are fertilized with both organic and mineral fertilizers.

One of the organic fertilizers with high practical significance is ripe manure. The optimal norm of manure fertilization is 20-25t/ha. The best fertilization time is late autumn, before the formation of steady snow cover.

Manure gradually deteriorates in the soil, enhancing the microbiological processes and making the semi-deteriorated organic matter (accumulation of residues, above-ground turf) decay. Manure has a great impact on the vegetation cover of the feeding area, helps increase of legume species and reduction of rushes and sedges.

Mineral fertilizers (nitric, phosphoric, potassic) are more effectively applied jointly, in certain dosages, depending on the nutrient content of the soil. Fertilization with phosphoric and potassic fertilizers can be organized both in autumn, as well as in early spring. It is researched and proven that it is more effective to organize joint mineral fertilization in early spring, at the regrowth of plants, by sprinkling on the moist soil surface.

Taking into account the fact, that grazing continues till late autumn in the Armenian pastures, where the perennial plants not having sufficient assimilation surface, are not capable of accumulating sufficient amount of reserve nutrients, therefore it is most advisable to organize mineral fertilization in autumn too. In this case, the plants will have enough nutrients in early spring for faster regrowth and tillering after use (grazing), thus ensuring higher productivity.

To achieve higher productivity and crop quality, the optimal average standard for mineral fertilization is as follows: 2c. ammonium nitrate, 3c. superphosphate and 1.5c. potassium salt per 1 hectare.

It has to be noted, that the justified preference in fertilizing the feeding area must be given to fertilizers with organic origin (manure, compost, litter), so as not only to improve soil quality and plant nutrition, but also to exclude all other potential aftershocks in the environment, which is greatly evident in the case of lasting use of chemical fertilizers. Over time, the use of chemical fertilizers leaves direct and indirect impact on the quality of natural resources (water, vegetation), thus endangering natural development of biodiversity and posing risks to the overall ecological balance of environment.

WEEDING

In order to raise the overall feeding area productivity and develop high quality botanical composition, it is important to take weeding measures.

In dominant part of Alpine pastures in Armenia, esculent

plants make around 40-45% of the overall mass, while in certain deteriorated and partly degraded feeding areas – less than 10-20%, therefore 55-60% and often 80-90% of soil nutrients are spent on the development of non esculent poor quality crops. The latter take the form of dead plant residues and accumulate on the soil surface, which supports the reduction of aeration, thus leading to aging and degradation of the feeding area.

In elaborating weeding measures, it is crucial to study the botanical composition of vegetation cover, the landscape, turf-cladding, vegetation coverage level, so that the vegetation cover of the feeding area does not suffer much and no soil runoffs begin.

The most effective measures against weeds include mowing before seed formation, fertilization, adequate use of fertilizers, mechanical destruction, chemical struggle, succession of mowing and grazing, regulation of turf layer aeration, applying pasture and crop rotation. Weeds must be mowed before their fruit formation stage starts.

Chemical control should be in the focus of special attention. During the use of herbicides (chemicals) the preference should be given to chemicals of selective affect, which mostly affect dicotyledonous weeds. In case of widespread weeding, the massive application of herbicides brings over high risks in terms of endangering the overall biodiversity. For that very reason, it is preferable to apply the herbicides on local or site level, especially for the purpose of eliminating pernicious shrublands and poor quality plant covers. Herbicides should be applied in those weed areas where high-value legumes and dicotyledonous motley grasses are relatively scarce. Herbicides are applied in the intense weed growth period (from leaf formation to stem formation). Most common herbicides include 2,4-D, reglone, phenagon and banvel.

From technical-economic perspective, and in general, the best alternative for fighting the spread and development of noxious weeds is to have sustainable management of the feeding areas, in which case the timely grazing and mowing will play preventive role in the spread and development of weeds. In the meantime, from environmental perspective, all possible risks of soil microflora changes, endangering the biodiversity, will be excluded, all these negative effects being true in the case of using chemical herbicides.

BURNING

At present, burning is almost prohibited all over the world, as a technological measure against weeding and plant residues, as it results in serious environmental issues, sometimes with irreversible consequences, since it greatly endangers overall biodiversity and breaches the regular development of the natural ecosystems. Corresponding legal regulations of the Republic of Armenia prohibit burnings in natural feeding areas of the country, and the failure to abide with the requirements will entail administrative fines and liabilities.

Autumn burnings of residual plant matter is particularly not justified, since in autumn the perennials form their soft assimilation surfaces (leaves) in order to synthesize the required reserve nutrients before the steady snow cover is in place. If burnings occur in this period, residual dry plant matter not only burns the assimilation surface of plants, but also the shrubbing nodes, which in its turn causes destruction of high quality plants (rhizomatous, tussock). Even if they survive, they shoot very few sprouts, which brings thinning and decline of efficiency of the feeding area. It has to be noted that autumn burnings are counter-indicated, because the dry matter accumulated on the soil surface is the best means for accumulating snow in winter, while in spring they prohibit the streaming of snowmelt waters especially on the slopes, promoting the surface flows absorption and prevention of potential water erosion.

FORTIFICATION OF THE VEGETATIVE COVER BY UNDERSEEDING

Along with agrotechnical and amelioration measures, addressed at increasing the natural feeding area productivity and crop quality, measures should be taken to ensure more intensive presence of valuable feeding plants in the vegetation cover. In order to increase the level of fortification of botanical composition and vegetation cover of the feeding areas with thinning vegetation cover, it is necessary to perform an underseeding, using a mixture of biologically compatible perennial legumes and true grasses. Underseeding is an agrotechnical measure, when the thinned or partly bare spots are being seeded in specific portions without overturning the turf layer. To cover the seeds with soil, raking should be done, or trampled by sheep flocks a number of times in humid weather.

To have underseeding with perennial plant seeds, proper selection of plant species and the calculation of seeding norms must be performed on the basis of soil-climatic conditions of the given zone. The underseeding norms should be calculated according to the density of botanical composition. To calculate the density per 1sq.m, the overall quantity of stems by 4 economic groups (legumes, true grasses, motley grasses and carex) should be calculated. It is necessary to consider the total number of legumes, true grasses and 50% of motley grass stems as useful species. In highly efficient feeding areas there is around 1000 stems per a sq.m (10 million per ha).

For underseeding, the quantity of calculated efficient stems on a unit of surface is compared to the quantity of provisionally considered stems of highly efficient feeding area and make up for the difference with underseeding. In this case, when setting the seed norms, it has to be kept in mind that to grow 100 stems it is necessary to sow 150 seeds. In this estimation, the percentage of seed and field reproduction capacity and the potentially eliminated plants over the first harvesting year need to be considered.

To prepare the mixture of plants required for underseeding, it is necessary to pick 3-5 species of compatible true grasses and legume seeds.

The timing of underseeding is mainly linked to the biological characteristics of selected crops and to the bioclimatic conditions of the given zone. The best time for seeding is early spring, summer or autumn. Underseeding can be done with seeder or manually (broadcast seeding). Broadcast seeding means covering the seeds with soil, raking or having the sheep flock trample the seeded area 2-3 times.

Underseeded area should not be grazed for at least 1-2 years, especially by small cattle - sheep.

Underseeding can be done in feeding areas through self-seeding. In thinning and partly bare feeding areas, where the majority of vegetation cover is comprised of several species of valuable feeding plants and it almost practically lacks harmful and poisonous species, stone gathering should be done, but fertilization, and grazing or mowing should be forbidden. In certain cases, grazing is justified when done in later periods, after the seed formation. In such cases, plant seeds develop and a natural self seeding takes place. To cover seeds with soil in late autumn, such areas can be raked.

Underseeding and ensuring self seeding opportunities are the best ways of rejuvenation and efficiency of the feeding areas.

FUNDAMENTAL IMPROVEMENTS

This is the set of agro-engineering measures, where ploughing devitalizes the sod layer of the feeding area and creates new vegetation cover through artificial grass seeding.

Fundamental improvement is performed in highly degraded areas, where superficial improvements are not capable of refining the feeding area efficiency and where the landscape does not contribute to runoffs.

Fundamental improvements are allowed to be done on up to 15^0 hill slopes and in basically plain areas with relatively thicker turf layers. Fundamental improvements are prohibited on steeper hills, as the revitalization of the feeding area's turf layer creates sufficient opportunities for the development of runoffs and landslides. Fundamental improvements are most needed in aged, degraded, azonal feeding areas after the regulation of water regimes, in areas where tree and shrub logging was performed, highly weeded (with harmful, noxious plants) areas, areas where the vegetation cover contains less than 10-15 percent of true grasses and legumes, in flatter landscapes or in relatively plain areas. In case of fundamental improvements, to establish a seeded artificial grass cover, we should use joint seeding of biologically compatible true grasses (Poaceae) and legumes (Fabaceae) plant seeds, hence initiating the creation of artificial feeding areas with plant mixtures. Natural feeding areas of Armenia are chiefly of landscape type and in the relatively plain semi-desert and dry steppe zones the turf layer is very thin, which makes the fundamental improvement unjustified, because there are high risks of washouts and openings of bedrocks.

Table 2. Improvement measures for decomposed, degraded pastures

Pasture condition	Assessment criteria	Recommended improvement measures
Overgrazed	Vegetation coverage 70–75%, quantity and varieties of plants very poor, no more than 10–20 species on 100m^2, weed species 80–85% and more, level of tussocks 15–20% and higher	Prohibited grazing for 2–3 years, cultural-technical works (stone gathering, fighting tussocks), fertilization with NPK, underseeding, raking.
Badly trampled	Vegetation coverage 75–80%, quantity and varieties of plants poor, 25–30 species on 100m^2, thin vegetation, 250–300 stems per m^2. Weed species – 50%, turf – 15%, average plant height – 8–10cm.	Allowable grazing pressure – up to 0.2 cattle units, application of rotation grazing, cultural-technical works (stone gathering, turf and weeding out). Fertilization with NPK, underseeding, raking.
Average or moderately trampled	Vegetation coverage 80–85%, quantity and varieties of plants – over 40–50 species on more than 100m^2. Number of stems on 1m^2– 500–700. Weed species 20–25%.	Application of rotation grazing, preservation of AGP, fighting weed, fertilization. Raking.
Covered with hard, non-esculent plants	Low quality species of motley grasses in vegetation cover – 70–75%. Turf – 20–25%.	Mechanical and chemical actions against weeds. Stone gathering, raking, fertilization and underseeding.
Aged, Degraded	Quantity and species of plants poor – 30–35 species per 100m^2. True grasses and legumes content – 15–20%. Tussock low quality weeds species – 70–80%.	Cultural technical works, deterioration of turf in up to 15^0 slopes through ploughing, artificial grass seeding, fertilization. Prohibited grazing for 2 years.

4.3. BASICS OF EFFICIENT GRASSLAND USE

Grass is the main and necessary hard matter food for feeding livestock during indoor winter maintenance. Agricultural animals can receive 30–40% of their required feed units and 50–60% of digestible proteins through grass. High quality grass can also successfully replace insufficient condensed forage. Therefore, in establishing sustainable feeding stock, it is extremely important to obtain large quantity grass rich in digestible nutrients and vitamins from natural and artificial grasslands.

The main issue of having highly nutritious grass is closely related to the organization of proper and efficient grassland uses, their systematic tending, defining effective harvest schedules and mowing heights, as well as to the appropriate and exact (without losses) performance of certain measures.

Hay-making is the main determining action of grass collection, which determines its quantity and quality.

To gather high quality and quantity grass, the following has to be strictly followed:

a) harvest schedule at certain stages of plant development;
b) harvest rotation in certain feeding areas rich in plant species composition;
c) mowing height;
d) second hay-making for the grass, provided it will not be used for grazing.

Harvest schedule

High quality and quantity crop is obtained in the result of having the hay-making at the time of heading-flowering (true grasses) and budding-flowering (legumes). The most efficient timing in natural feeding areas is the flowering stage of plants, when they contain the most amount of feeding mass and nutrients. Harvesting too early or too late lowers the grassland efficiency not only for the given year, but for the coming years, too. This is explained by the fact that nutrients are most intensively accumulated in the plant at the stages of tillering, branching, heading and budding, which is finalized at flowering stage. Although

in the flowering period the plants contain lower amount of nutrients, however, the potential for accumulating most quantity of feeding mass reaches its highest (productivity) level.

Harvesting should start with the flowering of dominating plants in the area and finished by the end of plant flowering. After the flowering of plants, the productivity and quality of harvested plants sharply drop, because of drying and falling of plant leaves, as well as the reduction in proteins in biochemical composition and increase of fibers. The latter causes the hardening of grass and decline in the edibility and digestibility for animals.

Mowing height plays a great role not only in the quantity and quality of obtained grass, but also in the further productivity of the grassland. When mowing higher plants, significant losses of plant masses and decline in grass quality occur. The quality decline has to do with the fact, that when mowing higher plants, their other leaves and shortened shoots rich in nutrients, are not harvested.

On the other hand, cutting the grass too short is harmful for the grassland. It damages the capacity of plants to regrow, resulting in gradual decline of crop yield for the coming years.

Efficient mowing height for grassland meadows should ideally be 4-6cm above soil, in which case it ensures higher quality and quantity crop without causing any harm to further natural development and persistent efficiency of grasslands.

Grassland crop rotation: harvesting plants at the same stage of development for years has a negative impact on the further productivity of the grassland. As annual harvesting degrades the seed formation and self-seeding of seed plants used as valuable animal feed, they consequently lead to gradual reduction of such species. To preserve the cultured condition of natural grasslands for long periods and to increase their overall productivity (crop yield and quality), it is essential to implement grassland crop rotation. As a technological measure, the grassland crop rotation assumes changing the harvesting time every other year, in compliance with the development stages of grasses in grasslands, at the same time every 4-5 years to leave the grassland to rest, either not to harvest or harvest after the seed formation of plants. The main goal is to allow the seed plants ensure reproduction through self-seeding and preserve the species.

In grassland crop rotation, to prevent spread of weeds during the resting year, it is necessary to mow the hard-stem noxious plants before their seed formation stage or kill them with selective impact herbicides. To implement grassland crop rotation in larger grasslands, the territory should be divided into 5 separate areas, and the harvesting time must be decided according to the following development stages of high value feeding plants:

For true grasses (Poaceae)	For legumes (Fabaceae)
1. Start of head formation;	1. Budding;
2. Heading;	2. Start of flowering;
3. Start of flowering	3. Full flowering;
4. Flowering;	4. Grain development (fruit formation);
5. Seed formation.	5. Seed formation (ripening).

To organize grassland crop rotation, a separate grassland area is divided into 5 equal parts, in each part the harvesting maturity time period for the dominant valuable plant family or species is determined, based on different development stages, so that in the 5th year the harvesting of separate grassland plot takes place after the seed formation of plants. In other words, every 5 years, in one of the 5 parts of the grassland, harvest must be conducted in the resting period, enabling the plants to form seeds and reproduce naturally.

Table 3. Five-plot grassland crop rotation scheme (Among dominantly true grasses)

Years of using	Number of the grassland plot				
	1	2	3	4	5
I	Start of ear formation	Ear formation	Start of flowering	Flowering	Seed formation
II	Ear formation	Start of flowering	Flowering	Seed formation	Start of ear formation
III	Start of flowering	Flowering	Seed formation	Start of ear formation	Ear formation
IV	Flowering	Seed formation	Start of ear formation	Ear formation	Start of flowering
V	Seed formation	Start of ear formation	Ear formation	Start of flowering	Flowering

Because of relatively bad conditions of natural grasslands of the country, a decree issued by the Government of Armenia established the procedure for grassland three-plot crop rotation. It aims at ensuring natural self-fortification of grassland vegetation cover, in possibly shortest time periods. To implement grassland crop rotation, the heading, flowering and seed formation stages of development were chosen for true grasses (Poaceae), while for legumes (Fabaceae) – the stages of budding, full flowering and seed formation.

4.4. BASICS OF EFFICIENT PASTURE USE

In order to solve the issues of feeding, establish sustainable and quality basis for pasture fodder for agricultural animals within the grazing period, it is vital to implement measures addressed at sustainable use, preservation and efficiency of natural pastures. The main prerequisite of efficient pasture use is to ensure high productivity of their vegetation and conservation of good qualities of feed - valuable botanical composition over the years of its utilization. The pasture should be used so, as to reduce or eliminate potential harmful consequences of grazing. To do that it is of utmost importance to follow the criteria of pasture use, i.e. the timing, mode, duration, quantity and procedure.

TERMS OF USE

Grazing too early (immediately after the snowmelt) or too late (after vegetation) contributes to the overall deterioration of pasture, the productivity gradually decreases on the account of reduced vegetation cover and good quality feeding plants, thus resulting in early aging and degradation of the pasture. Early spring grazing, immediately after the snowmelt, is prohibited, as the moderate accumulation and spending of reserve nutrients in regrowing plants is breached and ends up in worsened botanical composition and lowered productivity. This is explained by the fact, that newly emerging offshoots spend more spare nutrients in spring and only 10-15 days, following the regrowth, they start synthesizing and accumulating nutrients, creating conditions for the birth of the next generation. Apart from that, early spring regular grazing in moist feeding area allows sward deterioration, and the vegetation cover of pasture may decompose and disappear, because of trampling.

In spring, pasture grazing should start only 15-18 days after the plant regrowth, when the plants are either tillering or branching and have certain height; in semi-desert, steppe arid, mountainous-steppe and alpine zones – 6-8cm, in steppe zones – 10-12cm, while in reforested, meadow-steppe and subalpine zones – 12-15cm. In autumn, the grazing period should be completed 20-25 days before the completion of plants vegetation (before continuous cold starts) across all natural-economic zones, which will allow the wintering plants to supplement the required amount of reserve nutrients through synthesizing, in order to have successful wintering and develop efficient spring regrowth.

In the pasture season, grazing frequency at the same pasture depends on the following:

1. Vegetation cover height
2. Condition of plant cover
3. Condition of habitat
4. Species' composition of vegetation cover
5. Regeneration (regrowth) capacity
6. Duration of vegetation
7. Type of grazing animal

Starting and finishing grazing efficiently, within reasonable time period will ensure that animals always receive rich, nutritious and high edibility fodder, meanwhile ensuring better growth of the vegetation cover of pastures. It allows utilizing the same pasture several times, within the same grazing period. Overgrazing of the same pasture for long periods not only harms the vegetation cover, but also affects the soils of the feeding area, stiffens and changes physical qualities of soil in the result of trampling, impacts the water, air and food regimes, leading to exclusion of high quality plants from vegetation cover keeping mostly the low quality weed and harmful species, and thus the pasture gets degraded.

METHODS OF GRAZING

There are two key methods of grazing:

a) free or uncoordinated (irregular).
b) alternate regulated (pasture plot, paddock), per management units.

In free grazing, the animals graze in the pastures freely for the entire grazing season. In such cases the pasture feed is used inefficiently and selectively. It starts with excessive amount of feed and ends up with shortage in fodder. Higher quality fodder plants are grazed more, while medium and lower quality ones when left out become harder; they flower, form seeds and over the years spread out gradually moving away higher quality feeding plants. The condition and efficiency of pasture steadily drop. In addition, the animals move to wider areas during the day further contributing to trampling, spend enormous energy, which also affects their productivity.

At present, the most common, justified and practical method of grazing in the world is rotational – pasture plot or paddock grazing, when the pasture is divided into separate management units (plots, paddocks) to be used in turns and in determined periods.

The advantage of rotational (plots, paddocks) grazing is that the animals grazing on each management unit receive fresh green fodder and moving them to every next management unit (plot, paddock) allows regrowth of plants in the previously used management unit. When determining the number of plots (paddocks), the pasture's overall condition (level of degradation and erosion susceptibility), area, productivity, the capacity to ensure regrowth and regrowth duration of plants, the number of livestock going to grazing, the species and age composition, the daily feed intake should be considered. To avoid overgrazing in a management unit (plot), the number of grazing days should be calculated based on the plot productivity and the daily feed intake of the herd. The optimal usage period (duration) in each plot should be the maximum number of days that will not harm the assimilation segments, which ensure the regrowth of residual vegetation cover. For example, if the first grazing period is determined to last 5-6 days, then the plot should have a sufficient area to meet the daily feed intake of grazing herd for 5-6 days.

Rotational grazing by management units needs to be organized in such periods, where each used management unit is usable for the second time after the proper regrowth of plants. Let us assume that the regrowth of plants lasts 30 days. In the case of 5 day use of each management unit 6 MUs will be required (30:5=6). Besides, there should be another 2-3 spare plots (as a safeguard). Through rotational grazing, the pasture produces 15-20% more fodder, the grazing grass is used evenly, the average pasture stocking rate can be increased by 15-20% and animal productivity goes up by 20-25%, while excluding malnutrition.

The number of management units (plots) in pasture and use periods can vary according to natural-economic zone, overall pasture area, state of pasture index (SPI) and livestock units.

GRAZING DURATION (UNIT OF TIME)

Different management units (plot, paddock) of each pasture can have different stocking rate capacities (depending on actual condition). However, all of these MUs can be grazed by the same number of livestock units. Therefore, different units have to be grazed in different shares of grazing time to ensure right use. The share of grazing time (MU) shows how many days or which percentage of the grazing time should a herd use the management unit throughout the entire grazing season. Based on this shift schedule of the management units' usage (grazing) and rotational scheme

with possible cycles is developed.

$$\text{Share of grazing time (MU) \%} = \frac{\text{Recomended cattle units for management unit x 100}}{\text{Recomended cattle units for pasture}}$$

GRAZING REGIME

In spring, with the start of the grazing period, pastures with much earlier regrowing vegetation cover (in lower zones) must be grazed first. To allocate pastures for various types of animals, the state of vegetation cover and vegetation density should be considered. It has been scientifically justified and proven that the most reasonable regime of pasture use is the combined grazing by animals of diverse species, when the same management unit is first grazed by larger cattle, and later – by the smaller. Such use guarantees better outcome and allows increasing pasture volume by 35-40%, when applied, owing to its non-homogeneous vegetation cover, which contributes to balanced pasture use and enhanced future regrowth of the plants. One of the methods of effective pasture use is semi-grazing of the plant cover, which helps slow down certain plants' growth and development stages. This, in its turn, prolongs the terms of pasture use, which is even more critical in arid zones.

The most important data for developing the grazing regime is the share of grazing time, which shows how many days can the herd graze in the given management unit for the entire grazing period. This data will serve as the basis for certain cycles (or rotations), as we develop the calendar schedule for management units or plot utilization in the management plants.

Days of grazing in management units shall be calculated as follows:

$$\text{Grazing day (MU)} = \frac{\text{Share of grazing time (\%)}}{100} \text{ x Summer pasture period (day)}$$

GRAZING HEIGHT (STUBBLE HEIGHT)

In case of consumption of very short grass (1-2cm), the green part of the plants (leaves, sprigs) is grazed and the plant weakens as the chances for assimilation decrease. Over years, short grass grazing leads to decomposition and thinning of pasture vegetation cover. In case of consumption of tall grass (10-15cm) some of the crop is left ungrazed thus adding the amount of residue in the pasture. The best grazing height is when the plant is used in its permissible maximum intensity by regulated and scheduled grazing, without causing any harm to its future growth and the assimilation mass, ensuring its development. The best plant height in alpine and subalpine zones is 2-3cm above the ground, in arid steppes – 2-4cm, meadows – 4-5cm, semi-deserts – 3-5cm. The grazing height is mainly conditioned by the pasture type and botanical composition of vegetation cover.

ALLOWABLE GRAZING PRESSURE (AGP)

The surface of pasture allocated for grazing is determined on the basis of pasture state index (SPI) and allowable grazing pressure (AGP).

The SPI is developed in the result of preliminary pasture evaluations and studies during further monitoring, in compliance with the sum of indexes of erosion susceptibility and pasture degradation (see: Monitoring Manual 2014). SPI is a stable indicator, as it is generated in the result of multifarious studies (by variables) and estimations and shows the degradation level and susceptibility to erosion. Based on the above-mentioned, the maximum number of cattle units is calculated, which can show the pasture area unit (1ha) for the entire grazing period, in other words it also determines the allowable grazing pressure norm based on the current situation of the pasture.

Allowable grazing pressure shows the maximum quantity of animals to be eligible for feed per hectare for the entire duration of the grazing season, without any negative impact of the pasture productivity and state.

It is calculated by the following formula:

$$AGP = \frac{Y}{D \times D}$$

Where:

AGP – allowable grazing pressure,
Y –pasture yield per 1 ha (c/ha),
DI – daily pasture feed intake of cattle unit (kg),
D – duration of grazing period (day).

For example, the crop yield of 1 ha pasture is 4000 kg grazing grass, the daily intake of cattle unit (cow) – 40 kg/day, the grazing season duration – 150 days.

$$AGP = \frac{4000}{40 \times 150} = 0{,}66$$

This means 0,66 cattle units per ha, or one cattle needs 1,5ha pasture (1:0,66=1,5) for the entire grazing period.

The use of this simple procedure for calculating Allowable Grazing Pressure (AGP) is basically not too justified and can create risks of pasture overgrazing and malnutrition of animals, since this calculation is based on the average productivity indicator per unit area (ha) of pasture. The green matter of the unit area (1ha) of pasture is not always grazed by the animals as such mass often contains hardened, non esculent weed plants, and on the other hand, the average productivity can change consequently in the result of changes of pasture useful areas (productive area) in different management units.

Taking the above-mentioned issues into account, the calculation of the Allowable Grazing Pressure (AGP) shall be based on the state of pasture index (SPI) and pasture actual productivity (PAP).

PASTURE ACTUAL PRODUCTIVITY (PAP)

Estimation of pasture actual productivity (PAP) is based on the indicators of average productivity of pasture's (management unit) useful (fruit bearing) area and edibility of the grazing grass, which become more detailed in the result of assessments.

The PAP is calculated as follows:

$$PAP=(S\times U)\times (Pp\times P)$$

Where:

PAP - actual productivity of pasture or management unit (MU) in kg/h
S–area of pasture or MU (ha)
U–useful area coefficient (0,6-1)
Pp–pasture average productivity (kg/ha)
P–grazing green grass edibility coefficient (0,4-0,85)

For example, if the pasture is rocky in 20% and around 15-20% of existing plant mass is rough non esculent (according to monitoring), in this case:

$$PAP = (1\ ha\times 0{,}8)\times (4000\ kg\times 0{,}8)=0{,}8\times 3200\ kg/h=2560\ kg/ha$$

As per the results, in the calculation of AGP for this MU, we should use not the 4000 kg yield, but 2560kg/ha. When calculating the pasture yield, we have to keep the allowable grazing pressure in mind, which should not exceed 60-70% of the grass cover mass to ensure preservation of plant nods and assimilation residual stubble, thus enabling the plants to regrow further.

PASTURE AREA DEMAND (PA)

Based on allowable pressure of 1ha, as well as the number of cattle units, daily feed intake per a unit, grazing period duration, the overall grazing area demand of the herd within the overall grazing period should be calculated. It is calculated as follows:

$$P_a = \frac{U \times DI \times D}{Pm}$$

Where:

Pa- pasture area (ha),
U – provisional cattle unit (head),
DI – daily feed intake per cattle unit (kg),
D – duration of grazing period (day),
Pm – average productivity per ha (kg)

The area of usually required pasture must be added by 15-20% with a view of possible climate change.

The explanation of demands per a pasture is an important issue that may clarify the possibility of feed supply during the grazing period, and if the given community does not have this possibility, alternative solutions have to be found. For example, leasing pasture areas of other communities to reduce the pressure in community pastures and to prevent overgrazing.

To organize the grazing period efficiently and correctly, a sustainable management plan for pastures needs to be developed on the basis of monitoring results, in line with determined timing and in order to arrange alternate (rotational grazing) grazing in different MUs and implement the pasture rotation.

In case of alternate (plot) uses, the areas and quantity of management units (plot) in pastures is conditioned by the overall pasture area, SPI indicator and the number of cattle units.

In order to organize alternate grazing, mapping and demarcation of management units in the community pasture areas should be performed. To avoid the costly demarcation process of management units (plots), the entire community pasture areas according to the cadastre maps should be divided into separate management units – pasture plots using deans, rivulets, slopes, roads as natural borders. To arrange the mapping and conventional demarcation of management units in pasture, currently the community cadastre maps are used, which present all land parcels (including the natural feeding areas) of agricultural use by their use purpose. However, it is worth mentioning, that these maps often need adjustments.

Maps and models (of land uses, vegetative covers, pastures and etc) adjusted with the support of modern GIS technologies and remote sensing must be used, where available.

The demarcation and calculation of the area of management units (plots) must rely upon morphological units and landscape zones and conducted by means of digitalizing the satellite images.

Pasture rotation is a sustainable pasture use system that changes the methods and timing of pasture uses, which creates opportunities for long-lasting rest and self-renewal of certain plots (management units).

By applying pasture rotation in plots, the grazing sequence changes every year. Thus, if the grazing starts from the first management unit (plot) for the given year, then the next year it should start from the second management unit, the following year – the third one and so on. 1-2 of the more deteriorated plots must be periodically resting and rehabilitating themselves (if necessary, with applied improvements), or organization of the grazing at later stages, when the plants seed formation is over (Appendix 1).

Efficient use of pastures requires development of utilization (management) plan, taking into account the following:

1. number of cattle to be driven to the pasture,
2. State of Pasture Index (SPI),
3. pasture area,
4. duration of the grazing season,

The daily intake of grazing forage for agricultural animals over the entire grazing period should be estimated, first of all, and then the chances for meeting these demands must be examined. This allows identifying the volume of green feed, to be provided within the grazing period.

To calculate the intake of feed, all animal species, their gender and age groups are transformed into cattle units, with the help of a conversion coefficient (Appendix 2).

For sustainable and efficient pasture use, pasture rotation principle is applied, the successive use of management units in pasture, timing, number of cycles (rotation), grazing day and plot sizes. The start and end of the grazing period is determined every year, based on climatic conditions of the given year.

In case of alternate (coordinated) grazing, the management units (plots) are utilized according to the developed plan (rotation plan) from the first to the last one. The movement of herds and flocks in the pastures is organized in line with the positioning, landscape of the management units, before the end of grazing in all plots. After, all animals shift to the first plot and the next cycle of grazing starts, sequentially. Every next cycle should start at least 25-30 days after the last cycle, thus creating opportunities for further plant regrowth and the next generation.

Sustainable pasture management is conditioned by the availability of infrastructure, required for pasture uses, specifically shelter in remote pastures, cattle sheds, roads, availability of watering points in the vicinity of the pastures (close to the residential areas).

The cattle sheds (for daily rest, overnight stay) in pastures must be organized at a distance of ~300-500m from the watering point.

The watering points in pastures must be arranged in the radius of 1,5-2,00km from each other, to make the pasture areas used completely and in applying the alternate grazing and rotational grazing.

5.0

DRAFTING AND PREPARATION OF A SUSTAINABLE PASTURE MANAGEMENT PLAN

Pasture is a valuable and yet a vulnerable resource, which owes its productivity greatly to the procedure and modes of its use. Irregular and spontaneous management hampers the opportunities for development and use of pasture resources in the future, which results in lesser quantity and worse quality of the produced vegetation mass (pasture grass), but also causes serious environmental issues increasing risks of biodiversity vulnerability and breach of natural balance, necessary for sustainable ecosystems' development.

Organization and implementation of sustainable development of natural pastures entails a number of organizational, agroengineering and amelioration measures in place, to ensure pasture resource preservation and provision of feed to agricultural animals within the grazing period, by means of efficient uses.

To ensure efficient use of natural pastures and their further conservation, a sustainable pasture management program needs to be developed. For the purpose of fulfilling this function, it will be necessary to get valid data on the land fund structures in the given community, environmental and economic condition of the pastures, distribution within the land fund, general cattle units and species' composition, productivity, as well as on the duration of the grazing period.

The main source of information on land fund structures and their operational significance is contained in reports on availability and allocation of community land funds, approved as such by the Government of Armenia (form N22).

In order to obtain basic information from the land fund on environmental and economic situation in the pastures, it is crucial to conduct preliminary, baseline evaluations and consistent monitoring of the habitat and vegetation cover in the pastures. The basic information, acquired in the result of monitoring, describes the condition of pastures, which is very important in the process of organizing sustainable management, especially in terms of estimating the stocking rate of pastures, determining the terms and succession of MU utilization, as well as designing and providing maintenance and rehabilitation measures.

- The data on species of cattle units, gender and age composition is retrieved from annual reports or registers, held by the local government body (the municipality).
- For information on pasture distribution and areas, the community land development map can be used; the latter will also serve as a ground for mapping and separating the management units (pasture plots) for plot utilization purposes.
- To explain the overall duration of the grazing period, to rely on climate conditions and data on multi-annual averages of the given zone.

Given the data obtained, a pasture management program must be developed, which must include the implementation of the following functions, one after the other:

1. The overall demand of green feed, for the total number of cattle, must be identified and calculated per a grazing period, based on which the feed balance must be developed for the whole grazing period.
2. Potential sources of collection and provision of feed must be researched and evaluated. To do that based on the data obtained in the result of pasture monitoring, specifically on the overall state of pasture index, the total productivity and cattle unit daily intake norms, the pasture area demands of the entire cattle number shall be estimated for the grazing period.

3. The stocking rate or allowable grazing pressure (AGP) must be calculated. The basis for calculation should be the state of pasture index (SPI), as well as the average productivity indicator and cattle unit daily intake.
4. Actual productivity of a pasture or a management unit shall be identified per the fertile surface of a pasture and vegetation mass edibility indicator. This is a critical function, which clarifies the actual indicators of pasture productivity.
5. As per the community land development map, the mapping of pastures and separation of management units (pasture plots) must be conducted through calculating their number and areas.
6. The method and procedure of utilizing pastures and management units (plots) must be developed. Pasture rotation and alternate plot uses scheme shall be elaborated; the frequency and number of days of using management units will be calculated.
7. An alternate pasture use plan (grazing schedule) should be developed, presenting the pasture areas, distributed management units. The number of grazing days and frequency in each management unit should be determined, based on the pasture rotation procedure.

5.1. ESTIMATION OF FEED (PASTURE GRASS) CONSUMPTION

In order to decide (calculate) the consumption of feed, a feed balance must be prepared, which will present the consumption of feed by cattle for a certain period of time (day, month, entire grazing period).

The calculation of necessary feed consumption of the existing cattle units for the entire grazing period should be done, based on daily green feed intake (kg) per a cattle unit in compliance with accepted cattle-breeding norms.

1 cow (weighing 400 kg) shall be considered a cattle unit. When developing the feed balance, it is reasonable to express the daily consumption of feed by a cattle unit in dry matter, since the moisture (water) content indicator of pasture vegetation cover (in the plants) changes at different development stages of the plants in different vegetative periods, depending on the duration of the grazing period. The daily feed consumption of a unit shall be calculated by multiplying live weight by 0.025 (as per livestock breeding norms). This means, that each 100kg of a body mass needs 2.5kg of dry matter (grass). If a unit weighs 400kg in average, then the daily feed consumption (to ensure normal productivity) should be as follows: 400x0.025=10kg dry matter (DM), which is equal to 40kg pasture grass (10x4=40kg).

In order to calculate the feed consumption of cattle community herd for the entire grazing period, all different species and gender and age groups of cattle should be converted into cattle units (Appendix 4), using conversion coefficients (Appendix 2), in accordance with the defined procedure.

Table 4. Estimation of conversion of agricultural animals into cattle units (CU)

Agricultural animals (species, gender and age groups)	Number		Conversion coefficient		Cattle unit (CU) (number)
		x		=	
Total number of cattle units (sum)					(number)

After the estimation of cattle units, daily feed consumption per each CU – the quantity of dry matter should be calculated (by multiplying the body mass by 0.025).

Based on daily feed consumption norm per each CU, the daily feed consumption for the whole population for the duration of grazing period must be calculated (Appendix 5).

Table 5. Feed consumption of community cattle unit during grazing period

Cattle units number	CU average live weight (kg)	Daily feed consumption (DM) per one animal (kg)	Daily feed consumption of the overall CU (kg) (1x3)	Grazing period (day)	CU feed consumption during grazing period (kg) (4x5)
1	2	3	4	5	6

* 1 column data x 3 column

**4 column data x 5 column data

The calculation of consumption of pasture feed for the entire population should be followed by the study of all main and alternative options for meeting and satisfying the feeding demand. To do that, the pasture area demand needs to be calculated in order to assess the provision of estimated pasture feed.

5.2. CALCULATION OF PASTURE AREA DEMAND

Pasture area demand calculation is one of the most important issues, when it comes to developing pasture management program. This clarifies the availability of potential resources for meeting the demand of the cattle in pasture feed. In case of shortage, other alternative solutions for providing full-scope pasture feed are sought for.

The calculation of pasture area demand allows of the calculation of feed provision during the grazing period.

The calculation of pasture area demand should be done based on pasture resources available in the given community, as well as pasture feed demand of cattle unit during the grazing period.

The data obtained in the result of pasture monitoring should be used for calculating the state of pasture index (SPI), which allows determining the allowable grazing pressure on a pasture or a management unit. The AGP may serve as baseline information in determining the pasture area demand.

The pasture productivity indicator can serve as key data for calculating the pasture area demand. The same data can also help in calculating the stocking rate of cattle units per a unit of area (1 ha). Based on AGP and SPI indices, the pasture area demand of 1 cattle unit during the grazing period will be calculated. The area is multiplied by the number of general CU to get the entire pasture area demand (ha).

As a rule, when the average productivity of 1ha is known, then the daily feed consumption per 1 cattle unit, duration of the grazing period and pasture area demand are calculated as follows:

$$P_a = \frac{U \times N \times D}{P}$$

Where:

PA is the pasture area (ha), N – number of cattle units, D – daily intake of grass per a cattle unit (kg), P – average pasture productivity (ha).

When calculating the pasture area demand, special attention should be paid to useful (fruit bearing) surface of pasture and quality indicators of crops. These indicators become known in the result of pasture monitoring.

To meet the pasture feed consumption for the entire herd, to avoid possible malnutrition, as well as to prevent overgrazing, we need to focus on pasture actual productivity (PAP). It is estimated on the basis of the indicators for useful (fruit bearing) surface of the whole pasture area and useful (esculent) plant mass:

$$PAP = (AxU)x(PxPa)$$

Where:

PAP is the pasture actual productivity (kg),
A – the pasture area (ha),
U – the useful (fruit bearing) surface coefficient (0.6-1.0),
P – the productivity (kg), Pa – the crop edibility indicator (0.4-0.85).

Table 6. Pasture actual productivity and maximum grazing days

	Pasture	Area	Useful surface coefficient	Useful area, ha (2x3)	Productivity, kg/ha	Total green mass, kg (4x5)	Edibility coefficient	Total esculent mass, kg (6x7)	Grazing days
	1	2	3	4	5	6	7	8	9
1									
2									

* 2 column data x 3 column data
** 4 column data x 5column data
*** 6 column data x 7 column data

The calculation of pasture area demand helps understand the total volume of fodder obtained from pastures located in community administrative area, and the potential of meeting feed consumption required for the existing cattle over the entire grazing period. If the feed consumption is not provided by pasture resources, then potential alternative feed provision areas should come to help. The concept of alternative feed provision areas covers the vegetation of land plots of other designation, the residual vegetation and stubble of cultivated and non-cultivated arable lands (after the harvest), as well as the residual vegetation cover of harvested grasslands and regrown tillers. In respect to the mentioned areas, the potential fodder quantity should be identified to be used a basis for estimating the dates (days) for alternative feed provision. When using alternative feed provision areas, the areas and terms of use ought to be also included in the management plans.

5.3. MAPPING PASTURE AREAS (MANAGEMENT UNITS)

To organize alternate (plot) grazing by management units and pasture rotation in pastures, a demarcation of management units (plots) through pasture area mapping should be performed. The quantity and size depends on the overall space of pasture and productivity indicator.

The cadastre map of the community should be used for mapping purposes. The demarcation of management units (plots) and calculation of area surface can justifiably be done according to landscape zones and morphological units of the landscape (river valleys, hill ranges, etc), through digitalization of satellite imagery. In the management units demarcated by mapping, the area of each management unit (ha) is calculated. The demarcated management units are numbered, when the number of pasture is used so as the management plan clearly indicates the pasture, where the given management unit is located.

Depending on the landscape, the schedule and sequence of use of management units shall be determined. First of all, relatively lower situated management units are used followed by the medium and higher situated management units, in accordance with alternate use schedule and pasture rotation plan.

The data obtained in the result of monitoring will be used for calculation of share of grazing time (days) in the management units. The pasture condition index, average productivity and cattle unit density will serve as a basis for this calculation.

Share of grazing time in a management unit shows how many days can the herds use each of the management units during the grazing period. Therefore, based on that, alternate usage (grazing) schedule of the management units and rotational scheme with possible cycles are developed:

$$\text{Share of grazing time (MU) day} = \frac{\text{Recomended cattle units for a management unit} \times 100}{\text{Recomended cattle units for the pasture}}$$

The demarcation of management units (plots) in pastures should be done in accordance with the procedure and methods described in chapter 4.4.

5.4. SCHEDULE AND ORDER (MANAGEMENT PLAN) OF ROTATIONAL USE OF PASTURES

In order to have rotational use (grazing) in pastures and their integral parts – management units (plots), the terms and sequence of use should be determined in the management units demarcated by mapping. Successful implementation of this function requires development of order and schedule of rotational pasture use (management plan) presenting the schedule and sequence of pasture use, as well as potential repetitions by use cycles (rotations).

The rotational use schedule (management plan) should contain all community pastures with their names, areas and divided management units, as well as with the numbered cattle units. In a separate section it should present the grazing time and duration (day) of herds in each management unit (in accordance with monitoring results and calculations) and potential repetitions. As per the pasture rotation procedure and monitoring data, management units with higher degradation and erosion susceptibility are determined to rest (to put letter 'R' in front of MU in the 'grazing time' section). To ensure nature self-restoration, certain management units are used at later stages (after the seed formation of plants); in this case the letter 'L' should be put in front of MU.

Development of rotational grazing schedule (management plan) is the main instrument of organizing and implementing sustainable management, where rotational grazing with determined timing will help the pasture users in organizing and implementing sustainable management.

The plan of rotational pasture use needs to be updated on annual basis, because of possible changes in livestock number, state of pasture and climate of the given year.

Table 7. Rotational pasture use and schedule

Pasture					Number of herds, flocks	Grazing periods (cycles, rotation)		Grazing duration, day
Number	Name	Area, ha	Management unit			I period	II period	
			number	area, ha				
1								
2								

6.0 APPENDICES

6.1. DEVELOPING A SUSTAINABLE PASTURE USE (MANAGEMENT) PLAN

(Sample)

In order to develop a sustainable pasture management plan it is necessary to obtain data according to the orders presented in the manual:

- the structure of community land reserves;
- grazing territories, feed stock;
- economic condition of the pastures;
- distribution;
- length of the grazing period;
- composition of livestock, distribution per age, gender and species.

Based on the obtained data, and according to the requirements included in the Manual and the draft provisions of the pasture management plan, green feed balance shall be prepared for the grazing period, and relevant sources shall be identified and recorded. The size of the required grazing territory shall be calculated and possibilities for ensuring such a territory shall be examined. Based on the results of pasture evaluation, allowable grazing pressure shall be calculated, and management units shall be separated through mapping. A pasture rotation plan and a daily schedule for pasture usage shall be devised. The latter shall be observed according to the order and methodology presented in the Guidelines.

Below is an example of development of a sustainable pastures' management (productive usage) plan for community X.

The Community is comprised of 200 households, whose main occupation is cattle-breeding. Milk production in the community does not exceed 1500kg (annually). In general, the community has sufficient grazing territories. As to the distribution (conditioned by the landscape and the altitude), pastures are conditionally spread among three sub-zones: low altitude, medium altitude and high altitude, which have somewhat different botanical composition of plant vegetation, economic condition and productivity. The main reason for low livestock productivity is malnutrition, which is due to improper organization of the grazing period. It is envisaged to increase the productivity of pastures and livestock production (by 15-20%) through transfer to sustainable management.

Within the administrative territory of the Community there are 2350 hectares of agricultural land (Form-22), which have the following functional composition:

1. arable lands 657 hectares;
2. pastures 1350 hectares;
3. grasslands 150 hectares;
4. other 193 hectares.

The Community has 500 sheep and 800 bovine cattle of different age and gender groups, 350 of which are milking cows.

In order to effectively organize and maintain the grazing period, it is necessary to find out how much feed is needed and how much fodder is already available.

CALCULATING THE REQUIRED AMOUNT OF FEED

To calculate the required amount of feed for the community livestock for the whole grazing period, the daily ration of the required dry matter of feed for one unit of beef cattle shall be considered as a basis. (For calculation purposes we take a cow weighing 400kg, as a basic unit of bovine) The body weight is multiplied by a (zootechnical) coefficient of 0.025, which gives us the following daily intake for a cattle unit:

400x0.025=10kg (dry matter) or 40kg of green matter (400:100x10=40kg)

In order to calculate the required amount of feed for the whole livestock, we need to use conversion coefficients (for different species, age and gender groups) for the whole stock of animals (Appendix 2) and arrive at universal cattle units.

Table 8. Conversion of livestock into cattle units and calculation of their total number

Livestock	Number of units		Conversion coefficient		Cattle unit
Cows	350		1,0		350
Other cattle – the average of all ages	450		0,75		337
Sheep	500	x	0,14	=	70
Total number of cattle units					**757 (units)**

According to the calculation above, there are 757 basic or universal units of beef cattle in the community. Daily intake of every cattle unit is 10kg dry matter or 40kg of green feed.

The duration of the grazing period in the community for bovine is 170 days.

Based on the daily consumption per unit and the duration of the grazing period, we can calculate the feed consumption for the entire livestock during the grazing period.

Table 9. The total required amount of feed for the community cattle units for the grazing period

Number of cattle units	Average actual weight of cattle unit (kg)	Daily consumption (dry matter) of one cattle unit (kg)	Total daily consumption for cattle units (kg) (1x3)	Grazing period (days)	Total required amount of feed (dry matter) for all cattle units in the grazing period (kg) (4x5)
1	2	3	4	5	6
757	400	10	7570	170	1286900

For the whole grazing period (170 days), the total required amount of feed (dry matter) would comprise 1287 tons of dry matter or 1287x4=5147 tons of green matter. (The coefficient for converting dry matter into green matter is 4). The next would be to calculate the actual density of the whole livestock in the whole community grazing territory. This is done to find out the actual size of the grazing territory per cattle unit.

The land reserves of the community embrace 1350 hectares of pastures.

The actual density of livestock = the number of cattle units/grazing territory (hectares) = 757:1350=0.56 (units)

This means that the community has (1ha:0.56) = 1.78 hectares of pastures per a cattle unit.

After calculating the total required amount of feed for all cattle units, it is necessary to examine and determine how much feed is available on the pastures (based on monitoring results). In order to do that, we need to calculate the required grazing territory, which would allow us to determine the amount of feed available.

CALCULATING THE REQUIRED GRAZING TERRITORY

In order to efficiently organize the grazing period and ensure that the required amount of feed (green mass) is available for the whole livestock (cattle units), we need to examine and calculate the community's natural grazing territories and their overall production (productivity and quality), as well as the possible options for producing alternative green feed in the community land reserves.

According to the report on availability of community land reserves and their distribution (Form-22) there are 1350 hectares of pastures in the community.

Calculation of the state of pasture index (SPI), based on the baseline assessment (monitoring) of the pastures, had shown that different pastures have different productivity, which is conditioned by the calculated values of the susceptibility to erosion-index (SEI) and the pasture degradation index (PDI).

In the pastures of low altitude zone (close to the community), due to average level of degradation, the state of pasture index (SPI) is equal to a weighted value of 5 and the allowable grazing pressure constitutes 0.6 cattle units/hectares, or, in other words, one cattle unit requires 1:0,6≈1,7 hectares of pastures.

In the pastures of medium and high altitude zones the average value of pasture condition index is equal to a weighted average of 7.5 and the allowable grazing pressure constitutes 0,8 cattle units/hectares, i.e. one cattle unit requires 1:0.8=1.25 hectares of pastures.

As a next step, the results obtained with the help of the pasture condition index and the allowable grazing pressure (AGP) for the pastures are compared. The calculation of the latter is based on pasture productivity.

The average productivity (green mass) of the low altitude zone pastures is 4000 kg/nectar, and in medium and high altitude zones it is 5500-5600kg/hectare.

In the low altitude zone:

$$AGP = \frac{\text{Productivity}}{\text{Dailyration x GreezingPeriod}} = \frac{4000}{40 \times 170} = 0{,}58 \text{ unit/ha}$$

In the medium and high altitude zones:

5500:40x170=0.8 unit/ha.

In order to determine whether the territory and productivity of the community pastures can satisfy the feed consumption of the current community livestock, the required pasture territory has been calculated based on the values of the state of pasture index (SPI) and the allowable grazing pressure for the community pastures. The average productivity of pastures, the length of the grazing period and the required daily consumption for one cattle unit are the basis for calculation. Research shows that the cumulative average productivity for different zones of community pastures is:

4000+5500+5600=15100:3=5033kg/ha (average for production from different pastures)

$$\text{Required pasture territory} = \frac{\text{CU x Daily intake x Greezing Period}}{\text{Average Productivity}} = \frac{757 \times 40 \times 170}{5033} = 1023 \text{ ha}$$

This means that feed consumption of the community livestock for the whole grazing period can be satisfied by 1023 hectares of pastures.

However, here we should take into account that such a calculation using the average productivity indicator in practice can bring about some risks, in particular, related to the quality and edibility of green feed, which can lead to malnutrition of livestock and overgrazing of pastures. To clarify this issue we also need to determine the pasture actual productivity (PAP) of the community pastures. The calculation of the latter is based on the production area of the grazing territory and the green grass edibility coefficients.

PAP = (Size of the Pasture x Production Area Coefficient) x (Grazing Green Grass Yield x Edibility Coefficient)

We calculate the productive area (area covered with grass) of the pastures and the composition of the yield (based on the shares of plant groups) according to the baseline assessment (monitoring). The assessment shows that production area (grass covered) of the community natural pastures constitutes up to 90% of the total territory, the remaining 10% is mainly covered with stones, clods or bushes. The botanical composition of the grown green matter indicates that edibility does not exceed 85% (i.e. that maximum 85% of the grown yield is esculent). In such cases it is necessary to adjust the potential production of esculent mass per unit of pasture area. This is particularly important for preventing malnutrition of livestock grazing on the particular pastures and for increasing the livestock production.

Based on the assessment results, we arrive at the pasture actual productivity:

PAP = (1 ha×0,9) × (5033×0,85) = 3850kg/ha

This means that at best 3850kg of useful (esculent) feed can be grown, which is equal to 963kg dry matter (DM, grass).

Taking into account the landscape and altitude factors, all the community grazing territories are spread among three different altitudes (landscape zones):

1. Low altitude – (altitude of 1500–1700m) in the mountainous-steppe subzone;
2. Medium altitude – (altitude of 1800–2300m) meadow-steppe subzone;
3. High altitude – (altitude of 2300–2700m) sub-alpine subzones

According to the average pasture actual productivity coefficient, it is necessary to calculate the possibilities and duration of use for pastures of different subzones. This will serve as a basis for development of the management plan and the schedule for rotational use of pastures.

Table 10. Community Pastures Actual Productivity and Maximum Grazing (Usage) Duration per Location

Location (subzones)	Territory (ha)	Production area coefficient	Useful territory, hectares (2x3)	Productivity, kg/ha	Total green mass, kg (4x5)	Edibility coefficient	Total esculent mass, kg (6x7)	Grazing days (8:30280)
1	2	3	4	5	6	7	8	9
1. Low altitude	600	0,9	540	4000	2160000	0,85	1836000	60,6
2. Medium altitude	400	0,9	360	5500	198000	0,85	1683000	55,6
3. High altitude	350	0,9	315	5600	1764000	0,85	1499400	49,5
Total number of grazing days:								166 days

* Note: 30280 is the daily green feed consumption for 757 cattle units.

According to the calculations, in the whole grazing period the cattle units available in the community shall use the grazing territories close to the community for 60-61 days; the grazing territories of medium distance – for 55-56 days; and the distant grazing territories – for 49-50 days. As a rule, both bovine (heifers, bullocks) and sheep of different age and gender groups are taken to remote grazing territories (where camps are built). If there are properly developed infrastructures (mainly for milking and processing the milk) at the remote pastures then two-zone

grazing is organized also for milking bovine (cows).

If community pasture areas do not suffice the demand of the existing cattle, then in late summer or autumn, the cultivated and non-cultivated arable lands, as well as the grasslands' residual stubble and regrown tiller (post harvest), as well as the vegetation cover of other land plots can be used as an alternative.

MAPPING OF GRAZING TERRITORIES, DIVIDING INTO MANAGEMENT UNITS (MU) AND DEMARCATION

Having in hand the results of calculating the required quantity of feed (green fodder) and the required grazing territory, and in order to organize the pasture use (grazing) in shifts (alternate grazing) and to run a pasture rotation scheme, it is necessary to map the community pastures. This means that grazing territories (separate pastures) as represented in the land development maps shall be divided into management units (pasture plots). When dividing the pasture into management units, the total territory of the pasture, plant cover, productivity and the number of herds and cattle units grazing on the pasture should be taken into account. To differentiate the management units in the pasture rotation plan and pasture use management plan, it is necessary to name and number them, while the best and the most practical option would be the tagging. Taking the number of the pasture as a basis, an extension for each specific management unit is added with a dash.

In order to reflect the pasture use dates and duration for each management unit in the management plan, it is necessary to calculate the number of grazing days in the specific management unit.

For example, if the territory of the low altitude management unit N1-1 is 30ha, and, according to multi-annual average, the duration of efficient grazing period in the community pastures is approximately 170 days, then the calculation of the number of grazing days per CU in the pasture management unit would be as follows:

$$\text{Share of grazing time (MU) \%} = \frac{\text{Recomended number of CUs for the MU x 100}}{\text{Recomended number of CUs for the pasture}} = \frac{17{,}4 \times 100}{349} = 5{,}0\ \%$$

In our example, each CU requires 1:0.58 = 1.72ha of pastures.

30ha would provide pasture land for 30:1.72=17.4 CUs.

The total territory of the low altitude pastures is 600ha, on which according to the previous calculation it is recommended to graze 600:1.72=349 CUs (for the whole grazing period).

$$\text{Grazing days for MU 1-1} = \frac{\text{Share of grazing time \%}}{100} \times \text{grazing period} = \frac{5{,}0 \times 170}{100} = 8{,}5\ \text{days}$$

This means that for the entire grazing period on 30 hectares of pastures around 349CUs can graze for 8.5 days (repeating maximum twice).

Similarly, it is necessary to calculate the duration of grazing days for the whole population of cattle (CUs) in each management unit.

The number of grazing days per each management unit can be estimated on the basis of data of management unit area, yield and daily intake of conditional CU.

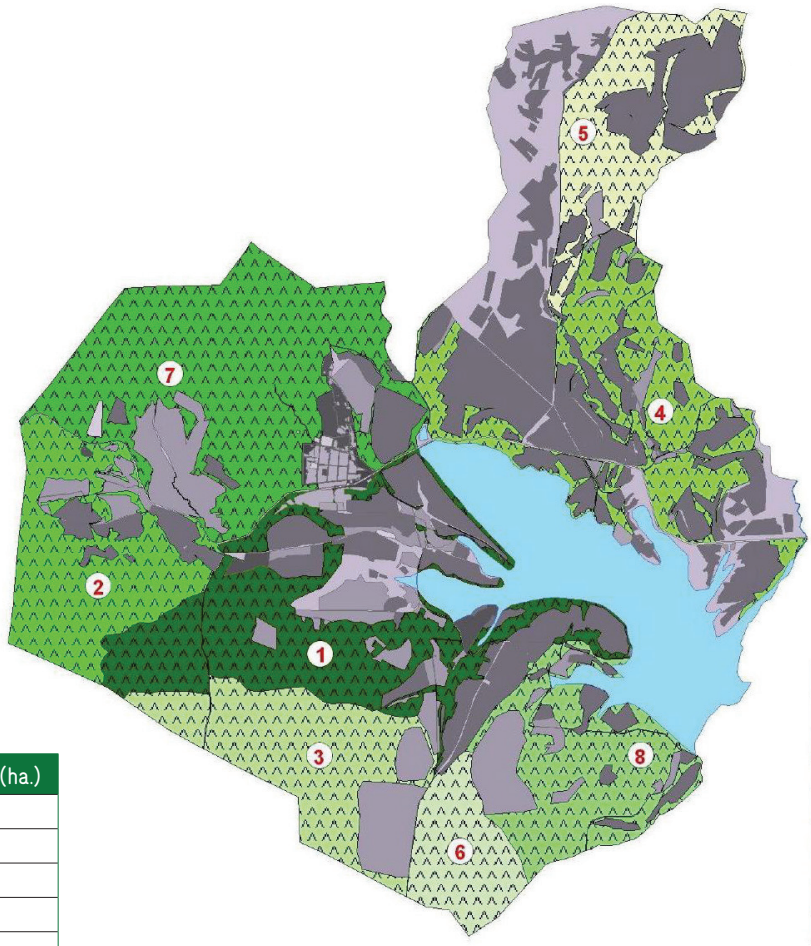
In this case, the estimation is done as follows: the area of management unit (ha) is multiplied by the indicator of average crop yield per hectare (60-70% allowable pressure) and the outcome is divided on the daily demand for feed/1 CU. The result shows the number of allowable grazing day per CU in the given management unit. To understand how many days a certain CU can graze the given management unit, the number of grazing days received per CU should be divided on the cattle heads in a herd.

In our example, the number of 349 CU grazing days in a 30ha plot shall be calculated as follows:

$$\text{Grazing days MU 1-1} = \frac{30\ \text{ha} \times 4000\ \text{kg}}{40\ \text{kg}} = 3000\ \text{days (1 CU)}$$

$$3000\ \text{days} : 349\ \text{CU} = 8{,}5\ \text{days}$$

If the number of CUs is changed for the same management unit, naturally the number of grazing days would also be changed.



Plot	Name	Surface (ha.)
1	Gyughi tak	220
2	Nerqin hand	200
3	Salov aghbyur	180
4	Verin hand	160
5	Arjakar	140
6	Mijnahand	100
7	Sari glukh	200
8	Qarin tak	150

Schematic map of the community pasture management

DEVELOPMENT OF THE SCHEDULE AND ORDER OF ALTERNATE USE OF PASTURES (MANAGEMENT PLAN, GRAZING SCHEDULE)

In order to apply the order of alternate use in pasture management units (pasture plots) six herds of bovine and one flock of sheep is formed out of the whole community livestock (757 cattle units).

Table 11. Tagging and number of units in community herds and flocks

Tagging of herds and flocks	Number of animals in a herd or a flock (units)
1. Cows herd – 1	120
2. Cows herd – 2	120
3. Cows herd – 3	110
4. Bulls herd – 4	150 (113 CUs)
5. Heifer herd – 5	150 (113 CUs)
6. Heifer herd – 6	150 (113 CUs)
7. Sheep flock – 7	500 (70 CUs)
Total number (CUs)	757

Herds and flocks are tagged and their movement in pastures and management units is organized, according to alternate pasture plot usage plan and the pasture rotation implementation order, for a certain period of time and with a certain frequency (in cycles), which would allow the plant cover to recover (regenerate) (Table 7).

Based on the conditional zoning of pastures, the grazing period should begin in pastures of the low altitude zones, moving up to the pastures of medium altitudes, and then to the high altitude zones.

Taking into account the average degradation of the adjacent (close to the community) pastures, there should be only one, maximum two (repeating twice, in cycles) grazing periods envisaged for the management units. In the pastures of medium and high altitude zones, taking into account the condition of the pasture plot (management unit), where the degradation is slow or is not manifested, two cycles of grazing can be envisaged, and in some parts also three cycles may be allowed. The calendar schedule of pasture use should contain a note on the grazing days and the period (months) in the management units.

In those pastures or management units, where degradation level is high, grazing (use) should be prohibited for one or two years, they should be left to rest (R), to recover, or have the animals graze later (L), after the plant seed formation.

In order to implement pasture rotation, in the following years, changes should be made in the grazing schedule, the dates of use of management units.

Table 12: Alternate Pasture Use Scheme and Schedule

Landscape zone	Pasture					Number of herds, flocks	Grazing timing (cycles, rotation)		Grazing duration, day
	Number	Name	Area, ha	Management unit			I round	II round	
				Number	Area, ha				
Mountainous-steppe (lower zone)	1	Gyughitak	220	1-1	30	Cattle 1-3	01-08 V	-	8
				1-2	70	Cattle 5-6	01-20 V	18-27 X	29
				1-3	70	Cattle 1-3	09-28 V	-	20
				1-4	50	Cattle 4 Goat and sheep 7	01-20 V	21-27 X	27
	2	Nerkin Hand	200	2-1	60	Cattle 1-3	29 V-14 VI	-	17
				2-2	40	Cattle 5-6	21 V-07 VI	-	17
				2-3	40	-	R	-	-
				2-4	60	Cattle 4 Goat and sheep 7	21V- 23 VI	-	32
	3	Salov Aghbyur	180	3-1	60	Cattle 1-3	15VI-01VII	-	16
				3-2	60	Cattle 5-6	08VI-01VII	05-18 X	38
				3-3	60	Cattle 5-6	L	25 IX-04 X	10
Meadow-steppe (medium zone)	4	Verin Hand	160	4-1	50	Cattle 5-6	02VII-02VIII	-	31
				4-2	40	Cattle 4 Goat and sheep 7	24VI-24VII	-	30
				4-3	70	Cattle 1-3	02-16 VII	25 IX-04 X	29
	5	Arjakar	140	5-1	40	Cattle 5-6	03-27 VIII	-	25
				5-2	40	-	R	-	-
				5-3	60	Cattle 1-3	17-31 VII	15 IX-24 X	25
	6	Mijnahand	100	6-1	40	Cattle 1-3	01-16 VIII	-	16
				6-2	30	Cattle 5-6	28VIII-14 IX	-	18
				6-3	30	Cattle 4 Goat and sheep 7	25VII-15VIII	-	20
Subalpine (higher zone)	7	Sari Glukh	200	7-1	60	-	R	-	-
				7-2	70	Cattle 1-3	17VIII-14IX	-	29
				7-3	30	Cattle 1-3	15-26 IX	-	12
				7-4	40	Cattle 4 Goat and sheep 7	21IX-20X	-	29
	8	Qarin Tak	150	8-1	50	-	R	-	-
				8-2	60	Cattle 4 Goat and sheep 7	16VIII-20IX	-	34
				8-3	40	-	R	-	-

6.2 PASTURE ROTATION SCHEME

APPENDIX 1.

Tabel 13: Pasture rotation scheme

Year of Use	Management units (pasture plots)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
First	1	2	3	4	L	R	5	6	7	8	L	R
Second	2	3	4	L	R	5	6	7	8	L	R	1
Third	3	4	L	R	5	6	7	8	L	R	1	2
Fourth	4	L	R	5	6	7	8	L	R	1	2	3
Fifth	L	R	5	6	7	8	L	R	1	2	3	4
Sixth	R	5	6	7	8	L	R	1	2	3	4	L

Note: numbers 1; 2; 3 and other numbers indicate the pasture (MU) usage shifts in the respective year.
L – pasture plot (MU) should be allowed for grazing later, after the seed formation.
R – pasture plot (MU) is left to rest.

6.3 CATTLE UNITS' (CU) CONVERSION FACTORS

APPENDIX 2.

Tabel 14: Conversion of livestock of different species, age and gender into cattle units (calculation units)

Bulls	1,10
Cows	1,0
Average of all the cattle of different age	0,75
Calves (older than 1 year)	0,60
Calves (up to 1 years)	0,25
Work horses	1,05
Horses of all ages (average)	0,80
Sheep and goats of all ages (average)	0,14
Sheep and goats (aged)	0,16
Pigs	0,25

6.4 LEGAL FRAMEWORK FOR MANAGEMENT OF NATURAL FEEDING AREAS (EXPLANATION)

APPENDIX 3

A significant part of the Republic's natural feeding areas, grasslands and pastures, is not privatized; as public property, such territories have been given to Marz and community authorities to administer, which they have done through leasing them out on short-term (1-3 years) and long-term (for more than three years) agreements. Terms of use, absent or improper regulations on pasture pressures, resulted in inconsolable conditions of feeding areas, especially those that are close to settlements. The latter are mainly administered and used by the community farmers, and generally there is no control over land uses or maintenance of land management norms. Pastures that are close to communities are usually overused and the grasslands have lost their quality in terms of productivity and varieties of plants growing there. This could be explained by the inconsistent land management of local self-government bodies, as well as the absence of government levers to stimulate activities aimed at recovery and maintenance of such areas.

In accordance with Point 5 of RA Government Decision 1477-N, dated October 28, 2010, the order of pasture and grasslands use has been approved, obliging the mayors to use community property pastures and grasslands in accordance with the order defined by that decision.

The goals and objectives of the mentioned order are as follows:

- Contribute to protection, sustainable and efficient use of pastures and grasslands;
- Create favorable conditions for increased productivity and recovery of pastures and grasslands;
- Contribute to keeping the pastures and grasslands in proper sanitary conditions.

Point 6 of RA Government Decision 1477-N, dated October 28, 2010 recommends (not requires) the leasing of pastures or grasslands in accordance with the order defined by the above mentioned Decision, i.e. using the sample contract for pasture or grasslands use.

Paragraph 3 of Point 14 of the RA Law on Legal Acts and Point 1 of the RA Government Decision 1477-N, dated October 28, 2010 specify that contracts for using pastures and grasslands located in lands that are public property shall be signed in a simple written form with a term of up to three years. This means that such contracts can be signed for a period not exceeding three years (in grazing or harvesting cycles).

The above-mentioned approach may imply two differentiated solutions:

1. Signing a short-term contract only for the use period;
2. Signing a long-term contract for a period of up to three years.

In the first case, payments will be made only for the use period, while in the second case they will be made for the whole period of the contract. The pasture or grassland use contract implies monthly payments.

Pasture or grassland use fee is equal to the land tax rate for the particular pasture or grassland land plot (Point 3 of RA Government Decision 1477-N, dated October 28, 2010).

"Land tax rate is not connected with the results of economic activity of the taxpayers and is set as a fixed payment for a unit of area of the land plot, which is paid for the year." Hence, taking into account that the fee paid for using pastures or grasslands is not a tax and that Article 3 of the aforementioned Decision refers to the mere size of the land tax and not the order of payment, the fee can be paid on a monthly basis, and the monthly payable amount would be calculated by dividing the annual amount of tax by the number of months.

Paragraph 4 of Point 48 of the RA Land Code defines that the right on tenancy of land from the public and community land is provided by tenders and by public auctions. However, taking into account that pasture and grasslands' use cannot be considered as land lease and that the RA Government has set a specific rate for the latter, it is not obligatory to provide them by tenders, not speaking about public auctions.

However, in practice, to avoid various problems it is recommended to take into account Paragraph 6 of Article 96 of RA Land Code, when leasing out pastures or grasslands. It specifies that in case of other equal terms for land provision the privileges shall be given to the residents of that community or Marz.

6.5 SAMPLE CONTRACT FOR PASTURE USE

_____ _____ 20 y.

_____

(place of concluding)

The Republic of Armenia (hereinafter referred to as "owner"), represented by _____

_____,

(position, surname and name of the authority or official)

Acting on the basis of _____,

(statute, power of attorney or other)

On one part, _____ and

(name of organization or the surname and name of natural entity or sole entrepreneur)

(hereinafter referred to as "user"), represented by _____,

(position, surname, name)

Acting on the basis of _____,

(statute, power of attorney or other)

On the other part, signed a Contract on the following:

1. SUBJECT OF CONTRACT

1. As per this Contract, the owner shall assume the responsibility to, for a respective fee, give the pasture of _____ sq. m. located within the territory of _____ community for temporary use by the user, in accordance with the pasture scheme and quality features (where available), presented in the Appendix of this Contract.
   The scheme and quality features of pasture shall be attached to the Contract and make up its integral part.
2. The user of pasture specified by clause 1 of this Contract shall make use of _____

   _____

   (state types, number of animal, data on grazing mode and timing)

   for arranging the animal grazing.
3. During the effective period of this Contract, the income gained from the use of pasture shall be deemed the ownership of the user.

2. RIGHTS AND RESPONSIBILITIES OF PARTIES

4. The owner has the right to:
   1) require from the user to utilize the pasture in compliance with the conditions set forth in this Contract and designation of the pasture;
   2) demand fines and penalties for the breach of due payment dates by the user, specified in the sizes defined by this Contract;
   3) access the pasture to exercise supervision over the execution of contractual duties without causing any obstacle for the normal functioning of the user;
   4) use other rights stipulated by the legislation of the Republic of Armenia.
5. The owner is obliged to:
   1) within 5 days period after signing this Contract, entitle right of using the respective pasture defined by this Contract, to the user;
   2) inform the user on all the rights (lease, mortgage, servitude etc) of third parties over the respective pasture, which is the subject of this Contract;

3) not to interfere with the actions of the user, provided it doesn't harm the pasture, environment, and does not infringe the rights and legitimate interests of other persons.

6. The user has the right to:
   1) use the pasture for animal grazing;
   2) dispose the income gained from pasture use on its own;
   3) require from the owner to grant the right of using the pasture for the time period defined by sub-clause 1 of clause 5 of this Contract;
   4) in case of detecting deficiencies hindering to exercise his rights of using the pasture, at his own choice:
      a. demand from the owner to remove these deficiencies free of charge or decrease the lease payment respectively;
      b. demand from the owner to prematurely rescind the Contract;
   5) deploy other rights defined by the legislation of the Republic of Armenia.
7. The user is obliged to:
   1) pay all due payments (rental)for pasture use, in timely manner and procedure defined by this Contract;
   2) make use of the pasture entitled for use by this Contract exclusively in line with the conditions of this Contract and pasture designation without allowing worsening of quality features and environmental condition;
   3) transport animals to pasture according to the routes and timing developed in advance;
   4) maintain the submitted area in appropriate sanitary and fire prevention state;
   5) not to conduct any other activity not specified by this Contract;
   6) in the case of premature rescission of Contract, to inform the owner in writing no later than one month prior on termination of the pasture use;
   7) after the completion of the time period specified by this Contract, to vacate the pasture from animals envisaged by clause 2 of this Contract and return it to its owner.

3. CONTRACTUAL PAYMENTS

8. The amount of monthly rental subject to payment upon signature of the Contract shall be defined _____ .
9. The rental defined for using the pasture as per this Contract shall be made _____ .
10. Current payment shall be made by the user by the 10th (including) of each month.

4. LIABILITIES OF PARTIES

11. Failure to make the payments in due time by the user will be subject to fines and penalties for each deferred day in the amount of 0.1 percent of the annual rental.
12. Payment of the fines and penalties defined in this Contract shall not relieve the parties from the fulfillment of their liabilities and their obligation to eliminate violations.
13. If the user fails to return the pasture after the termination of contract, or has returned it with breach of terms, then the owner has the right to demand the rental for the entire outstanding period. If this payment does not fully compensate the losses of the owner, he/she can demand to reimburse the outstanding liability.
14. The owner shall not be deemed liable for the deficiencies of pasture envisaged in the Contract, which he mentioned in drawing this Contract, or the user was aware of initially, or were to be detected by the user in inspecting the pasture.

5. EFFECTIVE DATE AND TERMINATION OF CONTRACT

15. This Contract shall be effective from _____ to _____ and enter into force upon its signature.
16. The Contract may be renewed on the basis of mutual consent of parties and in writing.
17. This Contract shall be terminated:
   1) in the case of completion of effective Contract date as specified by clause 15 of this Contract;
   2) by mutual consent of parties;
   3) in the cases and procedure prescribed by the Contract and the legislation of the Republic of Armenia in the case of premature rescinding of the Contract;
18. This Contract may be prematurely rescinded upon the demand of the user:

1) if the pasture has become unusable for reasons irrelevant to the pasture user;
2) on any other grounds, notifying the owner in writing one month before.

19. This Contract may be prematurely rescinded upon the demand of the owner:
    1) if the user has not paid the rental more than twice after the due date, or uses the pasture not by its designation;
    2) if the user has significantly worsened the state of pasture;
    3) as the owner changes,
    4) in case the parcel of the pasture has been authorized for use.

6. FORCE MAJEURE

20. When force majeure persists over one month or its consequences are not recovered for 6 months, the parties shall make a decision on continuing the Contract.

7. FINAL PROVISIONS

21. This Contract is drawn in Armenian language, in two copies with equal legal power.
22. Any amendment or addendum to this Contract shall be deemed valid only if concluded in writing and signed by both parties.
23. All disputes between parties shall be resolved by mutual consent or in the procedure prescribed by the legislation of the Republic of Armenia.

8. LOCATION, BANK REQUISITES AND SIGNATURE OF PARTIES

Owner	User
_____	_____
(location)	(location)
_____	_____
(signature)	(signature)
P.S	P.S.

6.6. SAMPLE CONTRACT OF GRASSLAND USE

_____ _____ 20 y.

_____

(place of concluding)

The Republic of Armenia (hereinafter referred to as "owner"), represented by _____

_____,

(position, surname and name of the authority or official)

Acting on the basis of _____,

(statute, power of attorney or other)

On one part, _____ and

(name of organization or the surname and name of natural entity or sole entrepreneur)

(hereinafter referred to as "user"), represented by _____,

(position, surname, name)

Acting on the basis of _____,

(statute, power of attorney or other)

On the other part, signed a Contract on the following:

1. SUBJECT OF CONTRACT

1. As per this Contract, the owner shall assume the responsibility to, for a respective fee, give the grassland of _____ sq. m. located within the territory of _____ community for temporary use by the user in accordance with the grassland scheme and quality features (where available), presented in the Appendix of this Contract. The scheme and quality features of grassland shall be attached to the Contract and make its integral part.
2. The user of grassland specified by clause 1 of this Contract shall make use of _____

_____

(state types, number of animal, data on grazing mode and timing)

for arranging the animal grazing.

3. During the effective period of this Contract, the income gained from the use of grassland shall be deemed the ownership of the user.

2. RIGHTS AND RESPONSIBILITIES OF PARTIES

4. The owner has the right to:
   1) require from the user to utilize the grassland in compliance with the conditions set forth in this Contract and designation of the grassland;
   2) demand fines and penalties for the breach of due payment dates by the user, specified in the sizes defined by this Contract;
   3) access the grassland to exercise supervision over the execution of contractual duties without causing any obstacle for the normal functioning of the user;
   4) use other rights stipulated by the legislation of the Republic of Armenia.
5. The owner is obliged to:
   1) within 5 days period after signing this Contract, entitle right of using the respective grassland defined by this Contract, to the user;

2) inform the user on all the rights (lease, mortgage, servitude etc) of third parties over the respective grassland, which is the subject of this Contract;
3) not to interfere with the actions of the user, provided it doesn't harm the grassland, environment, and does not infringe the rights and legitimate interests of other persons.

6. The user has the right to:
   1) use the grassland for animal grazing;
   2) dispose the income gained from grassland use on its own;
   3) require from the owner to grant the right of using the grassland for the time period defined by sub-clause 1 of clause 5 of this Contract;
   4) in case of detecting deficiencies hindering to exercise his rights of using the grassland, at his own choice:
      a. demand from the owner to remove these deficiencies free of charge or decrease the lease payment respectively;
      b. demand from the owner to prematurely rescind the Contract;
   5) deploy other rights defined by the legislation of the Republic of Armenia.
7. The user is obliged to:
   1) pay all due payments (rental) for grassland use, in timely manner and procedure defined by this Contract;
   2) make use of the grassland entitled for use by this Contract exclusively in line with the conditions of this Contract and grassland designation without allowing worsening of quality features and environmental condition;
   3) transport animals to grassland according to the routes and timing developed in advance;
   4) maintain the submitted area in appropriate sanitary and fire prevention state;
   5) not to conduct any other activity not specified by this Contract;
   6) in the case of premature rescission of Contract, to inform the owner in writing no later than one month prior to termination of the grassland use;
   7) after the completion of the time period specified by this Contract, to vacate the grassland from animals envisaged by clause 2 of this Contract and return it to its owner.

3. CONTRACTUAL PAYMENTS

8. The amount of monthly rental subject to payment upon signature of the Contract shall be defined _____.
9. The rental defined for using the grassland as per this Contract shall be made _____.
10. Current payment shall be made by the user by the 10th (including) of each month.

4. LIABILITIES OF PARTIES

11. Failure to make the payments in due time by the user will be subject to fines and penalties for each deferred day in the amount of 0.1 percent of the annual rental.
12. Payment of the fines and penalties defined in this Contract shall not relieve the parties from the fulfillment of their liabilities and their obligation to eliminate violations.
13. If the user fails to return the grassland after the termination of contract, or has returned it with breach of terms, then the owner has the right to demand the rental for the entire outstanding period. If this payment does not fully compensate the losses of the owner, he/she can demand to reimburse the outstanding liability.
14. The owner shall not be deemed liable for the deficiencies of grassland envisaged in the Contract, which he mentioned in drawing this Contract, or the user was aware of initially, or were to be detected by the user in inspecting the grassland.

5. EFFECTIVE DATE AND TERMINATION OF CONTRACT

15. This Contract shall be effective from _____ to _____ and enter into force upon its signature.
16. The Contract may be renewed on the basis of mutual consent of parties and in writing.
17. This Contract shall be terminated:
    1) in the case of completion of effective Contract date as specified by clause 15 of this Contract;
    2) by mutual consent of parties;

3) in the cases and procedure prescribed by the Contract and the legislation of the Republic of Armenia in the case of premature rescinding of the Contract;

18. This Contract may be prematurely rescinded upon the demand of the user:
    1) if the grassland has become unusable for reasons irrelevant to the grassland user;
    2) on any other grounds, notifying the owner in writing one month before.
19. This Contract may be prematurely rescinded upon the demand of the owner:
    1) if the user has not paid the rental more than twice after the due date, or uses the grassland not by its designation;
    2) if the user has significantly worsened the state of grassland;
    3) as the owner changes,
    4) in case the parcel of the grassland has been authorized for use.

6. FORCE MAJEURE

20. When force majeure persists over one month or its consequences are not recovered for 6 months, the parties shall make a decision on continuing the Contract.

7. FINAL PROVISIONS

21. This Contract is drawn in Armenian language, in two copies with equal legal power.
22. Any amendment or addendum to this Contract shall be deemed valid only if concluded in writing and signed by both parties.
23. All disputes between parties shall be resolved by mutual consent or in the procedure prescribed by the legislation of the Republic of Armenia.

8. LOCATION, BANK REQUISITES AND SIGNATURE OF PARTIES

Owner	User
_____	_____
(location)	(location)
_____	_____
(signature)	(signature)
P.S	P.S.

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